Dutch Seafloor Litter Monitoring in the North Sea

International Bottom Trawl Survey 2020

Author(s): Joey Volwater & Ralf van Hal

Wageningen University &
Research report C049/20

Dutch Seafloor Litter Monitoring in the North Sea

International Bottom Trawl Survey 2020

Author(s): Joey Volwater & Ralf van Hal

Wageningen Marine Research
IJmuiden, April 2020

Wageningen Marine Research report C049/20

Keywords: **Marine Seafloor macro Litter, North Sea, International bottom trawl survey**

Client: Rijkswaterstaat
Attn.: Mervyn Roos (project leader) and Willem van Loon (sr advisor marine litter)
Zuiderwagenplein 2
8224 AD, Lelystad

This report can be downloaded for free from https://doi.org/10.18174/523229
Wageningen Marine Research provides no printed copies of reports

Wageningen Marine Research is ISO 9001:2015 certified.

A_4_3_2 V30 (2020)

Contents

Dutch Seafloor Litter Monitoring in the North Sea 1

Summary 4

1 Introduction 5

2 Materials and Methods 7

2.1 IBTS Q1 2020 7
2.2 Sampling litter 9
2.3 Area surveyed 9
2.4 Litter data analysis 10

3 Results 11

3.1 Composition of the litter caught in the IBTS 2020 12
3.1.1 General litter composition 12
3.1.2 Plastic composition 12
3.1.3 Size composition 13
3.2 Abundance and distribution of marine seafloor litter 14
3.3 Comparison with earlier years 15

4 Discussion and conclusions 20

5 Recommendations 23

6 Quality Assurance 24

References 25

Justification 27

Annex 1 Data tables with sea floor litter monitoring data of Dutch IBTS Q1 2020 28

Annex 2 Photos of seafloor litter in the Dutch IBTS Q1 2020 33

Annex 3 Comparison with Beam Trawl catches 47

Annex 4 Litter data in DATRAS 50

Summary

The Marine Strategy Framework Directive (MSFD) requires EU Member States to develop programmes of measures that aim to achieve or maintain Good Environmental Status (GES) in European Seas. In order to be able to evaluate the quality state of marine waters on a regular basis and the effects of the measures taken, monitoring programs for MSFD descriptors and indicators have been established by the Member States.

GES is defined by 11 descriptors, including Marine Litter (D10). The Dutch monitoring program for this descriptor includes the collection of data on the presence, abundance and distribution of macro litter on the seafloor. According to the Dutch program, the data on seafloor litter must be collected during statutory task fish surveys using a standardised GOV (Grand Ouverture Verticale) fishing net as part of the International Bottom Trawl Survey (IBTS), which is carried out yearly in the North Sea.

This report presents the results of the seafloor litter monitoring during the IBTS of Quarter 1, 2020. Seafloor litter data have been collected annually since 2013, and the new data are presented and compared to the data collected in previous years. This is done for both the composition and the spatial distribution of the seafloor litter. The allocation of rectangles was the same as in 2019, however owing to permit issues of participating countries and extremely bad weather conditions during the survey period, the area covered by the Dutch IBTS 2020 was not as planned and deviates from the covered area in 2019 and earlier years. These deviations in the spatial coverage hampers comparisons over the years.

In 2020, litter was caught in 83% of the hauls. The composition of this litter was similar to that of previous years, more than 90% of the 155 items recorded was plastic and these were mainly monofilament lines and plastic sheets. The majority of these items was, as in previous years, small (<25 cm^2). The haul with the highest amount of litter items was in the south-east part of the North Sea towards the Dutch coast, with 19 separate items recorded.

Due to the spatial deviation of the surveyed area in each year, and the semi-random sampling in a grid cell, it is difficult to compare the data between years. Bearing this in mind, mean and median values from this year were nearly the same as those of the previous two years, but lower than those of earlier years since recording began in 2013. It should be noted that the net used during the IBTS (GOV) is not designed to catch litter, therefore, it probably has a small chance of catching a litter item when it is present in the trawl path. Thus, the fact that these items are caught indicates that it is likely that there are many more items in the trawl path and that current values are a large underestimation of the actual litter present. Consequently, the degree of litter pollution on the seafloor is probably much larger than presented in this report.

