



OSPAR Beach Litter Monitoring in the Netherlands 2011-2016

Annual Report



Authors: M. Boonstra & M. Hougee
North Sea Foundation, The Netherlands

Ministry of Infrastructure and the Environment
Report no. Rijkswaterstaat BM 17.16

Cover photo's: Various pictures from surveys conducted in 2016

Client: Ministry of Infrastructure and the Environment

RWS Water, Traffic and the Environment, Postbus 17, 8200 AA Lelystad

Reference number: 31066363

Contact: Mervyn Roos (RWS CIV)

Senior advisor marine litter assessment Rijkswaterstaat

Willem van Loon

Email: willem.van.loon@rws.nl

Project leader marine litter monitoring Rijkswaterstaat

Email: mervyn.roos@rws.nl

Publication date: 13-06-2017

North Sea Foundation project and author contact details

Report number: Rijkswaterstaat BM 17.16

m.boonstra@noordzee.nl

+31 30 2340016

Citation

M. Boonstra, M. Hougee, 2017. OSPAR Beach Litter Monitoring In the Netherlands 2011-2016. Annual Report. North Sea Foundation, Utrecht.

© 2017 North Sea Foundation Utrecht.

The Management of the North Sea Foundation is not responsible for resulting damage, as well as for damage resulting from the application of results or research obtained by North Sea Foundation, its clients or any claims related to the application of information found within its research. This report has been made on the request of the client and is wholly the client's property. This report may not be reproduced and/or published partially or in its entirety without the express written consent of the client.

Table of Contents

| | |
|---|-----------|
| Summary..... | 5 |
| 1 Introduction | 6 |
| 2 Materials and methods | 9 |
| 2.1 Selection of reference beaches..... | 9 |
| 2.2 Sampling areas | 11 |
| 2.3 Monitoring frequency and period | 12 |
| 2.4 Item classification | 13 |
| 2.5 Collection, identification and registration of litter..... | 13 |
| 2.6 Data Management | 13 |
| 2.7 Data analysis procedures | 14 |
| 2.7.1 Data preparation: item clustering..... | 14 |
| 2.7.2 Data preparation and analysis using Litter Analyst..... | 15 |
| 2.7.3 Trend analyses | 15 |
| 2.7.4 Calculation of total item counts..... | 16 |
| 2.7.5 Source analysis..... | 16 |
| 2.7.6 Material analysis | 16 |
| 2.7.7 Unknown items | 16 |
| 2.7.8 Special circumstances | 16 |
| 2.8 Reporting..... | 16 |
| 3 Results & Discussion | 17 |
| 3.1 Total counts..... | 17 |
| 3.2 Top-80% Analysis | 18 |
| 3.3 Sources of litter items | 20 |
| 3.4 Materials of litter items | 20 |
| 3.5 Unknown/new items..... | 21 |
| 3.6 Registration of other pollutants..... | 22 |
| 3.7 Pellets..... | 24 |
| 3.7 Plastic bags..... | 24 |
| 3.9. Plastic drinks (bottles, containers and drums)..... | 26 |
| 3.10. Pilots: weighting of litter and recording of dolly rope | 26 |
| 3.11. Moving Averages..... | 27 |
| 3.12 Special circumstances | 28 |
| 3.13 Discussion..... | 28 |
| 4 Conclusions..... | 29 |
| References..... | 31 |
| Appendix I OSPAR database exports of Dutch beach litter monitoring, year 2016. | 32 |

| | |
|---|----|
| Appendix II Scans of OSPAR litter survey forms, year 2016 | 32 |
| Appendix III Litter Analyst evaluation tables of items, materials and sources. | 32 |
| Appendix V Probability classification of the allocation of litter items to sources..... | 33 |
| Appendix VI Categorisation Litter Analyst Trend Top 100% items + using expert judgement of the North Sea Foundation | 37 |
| Appendix VII Recording the presence of “pollutants” on OSPAR Beach Litter Survey beaches | 41 |
| Appendix VIII Litter Analyst Trend Top 80% items – Top 15 (in order from 1 – 15) | 43 |

List of figures

| | |
|--|----|
| Figure 1: Lightbulb, piece of plastic and plastic eye, Terschelling | 6 |
| Figure 2 Piece of fishing net, Terschelling | 8 |
| Figure 3 Dutch monitoring beaches (map provided by RWS). | 10 |
| Figure 4 Walking pattern used for the beach litter monitoring..... | 11 |
| Figure 5 Photograph of the Dutch reference beach Terschelling | 12 |
| Figure 6 Trendplot Total counts period 2011- 2016 | 18 |
| Figure 7 Trendplot Net & Ropes period 2011- 2016..... | 20 |
| Figure 8 Seal for explosives container, Veere | 22 |
| Figure 9 Piece of step ladder, Terschelling | 22 |
| Figure 10 Number of paraffin like substances found per 100m per size category in period 2011-2016..... | 24 |
| Figure 11 Photograph of a large block of paraffin, Veere. | 24 |
| Figure 12 Trendplot Plastic bags in period 2011-2016..... | 25 |
| Figuur 13 Trendplot Plastic Drinks in period 2011-2016..... | 26 |
| Figure 14 Sources of marine litter in period 2011-2016 | 29 |
| Figure 15 Weighing marine litter, Veere | 30 |

List of tables

| | |
|---|----|
| Table 1 Contact information of local beach coordinators. | 10 |
| Table 2 Details of the 4 Dutch OSPAR Beach Litter reference beaches | 12 |
| Table 3 Items clustering that is performed on the initial items 31, 32, 46, 62, and 84 in the period 2002-2009 and in the period 2010..... | 14 |
| Table 4 Items that were removed from the survey list and their new assigned code..... | 14 |
| Table 5 Items that were added to the survey list in 2010 (Baggelaar & Meulen, 2014). Grey cells represent that an item was not on the survey form in that period (column) and also not registered yet. | 15 |
| Table 6 Average total item counts, trend and significance of the trend for Bergen, Noordwijk, Terschelling and Veere and for all four beached aggregated for the period 2011-2016..... | 17 |
| Table 7 Top 80% of most found items along the Dutch coast, including median and average count per 100 meter, percentage of total count, trend [counts/year], and significance of trend for the period 2011-2016. | 19 |
| Table 8 Material trend analysis of litter items for each material category at Bergen, Veere, Terschelling, and Noordwijk including trend in counts/year and significance of trend for the period 2011-2016 | 21 |
| Table 9 Presence of pellets during quarterly measurements in 2016..... | 24 |
| Table 10: Six year moving averages in periods 2004 – 2016..... | 27 |

Summary

Large quantities of marine litter are washed ashore worldwide. Marine litter is an environmental concern of global scale that may harm species in our seas; it affects the ecological, social, and economic status of coastal areas. Qualitative and quantitative information about marine litter in our seas and oceans is required for policy development aiming to reduce marine litter and/or to assess effectiveness of existing programmes of measures.

This annual report provides an overview of the Dutch beach monitoring and analysis results for 2011-2016. During the 2011-2016 period (January – December) 96 surveys were performed. The surveys took place in the Winter - between mid-December and mid-January; Spring - April; Summer - between mid-June and mid-July and in Autumn - between mid-September and mid-October. This research aims to provide insight in the Dutch situation; therefore analyses with aggregated results of all four Dutch beaches are displayed in this report. The number of specific litter items and total litter counts is given using 6-year median and arithmetic averages. Significance of trends of counts of specific and total litter types over time were assessed by non-parametric regression using untransformed data from item counts set out against the monitoring date.

In the period 2011-2016 during 46 surveys, other pollutants such as paraffin were recorded. During the survey conducted in April 2016 in Veere, large blocks of paraffin were found.

The six year data set suggests that the Dutch beaches are getting cleaner. On average 354 items were found per 100 meter beach during the period 2011-2016. The data shows a decreasing trend in average item counts per year for all beaches of -42.1 items per year. The trend is of high significance (p -value = 0.011). These new results are consistent with the total count trends for the period 2010-2015. The top-80% resulted in a top 15 of most found litter items on the four monitored beaches. The data shows decreasing trends for 14 of the top 15 most found items; 9 of these trends are significant. The largest decreasing trend in average item counts per year is from net and ropes (-18.1 counts/year). In the period 2011-2016, net and ropes account for 39% of all litter items found.

The litter items on the OSPAR lists are connected to different sources. Litter is allocated to shipping, fisheries, tourism, sanitation and a category labelled as 'other' for litter items that cannot be related to a source, for example small unidentified pieces of plastic. In this report the top 100% found items and the probability of their source is provided (sea, land or land & sea). Most of the items that are included in the plastic / polystyrene category are nets and ropes which have a high probability to originate from sea – based sources e.g. the fishing and shipping sector.

1 Introduction

Litter in the marine environment is harmful for marine life and a potential threat to biodiversity. It harms marine life in particular due to ingestion and entanglement. A recent study showed that at least 17% of species that were recorded to have been affected by entanglement or ingestion were on the IUCN red list of threatened species (Gall & Thompson, 2015). Due to weathering of macro plastics that enter the marine environment, plastics break down into smaller fragments - microplastics (smaller pieces of plastic >5 mm) and have widespread in marine habitats (Andrady, 2015).

These visible impacts may well be the tip of the iceberg as research indicates that there are impacts due to microplastics ingestion by organisms in lower levels of biological organization as well. So called 'ecosystem engineers' organisms such as sandworms, are affected by ingestion of microplastics (Browne et al., 2015). According to Hammer, recent studies show that microplastics can be easily ingested by small organisms such as plankton species and form a pathway for contaminants to enter the food web (Hammer et al., 2012).

Apart from the ecological impacts there are socioeconomic impacts such as costs for cleaning activities and reduced attractiveness for recreational activities. In addition, lost and discarded fishing nets can cause propeller issues and can consequently lead to shipping delays and lost fishing time.



Figure 1: Lightbulb, piece of plastic and plastic eye, Terschelling

Qualitative and quantitative information about marine litter entering our seas and oceans is required for the development of policies and measures aiming to reduce marine litter and/or to assess effectiveness of existing measures. Marine litter (marine debris) is any persistent, manufactured or processed solid material discarded, disposed of, abandoned or lost in the marine and coastal environment. This also includes such items entering the marine environment via rivers, sewage outlets and storm water outlets.

In the year 2000, a standardized protocol for the 'OSPAR Pilot Project on Monitoring Marine Litter' was developed aiming to monitor the amounts and sources of marine litter in the North East Atlantic region. In 2000 this protocol started with Sweden as coordinator. The protocols for 100-metres and 1-km surveys were developed, tested and used during fieldwork from 2000 onwards. The initial pilot project was executed for a period of six years (2000-2006) by nine countries: The Netherlands, Belgium, Germany, United Kingdom, Sweden, Denmark, France, Spain and Portugal. In 2007, after the pilot ended, it was decided to transfer the pilot in a regular OSPAR monitoring programme. The Netherlands and Belgium coordinated this regular programme.

The Dutch Ministry of Environment and Infrastructure (I&M) decided to continue with the beach litter monitoring. With the installation of an Intersessional Correspondence Group Marine Litter (ICGML) the project was embedded in OSPAR on an official basis

Within the European Marine Strategy Framework Directive (MSFD) marine litter is one of the descriptors (DG10) in order to assess the 'Good Environmental Status' of the marine environment. Monitoring beached litter is one of the obligations within this directive. Beach surveys performed according to the protocol can be used to monitor trends in amounts (quantitative), materials (quantitative), and sources (qualitative) of marine litter washed ashore. The Ministry of Transport and Environment (RWS Waterdienst) has assigned the North Sea Foundation to monitor the beaches according to the OSPAR protocol in the Netherlands during 2011-2016. The North Sea Foundation is: an independent, objective and authoritative non-governmental organization that provides knowledge necessary for an integrated sustainable protection, exploitation and spatial use of the North sea and its coastal zones. This report provides an overview and analysis of the field results from the 2011-2016 beach surveys.



Figure 2 Piece of fishing net, Terschelling

A guideline for monitoring marine litter on beaches has been developed by OSPAR (OSPAR Commission, 2010) as a tool to collect data on litter in the marine environment. This tool has been designed to generate data on marine litter according to a standardized methodology. A uniform way of monitoring allows for regional interpretation of the litter situation in the OSPAR area and comparisons between regions. The guideline has been designed in such a way that all OSPAR countries can participate, bearing in mind adequate quality assurance of the data generated. The guideline is based on the method developed during the OSPAR pilot project 2000-2006 and is complimented with information derived from UNEP's own realisation of a worldwide guideline.

The first dataset has been analysed and provides an indication of the presence of different types of litter in the marine environment. The report 'Marine litter in the North-East Atlantic Region' (OSPAR, 2009) serves as a background document for the marine litter paragraphs in OSPAR's Quality Status Report (QSR) 2010.

The current report aims to:

- provide an annual update of Dutch beach litter monitoring data of 2016;
- provide an overview of the Dutch beach litter data analysis results for 2011-2016 using Litter Analyst.

2 Materials and methods

2.1 Selection of reference beaches

Within the OSPBAR Beach Monitoring Guideline (OSPAR Commission, 2010) the following criteria have been identified for selecting reference beaches. The beaches should be:

- a) composed of sand or gravel and exposed to the open sea;
- b) accessible to surveyors all year round;
- c) accessible for ease of marine litter removal;
- d) have a minimum length of 100 metres and if possible over 1 km in length;
- e) free of 'buildings' all year round;
- f) not subject to any other litter collection activities.

In each case, these criteria should be followed as closely as possible. However, the monitoring coordinators can use their expert judgement and experience of the coastal area and marine litter situation in their particular country when making the final selection of the reference beaches. For example, in some countries the local conditions do not allow for selection of beaches composed mainly of sand, and in some places survey sections of 1 km in length cannot be selected.

The Dutch reference beaches are:

- Bergen (NL1)
- Noordwijk (NL2)
- Veere (NL3)
- Terschelling (NL4)

All the Dutch reference beaches are composed of sand, are accessible all year round, are easy accessible for marine litter removal, have a length of 100 metres and 1 km, are free of buildings all year round and comply with the OSPAR criteria a, b, c, d, e. The compliance of criteria (f), 'no collection of any other litter activities', does not apply to the beaches. The reference beach Bergen is cleaned on a weekly basis all year round. Volunteers or local authorities incidentally clean the other beaches.

Therefore contact with local beach authorities is essential. Before a monitoring on a reference beach is executed, the local beach coordinator is contacted to check for any local activities that can influence the monitoring session, e.g. a local clean-up, an accident with cargo, a recent storm, etc. In 2011-2016 all local beach coordinators have been contacted on a regular basis. As a guideline, no local beach cleaning should have occurred within the two weeks before a planned beach monitoring date. If this has occurred, it is attempted to postpone the monitoring to about two weeks after the cleaning date. However, in cases of extreme weather events, unexpected changes in employee schedules, or for any reason

poor communication with local beach coordinators, the monitoring may occur within two weeks after a cleaning activity.

Table 1 Contact information of local beach coordinators.

| | |
|--|---|
| Gemeente Veere Strand exploitatie Walcheren (SSW) Lucas Fransen Tel. 0118 586275 fransenssw@zeelandnet.nl | Gemeente Noordwijk Petri Biegstraaten Tel. 071 3660370 p.biegstraaten@noordwijk.nl |
| Gemeente Bergen Willem Taal Tel. 072 8880000 W.taal@bergen-nh.nl | Gemeente Terschelling Evert Van Leunen e.v.leunen@terschelling.nl Tel: 0562 4462518 |



Figure 3 Dutch monitoring beaches (map provided by RWS).

2.2 Sampling areas

Once sampling areas have been identified a beach is chosen. A sampling unit is a fixed section of beach covering the whole area between the water line to the back of the beach i.e. start of the dunes. Two sampling units are used within the OSPAR area: 100-metres: for identifying all marine litter items; and 1-km: for identifying objects larger than 50 cm. The monitoring sessions start at the back of the beach on the landside. A small strip of about 2-3 meters is monitored; walking distance between the two surveyors is about 2-3 meters. Two surveyors walk parallel with the beach towards the end of the 100 metre monitoring area and draw a line in the sand during monitoring of the litter items. After reaching the 100-metre border of the monitoring area, the surveyors make a turn and proceed with the next strip. All litter is collected in garbage bags. The drawn line is now the border of the monitoring strip. This method is repeated until the sea line is reached. See also the picture below.

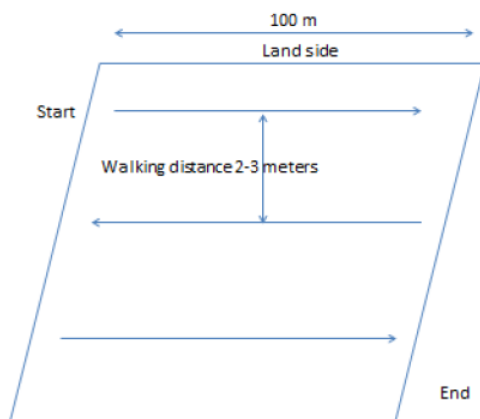


Figure 4 Walking pattern used for the beach litter monitoring. A monitoring strip is typically 2-3 m wide

For both 100 m and 1 km units a separate survey form is available from the OSPAR method and filled in (OSPAR, version 2010). The 100 metres is the standard sampling unit. The 100-metre stretch must be part of the 1-km stretch; but the surveyors must use a fixed part of the 1-km. An example is given in 2-3.

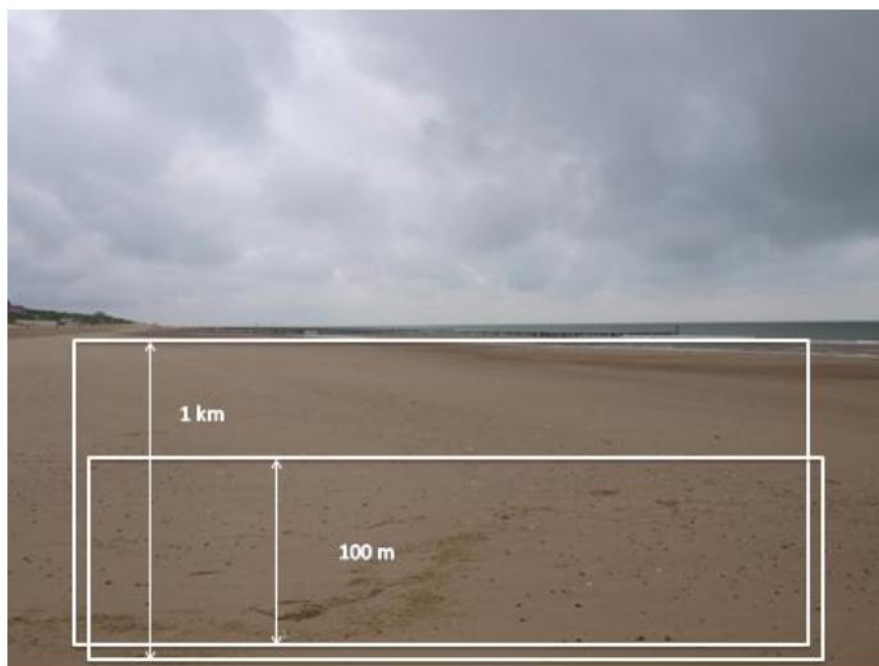


Figure 5 Photograph of the Dutch reference beach Terschelling

Permanent reference points are used to ensure that exactly the same site will be monitored for all surveys. The start and end points of each sampling unit can be identified by different methods. In the Netherlands the reference beaches are identified by marked beach poles.

Table 2 Details of the 4 Dutch OSPAR Beach Litter reference beaches

| # | Beach name | Access point | Start Beach Pole (start of 100 survey) |
|-----|---------------------|-----------------------------------|--|
| NL1 | Bergen | Boulevard Noord Egmond aan Zee | 35.250 |
| NL2 | Noordwijk | Langevelderslag | 72.250 |
| NL3 | Oostkapelle / Veere | Oranjezon | 10.300 |
| NL4 | Terschelling | Oosterend Badweg | 18.200 |

2.3 Monitoring frequency and period

The reference beaches are surveyed 4 times a year. However, circumstances may lead to inaccessible situations for surveyors: such as stormy wind, and hazards such as rain, snow or ice and may result in a postponed or even cancelled beach survey.

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).