The Dutch seafloor litter monitoring results are uploaded to the ICES DATRAS database, and are used in OSPAR assessments of seafloor litter in the North Sea. Due to this aggregation of many ICES seafloor litter surveys of the North Sea, an assessment of the presence/absence and total count of seafloor litter items can probably be made in the near future for the whole North Sea area.

1 Introduction

The European Marine Strategy Framework Directive (MSFD 2008/56/EC) dictates that EU member States are obligated to establish and implement measures to achieve or maintain good environmental status (GES) in their national marine waters. This GES is defined by 11 descriptors, of which one of these, descriptor 10, is Marine Litter. In order to be able to achieve GES by 2020 for Marine Litter, it is necessary that "Properties and quantities of marine litter, including their degradation products such as small plastic particles down to micro-plastics do not cause harm to the coastal and marine environment and their volume decreases over time." (MSFD 2008/56/EC).

The oceans are of substantial socio-economic importance, providing employment, food and recreation for much of the world's population (Costanza 1999). Yet, anthropogenic pollution abounds in our oceans, with marine litter threating wildlife, hindering human activities and reducing the recreational value of our coasts (Fleet et al. 2009). Sources of marine litter can be sea- or land-based, although it is widely assumed that the latter contributes the overwhelming majority of the litter to the marine environment (Jambeck et al. 2015). Land-based sources and pathways of marine litter include sewage and river outlets, landfills and recreational activities along the coast (Viega et al. 2016). Shipping, fisheries, offshore installations and illegal dumping all constitute some of the sources of sea-based marine litter (Viega et al. 2016).

Plastics represent the majority of marine litter (Galgani et al. 2015). According to Jambeck et al. (2015), between 5 to 13 million metric tonnes of post-consumer plastics entered the oceans solely from land-based sources in 2010. This has impacts on all groups of marine wildlife through effects such as entanglement and ingestion (Kühn et al. 2015). Entanglement may limit movement and inflict injury, thus, reducing an animal's ability to avoid predators, acquire food or increase the potential for drowning. Ingestion of marine debris (both intentional and accidental) may cause a suppressed appetite, blockage of the gastrointestinal tract leading to malnutrition or harmful toxicological effects which in some cases may be lethal (Kühn et al. 2015; Rochman 2015; Thompson 2015). On top of that, there is increasing evidence that plastic can enter and accumulate in predators (including humans) by indirect (accidental) ingestion via trophic transfer from contaminated prey (Nelms et al. 2018). Litter in the oceans can also have negative (sometimes lethal) effects on marine flora through smothering and crushing, resulting in reduced exposure to sunlight and the development of anoxic conditions on the seafloor (Kühn et al. 2015).

Various initiatives to reduce litter in the environment have recently been started or are currently under discussion. For example, in 2013, the law on dumping of garbage by marine vessels was changed from "all garbage may be dumped except" to "no garbage may be dumped except". Another example is the ban or taxation of single-use plastic carrier bags in shops and supermarkets in many countries. In the Netherlands, taxation was introduced in January 2016, which led to a significant reduction of single-use plastic carrier bags in litter. There has been a significant increase in awareness surrounding marine litter in recent years, with particular focus on plastics. In the Netherlands, litter-reduction initiatives include the "Green Deal", a program for Clean Beaches and Fishery for a Clean Sea. The Green deal on Fishery includes the "Fishing for litter" program by KIMO international, which aims to bring bycatch litter to land for recycling or processing, and studies to reduce litter from netting material. The most recent European initiative is a ban of single-use plastics (e.g. straws) and more usage of recycled plastics. The European parliament has voted for this in March 2019 and the legislation will be implemented from 2021 onwards. In addition, the Dutch parliament has accepted a deposit regulation for small plastic bottles in 2020, which should greatly reduce this source of litter.