2.4 Item classification

Items are classified according to the 'Guideline for monitoring Marine Litter on the Beaches in the OSPAR Maritime Area, Edition 1.0' using OSPAR scoring lists (OSPAR Commission, 2010).

2.5 Collection, identification and registration of litter

All items found on the sampling unit are entered on the survey forms provided (OSPAR, version 2010). On the survey forms, each item is given a unique OSPAR identification number. The survey forms also provide a box for a UNEP identification number. This is for UNEP use only. Unknown litter or items that are not on the survey form are noted in the appropriate "other item box". A short description of the "other" item will be included on the survey form. If possible, digital photos should be taken of unknown items in order for them to be identified later. The presence of recurring 'unknown' items may lead to the creation of a new category on the survey form. Following the advice from Van Franeker (2013), North Sea Foundation will continue to monitor OSPAR Item #117 (plastic/polystyrene pieces < 25mm); since this is essential for data continuity and statistical tests of trends over time.

2.6 Data Management

The national coordinator must complete a questionnaire for each reference beach. (OSPAR Commission, 2010). The questionnaire includes information on the location and the physical and geographical characteristics of each beach, including the proximity of possible sources of marine litter. Also included are questions regarding factors that could help explain the amounts, types, and composition of marine litter found on that beach, for example, cleaning activities. It is advisable to contact local, regional or national authorities for information on cleaning schemes etc. For questions on the proximity of shipping lanes, river mouths, waste water outlets, etc. official data from responsible authorities are used only. When circumstances change, the questionnaire will be updated.

The beach litter monitoring data are entered in the OSPAR database within three working days after the monitoring took place, in order to have a good visual memory of the results and circumstances. The transcribed monitoring forms are scanned and digitally stored and added to the annual report. The monitoring data are (digitally) presented in an export of the OSPAR database in Appendix I. The scanned field forms are added in Appendix III. Until 2013 the data was entered by North Sea Foundation surveyors into an Excel file, and RWS transferred the data from the Excel file into the online database. From 2014 onwards the North Sea Foundation enters the data from the (fresh) paper monitoring forms into the

online database. The Marine Conservation Society now hosts this database¹. In the near future, RWS CIV will also store the beach litter data in the RWS DONAR database.

2.7 Data analysis procedures

2.7.1 Data preparation: item clustering

The item list for 100-meter surveys is part of the data in Appendix I. The current 100m-survey form contains 116 categories (marked by item-codes). However, the database holds eleven additional categories that were used before 2010. Changes made to the categories in 2010 represent a serious complication in data analyses. For analyses that include data from before and after the changes in 2010, it is essential that clusters of items are used that contain both the old and the new categories. Usage of separate categories in these cases would lead to incorrect trend analysis results. Five item-codes got a different definition and – to avoid confusion – their time series from before 2010 got new item-codes, as listed in table 3.

Table 3 Items clustering that is performed on the initial items 31, 32, 46, 62, and 84 in the period 2002-2009 and in the period 2010 and later (Baggelaar & Meulen, 2014). Grey cells represent that an item was not on the survey form in that period (columns) and also not registered as such.

| Initial code | Period 2002-2009 New code: old definition | Period 2010 and later Old code: new definition |
|--------------|--|---|
| 31 | 200: plastic rope/cord/nets < 50 cm | |
| | | 31: plastic rope (diameter >1 cm) |
| 32 | 201: plastic rope/cord/nets > 50 cm | |
| | | 32: plastic string/cord (diameter <1 cm) |
| 46 | 202: plastic/polystyrene pieces <50 cm | |
| | | 46: plastic/polystyrene pieces 2.5-50 cm |
| 62 | 204: cartons/tetra packs | |
| | | 62: non-milk cartons/tetra packs |
| 84 | 205: metal oil drums (new, not rusty) | |
| | | 84 metal oil drums (new and old) |

Five other item-codes were removed (51, 58, 85, 106, and 107) and their time series from before 2010 got new item-codes, as illustrated in table 4.

Table 4 Items that were removed from the survey list and their new assigned code (Baggelaar & Meulen, 2014). The grey cells represent that an item was not on the survey form in that period (column) and also not registered anymore.

| Initial code | Period 2002-2009 New code: old definition | Period 2010 and later Item not on survey form |
|--------------|--|--|
| 51 | 203: rubber gloves | |
| 58 | 210: textile rope/strings | |
| 85 | 206: metal oil drums (old, rusty) | |
| 106 | 207: human faeces | |
| 107 | 208: animal faeces | |

¹<http://www.mcsuk.org/ospar/home>

In 2010, ten new items were introduced (112-121), as shown in table 5.

Table 5 Items that were added to the survey list in 2010 (Baggelaar & Meulen, 2014). Grey cells represent that an item was not on the survey form in that period (column) and also not registered yet.

| Initial code | Period 2002-2009 Item not on survey form | Period 2010 and later Code: definition |
|--------------|---|---|
| 112 | | 112: plastic bag ends |
| 113 | | 113: rubber gloves (industry./profess.) |
| 114 | | 114: plastic lobster and fish tags |
| 115 | | 115: plastic nets and pieces of net < 50 cm |
| 116 | | 116: plastic nets and pieces of net > 50 cm |
| 117 | | 117: plastic/polystyrene pieces < 2.5 cm |
| 118 | | 118: cartons/tetra packs (milk) |
| 119 | | 119: wooden fish boxes |
| 120 | | 120: disposable metal BBQs |
| 121 | | 121: bagged dog faeces |

2.7.2 Data preparation and analysis using Litter Analyst

The data preparation (i.e. clustering, removal, and addition of items) is performed by the new tool Litter Analyst (version 2.0). Litter Analyst is able to read the data-exports from the OSPAR database (in the .CSV format), preparing the data for analysis, to export data as a .CSV file or a Microsoft Excel™ file, and perform trend analysis on individual litter items and total items with the Mann-Kendall test and Theil-Sen slope estimator. For more details on the chosen analysis and Litter Analyst, the reader is kindly referred to Baggelaar en Van der Meulen (2014) and the User Manual of Litter Analyst². Outputs of Litter Analyst are evaluation tables of items, sources, and materials, but also a data series plot, boxplots of item counts per year, a table of data series, and a data density matrix can be created and saved externally (Meulen & Baggelaar, december 2014). For the analyses in this report, the following settings in Litter Analyst were used:

- Aggregation condition 75%, minimum percentage of counts of items in top-X list 80%.

For analysis of the 1 km dataset it is recommended to simply look at total counts of all items recorded for any data use combinations that include data from before and after 2010.

2.7.3 Trend analyses

In the annual report trend analyses are performed on the total item counts and the top-80% items. The top-80% is defined as the list of most abundant items that during a six-year period constitutes on average at least 80% of the total counts. Trends are analysed by non-parametric Mann Kendall trend analysis of specific item counts against the year of the survey. In the current beach analysis, the dataset of 6 years (2010-2015) was used.

²<http://www.amo-nl.com/pdf/User%20manual%20Litter%20Analyst.pdf>

2.7.4 Calculation of total item counts

The occurrence of considerable fluctuations in the total counts of beach litter surveys was avoided by using 6-year arithmetic averages and median values to describe total abundance. The averages are calculated from individual beach survey counts, and not from annual averages.

2.7.5 Source analysis

The assignment of sources categories to litter items by Litter Analyst, based on an older OSPAR list, is still under debate because it is complex and not always clear-cut. Therefore these results have not been added to this annual report. Instead, for the Dutch top-75% items the probable sources are reported in Table 3.5: Top 75% of most found items and their most probable sources.

2.7.6 Material analysis

It is also essential for the MSFD to connect monitoring results to the litter material composition. Especially the fraction of plastic/synthetic items is of interest for MSFD policy makers, in light of the increased awareness and attention on plastic in the seas and oceans. A relative contribution of each litter material is provided as an average for the period 2009-2014. Trend analysis is performed of the total abundances of items (period 2010-2015) which have been assigned with sufficient confidence to either of the following material categories: Plastic/polystyrene [406], Rubber [407], Sanitary [414], Paper/cardboard [409], Wood [410], Glass [412], Cloth/textile [408], Metal [411], Ceramic/pottery [413], and Medical [415].

2.7.7 Unknown items

Photographs of unknown items are stored in a photo database at the North Sea Foundation, sent to ICGML Basecamp for judgment of other marine litter experts and are displayed in the annual report.

2.7.8 Special circumstances

Special circumstances, such as extreme weather conditions, nearby sand suppletions or any other activities that may influence the monitoring, are listed on the field forms and published in the annual report.

2.8 Reporting

The North Sea Foundation produces an annual report with an update of the state and trend analyses of Dutch beach litter using data from the current and preceding years. This report will be finished within four months after the last monitoring activity.

3 Results & Discussion

Exports from the OSPAR database containing all litter data from 2011- 2016 have been added in the digital Appendix II. In the following sections, the total counts for each beach and for all beaches aggregated are shown. The top-80% analysis of total item abundance, source analysis, and material analysis will be elaborated on in more detail.

3.1 Total counts

The average total item counts per 100-meter beach, the trend and the significance of the trend are displayed in table 3.1. 6-year arithmetic averages and median values are presented. An increasing trend is found for Bergen and a decreasing trend for Noordwijk, Terschelling and Veere. The total average number of items counts for all beaches aggregated amounts to 354 items per 100 m beach. The decreasing aggregated trend is significant. (p 0.011).

Table 6 Average total item counts, trend and significance of the trend for Bergen, Noordwijk, Terschelling and Veere and for all four beached aggregated for the period 2011-2016.

| <i>Location</i> | <i>Period</i> | <i>Average total counts per survey</i> | <i>Median counts per survey</i> | <i>Trend (counts/year)</i> | <i>Significance of trend (p-value)</i> |
|-----------------|-----------------------|--|---------------------------------|----------------------------|--|
| Bergen | 01/01/2011-31/12/2016 | 356,4 | 302,5 | 36,0 | 0,264 |
| Noordwijk | 01/01/2011-31/12/2016 | 395,5 | 303,0 | -52,9 | 0,040 |
| Terschelling | 01/01/2011-31/12/2016 | 382,1 | 360,5 | -85,0 | 0,004 |
| Veere | 01/01/2011-31/12/2016 | 301,4 | 245,5 | -76,4 | 0,003 |
| Ber Noo Ter Vee | 01/01/2011-31/12/2016 | 354,0 | 345,9 | -42,1 | 0,011 |

It appears that the significant total count trend found for the period 2010-2015 is again observed in the period 2011-2016. This confirms the significant decrease of beach litter in The Netherlands in recent years. This situation is in marked contrast with the 6-year periods before 2010-2015 (see Table 10).

The seasonal data points in Figure 6 show a considerable variation, as is well known for beach litter. This underlines the importance of conducting at least surveys every 3 months, resulting in four datasets per beach per year, as described in the OSPAR CEMP guideline (OSPAR, 2017).

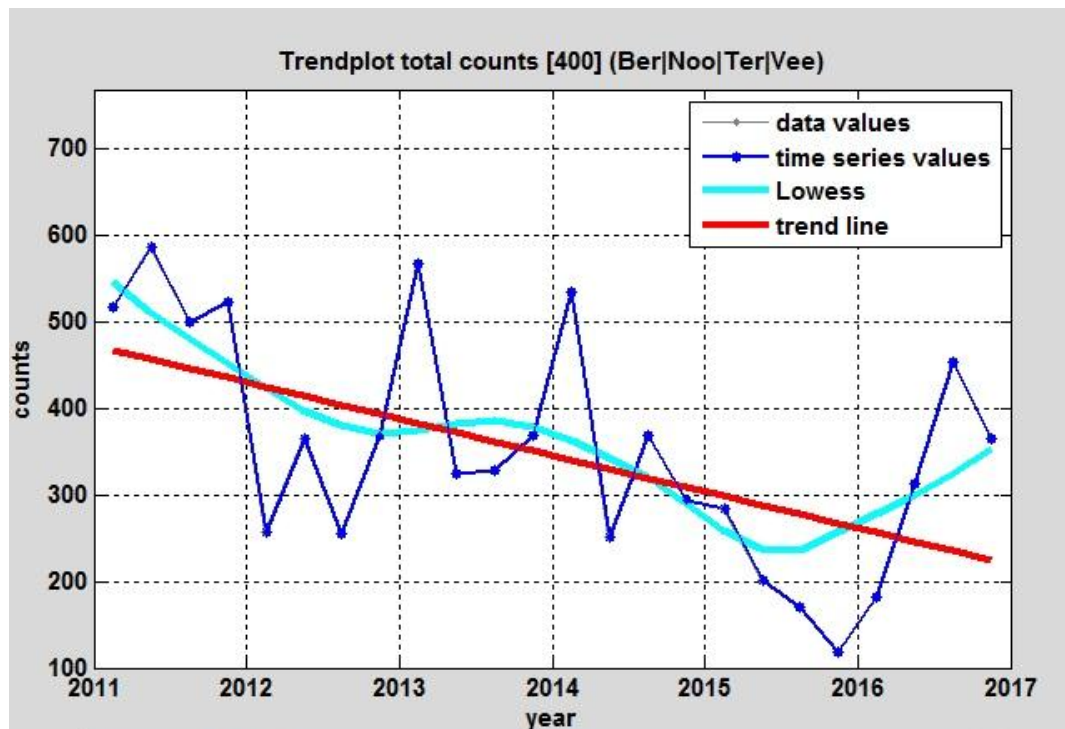


Figure 6 Trendplot Total counts period 2011- 2016 with decreasing significant trend (p 0.011)

3.2 Top-80% Analysis

Top-80% analysis has resulted in a top-15 for all four beaches for the period 2011-2016. Since this research aims to provide insight in the Dutch situation, results are displayed as aggregated results for all four beaches. The aggregated results for the four Dutch beaches are given in table 7. Figure 6 shows the trend plot for the total counts in the period 2011-2016. Figure 7 shows the trend plot for the top 1 category found; net and ropes Trend plots of the top 5 most found categories in the period 2011-2016 are included in Appendix VII. Most found items, median and average item count per 100 meter beach (6-year arithmetic averages), the relative abundance of each item (%) related to total litter count, the trend per item in counts per year, and the significance of the trend, are provided.

Nets and ropes rank as the number one most found item and plastic polystyrene pieces smaller than 50 cm were the second most found item. Together, they account for more than half of the total number of litter items found (56,7%).

The data shows decreasing trends with a high ($p < 0.05$) significance for most of the items from the top 80% list.

Table 7 Top 80% of most found items along the Dutch coast, including median and average count per 100 meter, percentage of total count, trend [counts/year], and significance of trend for the period 2011-2016. Significant trends are printed in bold.

| Aggregated results for Terschelling / Bergen / Noordwijk / Veere | | | | | | |
|--|--|--------------------------|--------------------------|------------------------|----------------------------|---------------------------------------|
| Rank | Litter category [OSPAR-100-ID] | Med. Count / 100 m | Aver. count/ 100 m | % of total count | Trend (counts/ Year) | Significance of trend (p-value) |
| 1 | Nets and ropes [300] | 128,8 | 138,0 | 39,0% | -18,1 | 0,009 |
| 2 | Plastic polystyrene pieces < 50 cm [301] | 62,9 | 62,8 | 17,7% | -4,0 | 0,275 |
| 3 | Plastic: Caps [15] | 19,0 | 19,0 | 5,4% | -1,9 | 0,150 |
| 4 | Plastic: Crisp [19] | 10,9 | 13,1 | 3,7% | -2,0 | 0,101 |
| 5 | Plastic: Foam_sponge [45] | 13,1 | 12,6 | 3,6% | -0,8 | 0,274 |
| 6 | Rubber: Balloons [49] | 10,8 | 12,4 | 3,5% | -2,2 | 0,000 |
| 7 | Plastic: Tangled [33] | 9,5 | 12,2 | 3,4% | -2,8 | 0,003 |
| 8 | Plastic: Small_bags [3] | 7,0 | 8,6 | 2,4% | -1,6 | 0,000 |
| 9 | Plastic: Industrial [40] | 7,4 | 8,6 | 2,4% | 0,4 | 0,165 |
| 10 | Plastic: Other [48] | 5,4 | 6,1 | 1,7% | -1,6 | 0,003 |
| 11 | San: Buds [98] | 5,5 | 6,0 | 1,7% | -0,9 | 0,033 |
| 12 | Plastic: Bags [2] | 4,5 | 5,0 | 1,4% | -1,9 | 0,000 |
| 13 | Plastic: Drinks [4] | 4,8 | 4,7 | 1,3% | -0,7 | 0,000 |
| 14 | Plastic: Cutlery [22] | 5,0 | 4,6 | 1,3% | -0,2 | 0,471 |
| 15 | Plastic: Food [6] | 3,1 | 3,2 | 0,9% | -0,7 | 0,005 |

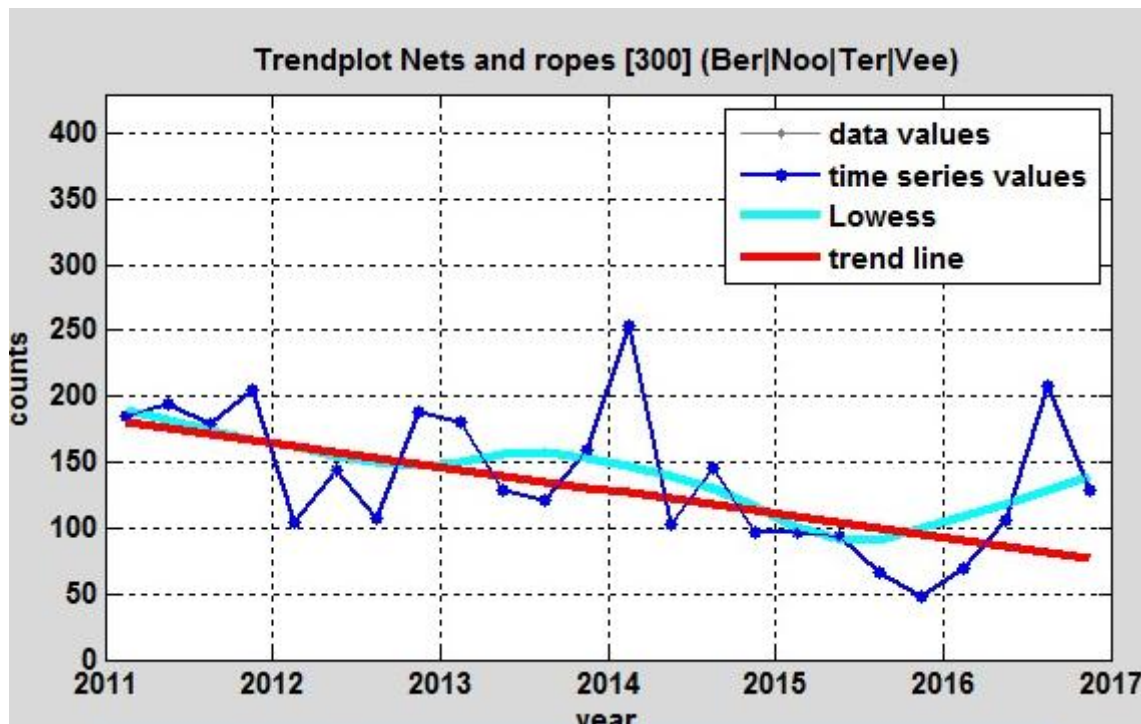


Figure 7 Trendplot Net & Ropes period 2011- 2016 with decreasing significant trend (p 0.009)

3.3 Sources of litter items

OSPAR identified the following sources: fishing, shipping, tourism, sanitation and a category 'other' for unknown sources. The assignment of source categories to litter items is complex. In many cases, litter items can originate from different sources. Nets and ropes for example, often originate from fishing vessels, but can also originate from cargo vessels. Therefore, the top 100% of found items is provided in Appendix VII with a probability classification of the source 1) land (including river outlets; 2) sea; 3) land & sea. The probability classification is based on expert judgment from the North Sea Foundation surveyors. It aims to serve as input for the current discussions within OSPAR about the allocation of litter items to different sources.

3.4 Materials of litter items

Trend analyses of litter materials for the period 2011-2016 are provided in table 8.

The data shows decreasing trends for plastic/ polystyrene, rubber, sanitary and paper / cardboard material categories. For wood, glass, metal, cloth/textile, ceramic/pottery and medical materials no trends were found. The largest decreasing trend is from plastic/polystyrene material (-38.8 counts/year).

Table 8 Material trend analysis of litter items for each material category at Bergen, Veere, Terschelling, and Noordwijk including trend in counts/year and significance of trend for the period 2011-2016

| Aggregated results for Terschelling / Bergen / Noordwijk / Veere | | |
|--|---------------------|---------------------------------|
| Material category | Trend [counts/year] | Significance of trend (p-value) |
| plastic/polystyrene [406] | -38,8 | 0,010 |
| rubber [407] | -2,4 | 0,001 |
| sanitary [414] | -1,0 | 0,029 |
| paper/cardboard [409] | -0,7 | 0,031 |
| wood [410] | -0,4 | 0,081 |
| glass [412] | 0,1 | 0,655 |
| metal [411] | -0,1 | 0,294 |
| cloth/textile [408] | -0,2 | 0,080 |
| ceramic/pottery [413] | 0,0 | 0,090 |
| medical [415] | 0,0 | 0,071 |

3.5 Unknown/new items

Figure 9 and 10 show the two unknown/new items that were found during the surveys in 2016. The item shown on figure 8 looks like some sort of explosive-related part. It reads the text 'Rijkswaterstaat, D.M. 119'. The other item (figure 9) is a piece of a step ladder used on board of ships.



Figure 8 Seal for explosives container, Veere **Figure 9 Piece of step ladder, Terschelling**

3.6 Registration of other pollutants

The presence of pollutants such as paraffin is separately recorded on the OSPAR Marine Litter Monitoring Survey Form since the beginning of the beach litter monitoring from 2002. The size (range 0->10 cm) and the frequency of paraffin per 100m (estimated number per metre of strandline) is recorded.

In 2016 the EIHA 2016 Environmental Impact of Human Activities Committee (EIHA) requested ICG-ML to examine the information held in the beach litter database on paraffin items to determine if there is a cause for concern that should be brought to the attention of the IMO. It was concluded *“The results show that the monitoring of floating pollutants (note: in this case paraffin) washed ashore on the coast in the OSPAR region using the OSPAR beach litter surveys appears to supply feasible results”* (OSPAR, 2017).

The analysis of the registration of other pollutants in the period 2002 – 2015 (appendix VIII) shows that The Netherlands belong to the Top 3 countries where most paraffin is recorded. In the period 2011-2016 where 96 surveys were conducted, during 46 surveys, other pollutants such as paraffin were recorded. During the survey conducted in April 2016 in Veere, large blocks of paraffin were found (figure 10). In 2016, during 64% of the surveys conducted other pollutants such as paraffin was found (figure 11).

The average number of paraffin or wax pieces recorded for all sites in the period 2011-2016* is presented below:

- size range 0-1cm 229 pieces/m²
- size range 1-10cm 529 pieces/m²
- size range >10cm 7 pieces/m²

*average of all surveys where paraffin & wax was recorded as present in the given size range

Whether the presence of paraffin on the Dutch coastline has increased is difficult to determine due to registration method of the pollutants. It was recommended to improve the value of the results by standardized analysis of samples of pollutants and by monitoring and registering paraffin in every Dutch beach survey.

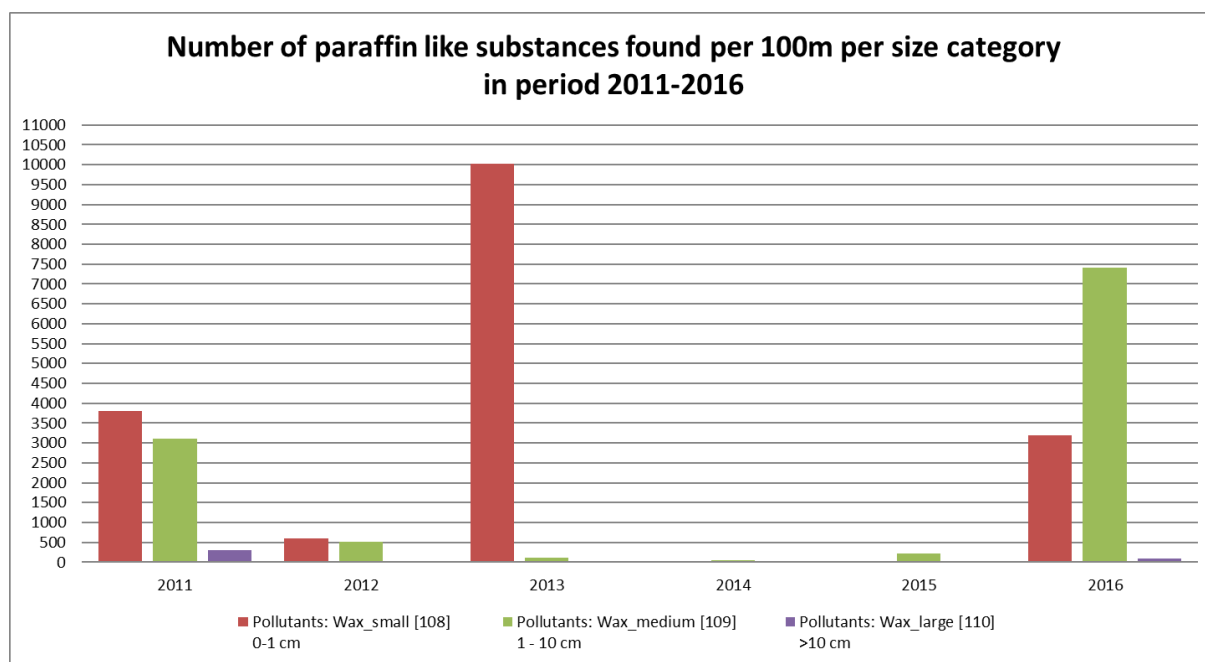


Figure 10. Number of paraffin like substances found per 100m per size category in period 2011-2016



Figure 11 Photograph of a large block of paraffin, Veere.

3.7 Pellets

In 2016 during every survey the presence of plastic pellets was recorded. In 2016, during 8 (57%) of the 14 surveys conducted, plastic pellets were found. In some cases, it was only a few (1-50), in other cases more than (50 - <500) pellets. In table 9 the periods where plastic pellets were found are included. Plastic pellets were mostly found in Q2 and Q4.

Table 9 Presence of pellets during quarterly measurements in 2016.

| Period where pellets were found | Number of surveys per quarter where pellets were found |
|---------------------------------|--|
| Q1 | 0 |
| Q2 | 3 |
| Q3 | 2 |
| Q4 | 3 |
| Total | 8 |

3.7 Plastic bags

On January 1st 2016, a ban on free plastic bags in shops was introduced in the Netherlands. The purpose of this ban was to reduce street- and marine litter. The trend plot for OSPAR item – Plastic Bags [002] is included in figure 12. In the period 2011-2016 the average count

per year was 5.0 plastic bags per 100m beach and shows a decreasing trend of -2,0 counts/year (p value = 0.000). In 2016 the average count per year was 0.8 plastic bags per 100m beach. Compared to 2015, the average count per year was 1.2 plastic bags per 100m beach. The average count decreased in 2016 compared to 2015 by 0.4 plastic bags per 100m beach. Since 2014, the trend is decreasing and it seems that the ban possibly has contributed to the already decreasing trend, however future results must determine if the trend continues to decrease.

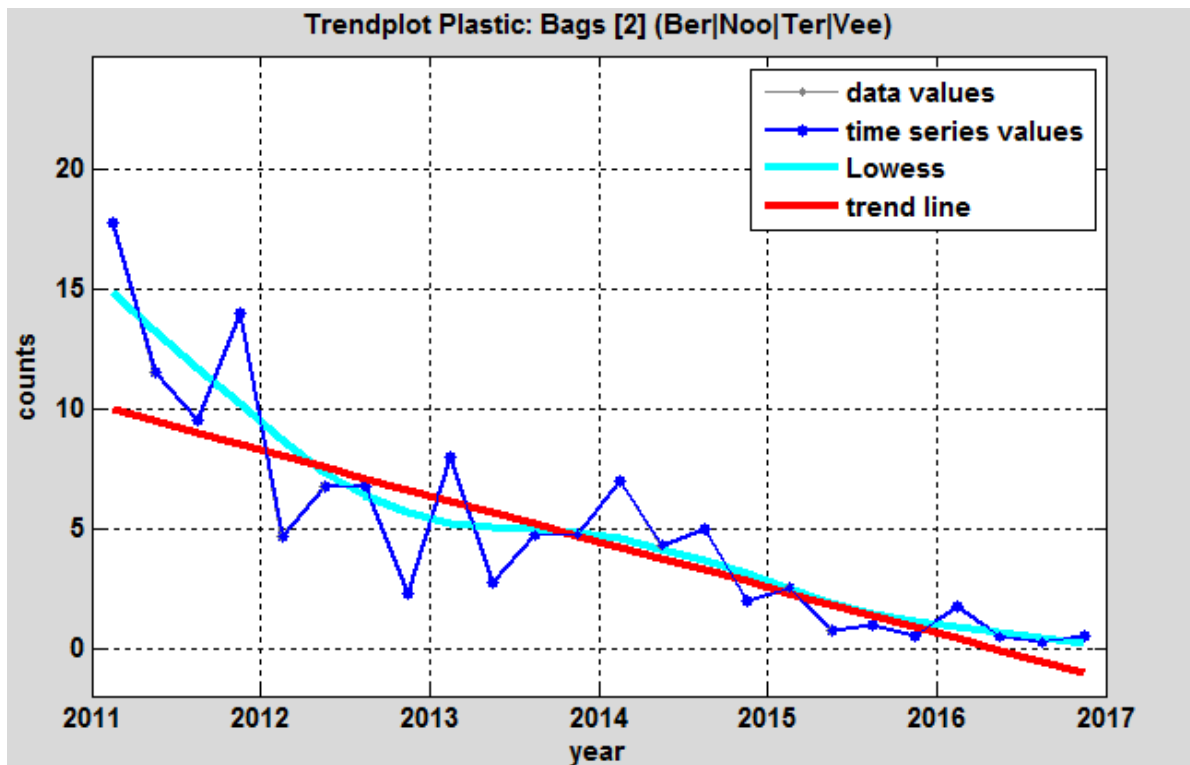
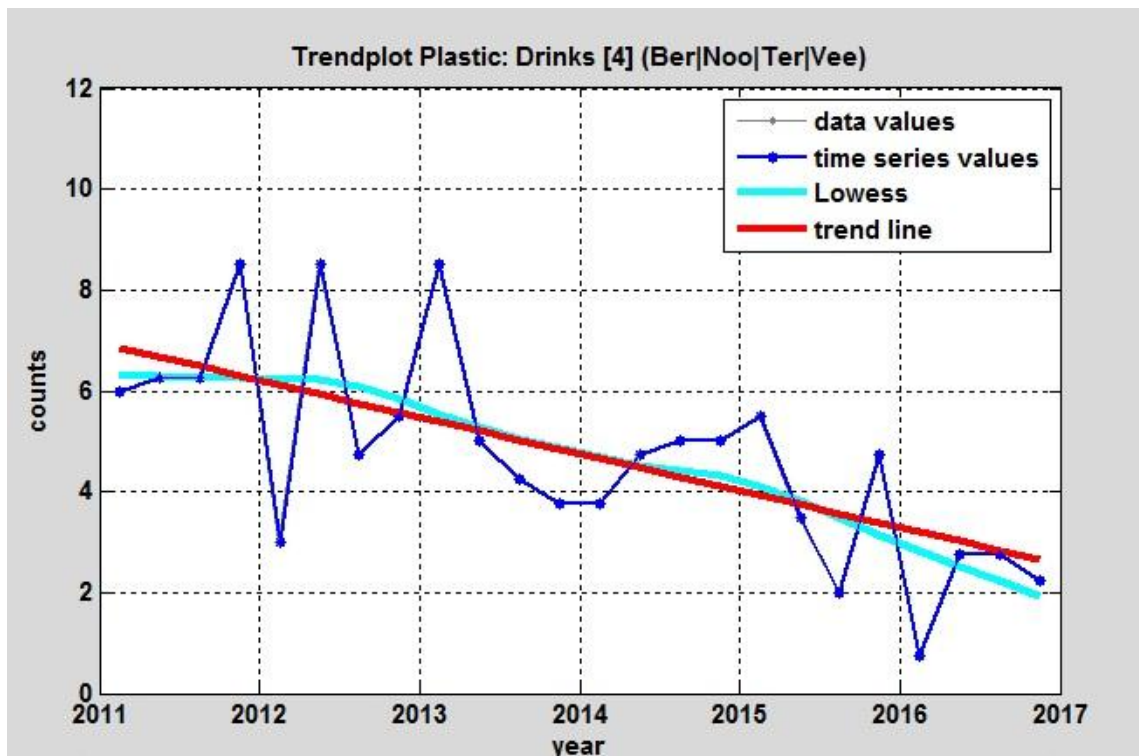


Figure 12 Trendplot Plastic bags in period 2011-2016 with decreasing significant trend (p 0.000)

3.9. Plastic drinks (bottles, containers and drums)

The trend plot for OSPAR item – Drinks (bottles, containers and drums)[004] is included in figure 13. In the period 2011-2016 the average count per year was 4.7 plastic drinks per 100m beach and shows a decreasing significant trend of -0.8 counts/year (p value = 0.000). In 2016 the average count per year was 2.1 plastic drinks per 100m beach. Compared to 2015, the average count per year was 3.9 plastic drinks per 100m beach. The average count decreased in 2016 compared to 2015 by 1.8 plastic drinks per 100m beach.



Figuur 13 Trendplot Plastic Drinks in period 2011-2016 with decreasing significant trend (p 0.000)

3.10. Pilots: weighting of litter and recording of dolly rope

In 2016, two extra measurements were added to the field surveys from April 2016. The first pilot involved the weighing of marine litter after each monitoring to get a better insight in the weight amount of kilo's and thereby the volumes of marine litter washing ashore. In 2016, marine litter was weighed at 10 surveys. All items were collected in a plastic bin bag after the sand was manually removed by shaking off the sand as much as possible. The bag was weighed with a digital weighing device. The average weight based on 10 surveys was 5,9 kg per survey. More surveys must be conducted before enough data is collected to draw conclusions.

The second pilot includes the separate recording of dolly rope. Dutch surveyors estimated that 90% of the items under OSPAR Litter category [OSPAR- 0032] String and cord and [OSPAR- 0033] Tangled nets/ cord/rope and string consist of dolly rope. In order to test this

assumption, the dolly rope was recorded separately. The pilot was carried out without affecting the OSPAR dataset. An extra field form was developed where the number and the colour (blue, red/orange, black and other) of each dolly rope is recorded separately. This was done because the assumption is that the colour could be related to the type of fishing industry and preference of colour use of Belgium and Dutch fishermen. Black and blue coloured dolly rope is mainly used by Belgium fishermen and Southern Dutch fishermen and orange dolly rope is mainly used by Northern Dutch fishermen (source: personal communication with fisheries expert Wouter- Jan Strietman from Wageningen Economic Research).

More information will be collected in 2017. The data is later added to the string and cord category on the regular OSPAR field form. In 2016, the separate recording of dolly rope was done at 7 surveys. Most dolly rope was found in Bergen aan Zee and was blue. Blue dolly rope accounted for more than 70% of the total of 651 dolly rope items recorded separately. More surveys must be conducted before enough data is collected to draw conclusions. Dolly rope is one the most found items on the Dutch beaches. It is a unique item because is possibly one of the few plastic items on North Sea beaches that can be traced back to a specific type of fishing activity in an certain geographical area.

The pilots will be continued in the next monitoring rounds in 2017.

3.11. Moving Averages

The data of 2011-2016 shows a decreasing significant trend. Table 10 includes the 1) moving averages; 2) median; 3) trend slope and p values during six year periods from 2004 – 2016. The average counts are between 447 – 354 per 100m of beach. In the first six periods the trends slope showed various results e.g. an increasing slope in 2008-2013 and relatively minor decreasing trends slopes of maximum -4,3. The periods 2010-2015 and 2011-2016 both show a significant decreasing trend and large decreasing trend slopes of more than -40,0. Two periods in sequence that show large decreasing trends could indicate a trend breach. However previous periods also show large differences between periods with one period showing a small decreasing trend followed by a year with a large increasing trend.

Table 10: Six year moving averages in periods 2004 – 2016 and trend slopes and p-values.

| Period | 2004-2009 | 2005-2010 | 2006-2011 | 2007-2012 | 2008-2013 | 2009-2014 | 2010-2015 | 2011-2016 |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|--------------|
| 6-year arithmetic averages | 397 | 406 | 447 | 399 | 393 | 383 | 364 | 354 |
| Median | 352,4 | 404,0 | 430,6 | 408,8 | 368,9 | 368,6 | 366,6 | 345,9 |
| Trend, slope | 7,2 | -4,3 | -4,2 | -3,0 | 25,7 | 2,0 | -40,0 | -42,1 |
| Trend, p value | 0.573 | 0.712 | 0.901 | 0.823 | 0.785 | 0.941 | 0.011 | 0.011 |

3.12 Special circumstances

During one survey, the beach in Noordwijk (Q1 2016) was extremely clean compared to past surveys. However, no recorded cleaning activities have taken place before the survey. During another survey in Bergen (Q4 2016) the beach was abundant with marine litter. During a survey at Terschelling, puddles of water were formed due to heavy rain in the survey area. During almost all surveys in 2016, tractor and car tracks were visible in the survey area.

3.13 Discussion

For the allocation of items to different sources, we suggest to develop a probability matrix for the OSPAR region in order to avoid a bias towards certain sources (see Appendix V). This probability matrix was presented at the OSPAR meeting in November '2016 in Copenhagen. As items can- and are likely to- originate from different sources, an estimation by experts on the probability of the source creates a more balanced way of allocating items to different sources.

In addition, a separate source allocation is proposed which differentiates between land (tourism and recreation) and sea-based (fishing and- shipping sector) and land & sea sources (included both sources if the source can be allocated to both land and sea sources). The source allocation is based on the probability matrix and included in Appendix V & VII. All items have been included. Based on this analysis, most items found during the Dutch beach surveys originate from sea-based sources (see figure 14).

The data of the periods 2010- 2015 and 2011-2016 both show a decreasing significant trend. This may be an indication that the amount of litter that enters the North Sea is decreasing. Since marine litter has received a lot of public attention in recent years, the number of beach cleaning efforts in The Netherlands have increased. The list below describes a number of (beach) cleanup events and activities that are organised on a regular basis.

Cleanup activities in the Netherlands

- Clean Beach elections organised by Nederland Schoon (organised since 2013)
 - cleaning efforts by coastal municipalities;
- Yearly organised Boskalis Beach Cleanup organised by the North Sea Foundation where the entire North Sea coast is cleaned (organised since 2013);
- Increasing awareness concerning marine litter and efforts by beach goers to clean up beaches;
 - growing number of organisations organising beach cleanup activities i.e. TrashureHunt, SeaFirst, Juttersgeluk.
- Best beach pavilion election (organised since 1998);
 - one of the winning categories is cleanest beach pavilion (inside and outside);
- Fishing for Litter – an initiative that aims to reduce marine litter by involving the fishing industry to collect marine litter at sea (organised since 2013).

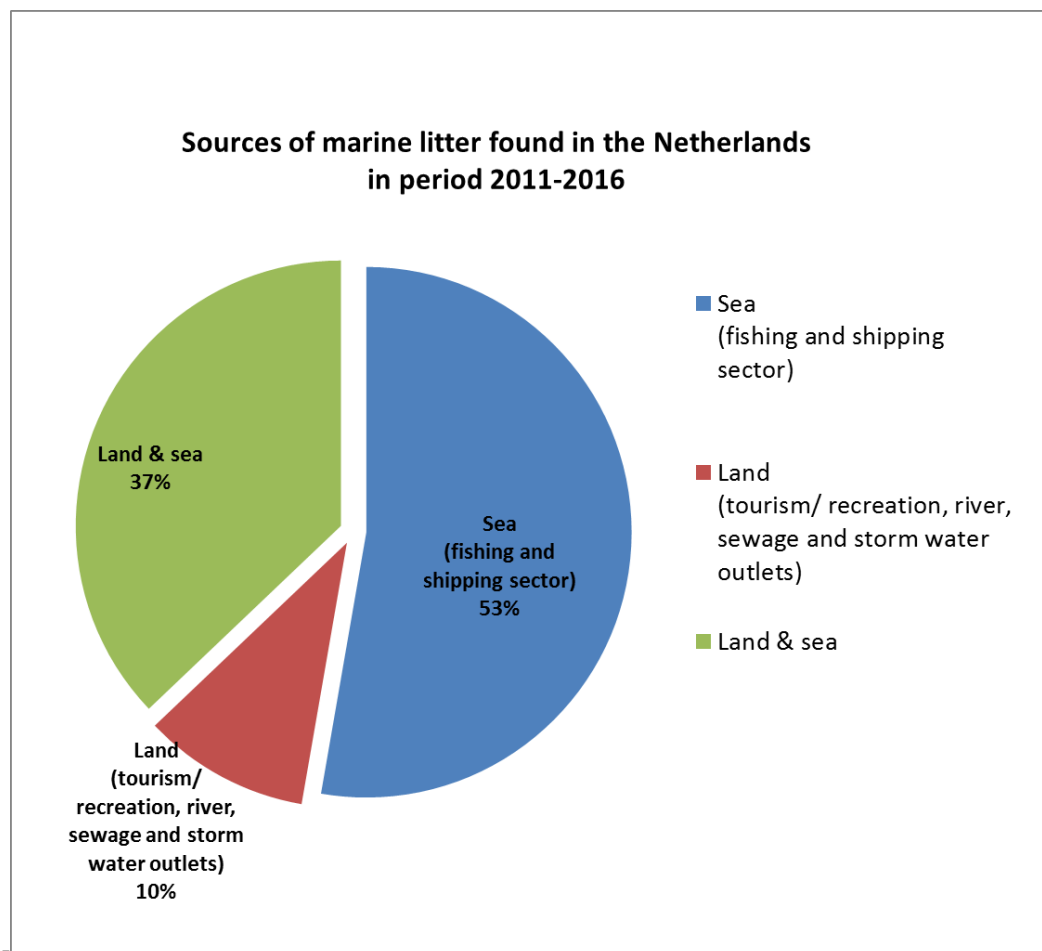


Figure 14 Sources of marine litter in period 2011-2016

4 Conclusions

The data suggests that the Dutch beaches are getting cleaner. On average 354 items were found per 100 meter beach during the period 2011-2016. There is a decreasing trend in total litter counts (-42.1) with a high significance ($p=0.011$). During 2016, on average 329 items were found per 100 m beach. During 2015, 227 items were found on average. Despite this increase compared to 2015, the 6 year trend is negative, with a high significance.

The beaches Noordwijk, Terschelling, Veere show a decreasing trend in average items counts per year. Terschelling has the highest decreasing trend in average item counts per year, namely -85.0. Bergen shows an increasing trend for average item counts per year of +36.0.

The top-80% resulted in a top 15 of most found litter items on the four Dutch beaches monitored. The most found items are nets and ropes (nr. 1) and plastic/polystyrene pieces smaller than 50 cm (nr. 2). Together these two items account for more than half of the total number of litter counts.

No trend analysis for litter items connected to different sources was performed as the allocation of items to different sources is currently under debate within OSPAR. Items can originate from different land and sea- based sources. This is made visible by a probability classification. Most items originate from sea-based sources. Nets and ropes, mostly originating from the fishing sector, account for 39% of all litter items found.

Decreasing trends in average counts per year were found for plastic/polystyrene, rubber, sanitary and paper / cardboard material categories. For wood, glass, metal, cloth/textile, ceramic/pottery and medical materials no trends were found. The largest decreasing trend in material categories is from plastic/polystyrene with -38.8 average item counts per year.



Figure 15 Weighing marine litter, Veere

References

- AMO-Icastat. (2016). *Litter Analyst*. Retrieved April 20, 2016 from <http://www.amo-nl.com/wordpress/software/litter-analyst/>
- Hammer J, Kraak MH, Parsons JR 2012. *Plastics in the marine environment: the dark side of a modern gift*. Marine Pollution Bulletin 30: 713–717
- Baggelaar, P., & Meulen, E. v. (2014). *Evaluation and fine-tuning of a procedure for statistical analysis of beach litter data*. n.a.: AMO-Icastat.
- Blokhuis, C., de Ruiter, M., Hougee, M., 2015. OSPAR Beach Litter Monitoring in the Netherlands 2009-2014. Annual Report. North Sea Foundation, Utrecht.
- Blokhuis, C., de Ruiter, M., Hougee, M., Van Loon, W.M.G.M., 2015. OSPAR Beach Litter Monitoring in the Netherlands 2013. Annual Report. North Sea Foundation, Utrecht.
- M. Hougee & M. Boonstra, 2016. OSPAR Beach Litter Monitoring In the Netherlands 2010-2015. Annual Report. North Sea Foundation, Utrecht.
- Browne, M. A., Underwood, A. J., Chapman, M. G., Williams, R., Thompson, R. C. & van Franeker, J. A. 2015 Linking effects of anthropogenic debris to ecological impacts. Proceedings of the Royal Society B-Biological Sciences 282
- Dagevos, J., Hougee, M., Van Franeker, J., Van Loon, W., & Oosterbaan, A. (2013). *OSPAR Beach Litter Monitoring in the Netherlands. First Annual Report 2002-2012*. Lelystad: RWS.
- Gall, S. C. & Thompson, R. C. 2015. *The impact of debris on marine life*. Marine Pollution Bulletin 92, 170-179.
- Meulen, E. v., & Baggelaar, P. (december 2014). *Litter Analyst 1.0. User Manual*. n.a.: AMO-Icastat.
- OSPAR Commission. (2010). *Guideline for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area. Edition 1.0*. n.a.: OSPAR.
- OSPAR. (2009). *Marine Litter in the North-East Atlantic Region: Assessment and priorities for response*. London: United Kingdom.
- OSPAR, 2017. Agenda item during Environmental Impact of Human Activities Committee (EIHA) meeting in April 2017 in Cork, Ireland. Recording the presence of “pollutants” on OSPAR Beach Litter Survey beaches presented by Germany and the Secretariat.
- C-171 Green Deal Visserij voor een Schone Zee RWS, 2014.
- OSPAR, 2017. CEMP- Guidelines for monitoring marine litter washed ashore and/or deposited on coastlines (beach litter) - Working Document.
- Andrady, A. L. in Marine Anthropogenic Litter (eds Bergmann, M., Gutow, L. & Klages, M.) 57–72 (Springer, 2015).

Appendix I OSPAR database exports of Dutch beach litter monitoring, year 2016.

Appendix II Scans of OSPAR litter survey forms, year 2016.

Appendix III Litter Analyst evaluation tables of items, materials and sources.

Appendix V Probability classification of the allocation of litter items to sources.

Table 1 Probability classification of the allocation of litter items to sources

| Sign | Probability | Comment |
|------|--------------------|---|
| - | Unlikely | Items not likely to originate from source |
| x | Low probability | 0-25% of items originate from source (estimation) |
| xx | Medium probability | 25-75% of items originate from source (estimation) |
| xxx | High probability | > 75% of the items originate from source (estimation) |

Table 2 Top 80% of most found items and their most probable sources

| Aggregated results for Terschelling / Bergen / Noordwijk / Veere | | | | | | |
|--|--|---------|----------|----------------------|-------|--|
| Rank | Litter category [OSPAR-100-ID] | Fishing | Shipping | Tourism / Recreation | Other | Description |
| 1 | Nets and ropes [300] | xxx | x | - | - | This category contains pieces of nets, dolly rope and ropes. These items are mainly used for fishing activities. A smaller percentage is likely to originate from merchant vessels, these are mainly mooring and tow ropes. It is estimated that a small percentage can originate from recreational sailing vessels that have accidentally lost ropes. |
| 2 | Plastic polystyrene pieces < 50 cm [301] | x | x | x | x | This category contains polystyrene pieces < 50 cm. The pieces of plastics can originate from various sources. In most cases, they are unidentifiable pieces which makes it difficult to determine its source. |
| 3 | Plastic: Caps [15] | x | x | x | x | This category contains caps from drinking bottles but also from other bottles such as |

| | | | | | | |
|---|-------------------------|-----|---|----|----|--|
| | | | | | | cleaning detergents and spray cans. Also large caps/lids of jerrycans are counted under this category. This type of waste can originate from different sources such as industrial offshore activities, domestic shipping and fishing waste, beach littering by recreants / tourist and river, sewage and storm water outlets. |
| 4 | Plastic: Tangled [33] | xxx | x | - | - | This category contains tangled pieces of net and dolly rope. Net and dolly rope are mainly used by the fishing industry. |
| 5 | Rubber: Balloons [49] | - | - | xx | xx | This category contains balloons and string found on the beach. Balloons are mainly launched from land for recreation activities. Other sources can be river, sewage and storm water outlets. |
| 6 | Plastic: Crisp [19] | x | x | x | x | This category contains wrappers of crisp bags. These items can originate from different sources. 1) Domestic shipping / fishing waste that is accidentally or purposely discarded in the sea; 2) Recreants and / or tourists that have accidentally and / or purposely discarded these bottles on the beach; 3) Waste from river, sewage and storm water outlets. |
| 7 | Plastic: Small_bags [3] | x | x | x | x | This category contains small plastic bags. It is difficult to determine its source. |
| 8 | Plastic: Bags [2] | x | x | x | x | This category contains plastic bags. These items can originate from different sources: 1) Domestic shipping / fishing waste that is accidentally or purposely discarded in the sea; |

| | | | | | | |
|----|---------------------------|---|-----|---|----|---|
| | | | | | | <ul style="list-style-type: none"> 2) Recreants and / or tourists that have accidentally and / or purposely discarded these bags on the beach; 3) Waste from river, sewage and storm water outlets. |
| 9 | Plastic: Foam_sponge [45] | x | x | - | xx | <p>This category contains foam sponge. These items can originate from different sources:</p> <ul style="list-style-type: none"> 1) Domestic shipping / fishing waste that is accidentally or purposely discarded in the sea; 2) Waste from river, sewage and storm water outlets; 3) Other activities such as industrial offshore and construction activities. |
| 10 | Plastic: Industrial [40] | - | xxx | - | x | <p>This category contains industrial plastic sheeting. These items can originate from different sources:</p> <ul style="list-style-type: none"> 1) Waste from river, sewage and storm water outlets; 2) Other activities such as industrial offshore and construction activities. |
| 11 | Plastic: Drinks [4] | x | x | x | x | <p>These items can originate from different sources:</p> <ul style="list-style-type: none"> 1) Domestic shipping / fishing waste that is accidentally or purposely discarded in the sea; 2) Recreants and / or tourists that have accidentally and / or purposely discarded these bottles on the beach. 3) Waste from river, sewage and storm water outlets. |

| | | | | | | |
|----|------------------------|---|---|---|------|---|
| 12 | Plastic: Other [48] | - | - | - | xxxx | This category contains various types of plastics which are unidentifiable and it is very difficult to determine its source. |
| 13 | Plastic: Food [6] | x | x | x | x | This category contains plastic food containers. These food containers such as ketchup bottles can originate from different sources: 1) Domestic shipping and fishing waste that is accidently and / or purposely discarded in the sea. 2) Waste from river, sewage and storm water outlets. |
| 14 | San: Buds [98] | x | x | - | xx | This category contains sanitary cotton bud sticks. These items can originate from different sources: 1) Domestic shipping / fishing waste that is accidently or purposely discarded in the sea; 2) Waste from river, sewage and storm water outlets. |
| 15 | Wood: Other_small [74] | - | x | - | xxx | This category contains small pieces of (drift) wood. It can originate from: 1) Wooden pieces that are accidently and/ or purposely discarded in the sea; 2) Lost cargo from a ship; 3) Remains from sunken wooden ships. |

Appendix VI Categorisation Litter Analyst Trend Top 100% items + using expert judgement of the North Sea Foundation

| <i>OSPAR item code</i> | <i>Percentage</i> | <i>Land / Zee</i> |
|--|-------------------|-------------------|
| Nets and ropes [300] | 38.94% | Sea |
| Plastic polystyrene pieces < 50 cm [301] | 17.64% | Land& Sea |
| Plastic: Caps [15] | 5.40% | Land& Sea |
| Plastic: Crisp [19] | 3.74% | Land& Sea |
| Plastic: Foam_sponge [45] | 3.64% | Sea |
| Rubber: Balloons [49] | 3.50% | Land |
| Plastic: Tangled [33] | 3.43% | Sea |
| Plastic: Industrial [40] | 2.43% | Land& Sea |
| Plastic: Small_bags [3] | 2.38% | Land&Sea |
| San: Buds [98] | 1.70% | Land |
| Plastic: Other [48] | 1.70% | Land&Sea |
| Plastic: Bags [2] | 1.39% | Land |
| Plastic: Drinks [4] | 1.34% | Land& Sea |
| Plastic: Cutlery [22] | 1.31% | Land |
| Plastic: Food [6] | 0.93% | Sea |
| Plastic: Strapping [39] | 0.83% | Sea |
| Wood: Other_small [74] | 0.58% | Land&Sea |
| Plastic: Shotgun [43] | 0.57% | Land |
| All cartons/tetrapacks [302] | 0.54% | Land& Sea |
| Glass: Other [93] | 0.44% | Land& Sea |
| Metal: Drink [78] | 0.41% | Land& Sea |
| Plastic: Cups [21] | 0.37% | Land& Sea |
| Paper: Cig_stubs [64] | 0.37% | Land& Sea |
| Glass: Bottles [91] | 0.33% | Land& Sea |

| | | |
|---------------------------------|-------|-----------|
| Cloth: Clothing [54] | 0.31% | Land& Sea |
| Plastic: Cigarettelighters [16] | 0.25% | Land& Sea |
| Plastic: Plastic_vlarge [47] | 0.24% | Land& Sea |
| All gloves [304] | 0.24% | Sea |
| Plastic: Toys [20] | 0.24% | Land |
| Plastic: Fish_tags [114] | 0.23% | Sea |
| Rubber: Tyres [52] | 0.22% | Land |
| Plastic: Meshbags [24] | 0.21% | Sea |
| Plastic: Cleaner [5] | 0.21% | Sea |
| Plastic: Toiletries [7] | 0.21% | Sea |
| Plastic: Fishing_line [35] | 0.20% | Sea |
| Wood: Other_large [75] | 0.20% | Land& Sea |
| Plastic: Pens [17] | 0.19% | Land& Sea |
| San: Towels [99] | 0.19% | Land |
| Rubber: Other [53] | 0.16% | Land& Sea |
| Plastic: Bag_ends [112] | 0.15% | Land& Sea |
| Paper: Cig_packets [63] | 0.14% | Land& Sea |
| Other textiles [303] | 0.13% | Land& Sea |
| Pottery: Other [96] | 0.13% | Land |
| Wood: Corks [68] | 0.12% | Land& Sea |
| Plastic: Oyster_nets [28] | 0.12% | Sea |
| Plastic: Jerry_cans [10] | 0.11% | Sea |
| San: Tampons [100] | 0.11% | Land |
| Plastic: Shoes [44] | 0.11% | Land& Sea |
| Plastic: Injection_gun [11] | 0.10% | Sea |
| Glass: Bulbs [92] | 0.10% | Sea |
| Plastic: Buckets [38] | 0.09% | Sea |

| | | |
|-------------------------------|-------|-----------|
| Plastic: Floats [37] | 0.09% | Sea |
| Pottery: Construction [94] | 0.08% | Land |
| Metal: Aerosol [76] | 0.07% | Sea |
| Metal: Other_small [89] | 0.06% | Land& Sea |
| San: Other [102] | 0.06% | Land |
| Paper: Other [67] | 0.06% | Land& Sea |
| Plastic: Fertiliser [23] | 0.06% | Land |
| Plastic: Other_bottles [12] | 0.05% | Land& Sea |
| Plastic: Light_sticks [36] | 0.05% | Sea |
| Metal: Foil [81] | 0.05% | Land& Sea |
| San: Toilet [101] | 0.05% | Land |
| Plastic: Mussel_sheeting [30] | 0.05% | Sea |
| Plastic: Oil_small [8] | 0.04% | Sea |
| Paper: Newspapers [66] | 0.04% | Land |
| Wood: Brushes [73] | 0.03% | Land& Sea |
| Plastic: Fishboxes [34] | 0.03% | Sea |
| Cloth: Shoes [57] | 0.03% | Land |
| Paper: Cardboard [61] | 0.03% | Land& Sea |
| Med: Other [105] | 0.03% | Land& Sea |
| Metal: Scrap [83] | 0.03% | Land& Sea |
| Wood: Lolly [72] | 0.03% | Land |
| Plastic: Yokes [1] | 0.03% | Land& Sea |
| Plastic: Crates [13] | 0.03% | Sea |
| Cloth: Sacking [56] | 0.03% | Land& Sea |
| Wood: Pallets [69] | 0.03% | Sea |
| Pottery: Octopus_pots [95] | 0.03% | Sea |
| Plastic: Oyster_trays [29] | 0.03% | Sea |

| | | |
|----------------------------|-------|-----------|
| Metal: Food [82] | 0.02% | Land& Sea |
| Med: Containers [103] | 0.02% | Sea |
| Metal: Paint_tins [86] | 0.02% | Sea |
| Plastic: Car_parts [14] | 0.02% | Sea |
| Plastic: Lobsterpots [26] | 0.01% | Sea |
| Plastic: Hard_hats [42] | 0.01% | Sea |
| Plastic: Combs [18] | 0.01% | Land& Sea |
| Plastic: Oil_large [9] | 0.01% | Sea |
| Metal: Caps [77] | 0.01% | Land& Sea |
| Rubber: Boots [50] | 0.01% | Sea |
| Cloth: Furnishings [55] | 0.01% | Sea |
| Paper: Cups [65] | 0.01% | Sea |
| Wood: Crates [70] | 0.01% | Sea |
| Metal: Fishing [80] | 0.01% | Sea |
| Med: Syringes [104] | 0.01% | Land& Sea |
| Wood: Fish_boxes [119] | 0.01% | Sea |
| All metal oildrums [305] | 0.01% | Sea |
| Metal: Wire [88] | 0.00% | Land&Sea |
| San: Condoms [97] | 0.00% | Land |
| Metal: Bbqs [120] | 0.00% | Land |
| Plastic: Octopus_pots [27] | 0.00% | Sea |
| Plastic: Fibre_glass [41] | 0.00% | Land& Sea |
| Paper: Bags [60] | 0.00% | Land& Sea |
| Wood: Lobsterpots [71] | 0.00% | Sea |
| Metal: Electrical [79] | 0.00% | Sea |
| Metal: Lobsterpots [87] | 0.00% | Sea |
| Metal: Other_large [90] | 0.00% | Land&Sea |

Appendix VII Recording the presence of “pollutants” on OSPAR Beach Litter Survey beaches

Agenda Item - OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic Meeting of the Environmental Impact of Human Activities Committee (EIHA - Cork (Ireland): 3 – 7 April 2017

Table 2: Number of surveys with records of chemicals in each country

| Country | paraffin or wax 0-1cm | paraffin or wax 1-10cm | paraffin or wax >10cm | other pollutants |
|-------------|-----------------------|------------------------|-----------------------|------------------|
| Belgium | 2 | 4 | 1 | 1 |
| Denmark | 4 | 14 | 8 | 2 |
| France | 8 | 48 | 29 | 20 |
| Germany | 22 | 34 | 16 | 9 |
| Netherlands | 24 | 44 | 11 | 15 |
| Norway | 4 | 8 | 5 | 4 |
| Portugal | 5 | 15 | 4 | 12 |
| Spain | 4 | 19 | 2 | 14 |

| | | | | |
|----------------|---|----|----|----|
| Sweden | 9 | 42 | 20 | 10 |
| United Kingdom | 1 | 1 | 0 | 4 |

Appendix VIII Litter Analyst Trend Top 80% items – Top 15 (in order from 1 – 15)

| <i>Litter category [OSPAR-100- ID]</i> | <i>Trend (counts/ Year)</i> | <i>Significance of trend (p- value)</i> | Trendplot |
|--|---------------------------------|---|-----------|
|--|---------------------------------|---|-----------|