The measures described above can help towards achieving GES. In addition, the MSFD requires monitoring of the effects of these measures. This is interpreted as a requirement to monitor the amount of litter in the marine environment and where possible, monitor potential effects of the measures taken to reduce the amount of litter as well. The requirements for monitoring are divided in a number of categories: monitoring litter in the water column, washed ashore, in biota and deposited on the seafloor. The beach litter monitoring indicates that a large part of the North Sea litter washes ashore on beaches near the Skagerrak. The monitoring of litter washed ashore results in the indicator on Beach litter (Ospar commission 2010, Schulz et al. 2017), and monitoring in biota results in the indicator Plastic particles in fulmar stomachs (Van Franeker et al. 2017). Additionally to these two indicators, there is the Seabed litter indicator to describe the litter deposited on the seafloor (Ospar commission 2017).

Approximately 70% of marine litter reaches the seafloor where it can accumulate (Pham et al. 2014). Once on the sea floor, marine litter degradation leads to the formation of small microplastics, whereby it degrades very slowly since the degradation of it occurs primarily through temperature-dependent solar UV-radiation (Andrady 2015).

This report describes the methods used and data collected in 2020 for the Dutch part of the monitoring of litter deposited on the seafloor as commissioned by Rijkswaterstaat (RWS). The OSPAR commission proposed to collect seafloor litter by using the catches of the International Bottom Trawl Survey (IBTS). This is an internationally coordinated survey covering the Greater North Sea, providing a good platform for internationally collecting litter data, despite the fact that the sampling gear is not optimal for sampling litter.

A successful pilot study for collecting and recording seafloor litter on board was carried out during the Dutch IBTS in 2013 (van Hal & de Vries 2013), following the protocol for collecting data on marine litter as developed by working groups of the International Council for the Exploration of the Sea (ICES) (e.g. WGISUR, IBTSWG, WKMAL) (ICES 2015). This pilot only looked at the practical implications on board. Following the pilot, it was decided that monitoring of seafloor litter would become a regular part of the Dutch IBTS. As a result of this, the international IBTS protocol on marine litter (ICES 2015) adjusted according to advice by the ICES Working Group on Marine Litter (WGML) (ICES 2018a) was included in the Dutch survey manual (van Damme et al. 2019), along with additional guidelines on how to classify specific litter items based on decisions made during the pilot (van Hal & de Vries 2013).

Aims:

Since 2013, the IBTS data on seafloor litter have been provided to RWS and stored in the ICES DATRAS database. Including the data collected in 2020, a total of eight years of data are available. RWS has requested to compare the 2020 data with those of earlier years.

This report presents the seafloor litter data collected during the Dutch International Bottom Trawl Survey during Quarter 1 of 2020. The objectives of this report are to:

- Provide insight regarding the abundance and composition of seafloor litter of mainly the Dutch continental shelf of the North Sea in the first quarter of 2020.
- Assess the spatial distribution of seafloor litter of mainly the Dutch continental shelf in the first quarter of 2020.
- Compare these findings to those of previous years (2013-2019).

2 Materials and Methods

2.1 IBTS Q1 2020

The International Bottom Trawl Survey Q1 (IBTS Q1) is carried out annually in January and February, and is performed by France, Scotland, Germany, Sweden, Norway, Denmark and The Netherlands (ICES 2015, 2018b). The survey design is such that the North Sea is divided into grids (ICES rectangles) of 0.30° latitude and 1° longitude, which are distributed amongst the participating countries. Each rectangle needs to be sampled twice over the course of the IBTS but the allocation of rectangles among countries means that the majority of the rectangles is sampled once by two different countries. For many years, the distribution of areas covered by each country remained unchanged. However, in 2017, France had to reduce its effort and was no longer able to cover all its allocated rectangles resulting in a redistribution of rectangles among the participating countries. This change affected the area covered by the Netherlands: it became more compact, no longer reaching as far north to Aberdeen nor as far south as the Channel and the southern English coast. The planned area for 2020 (Figure 2.1) remained unchanged compared to the 2019 survey (van Hal 2019).

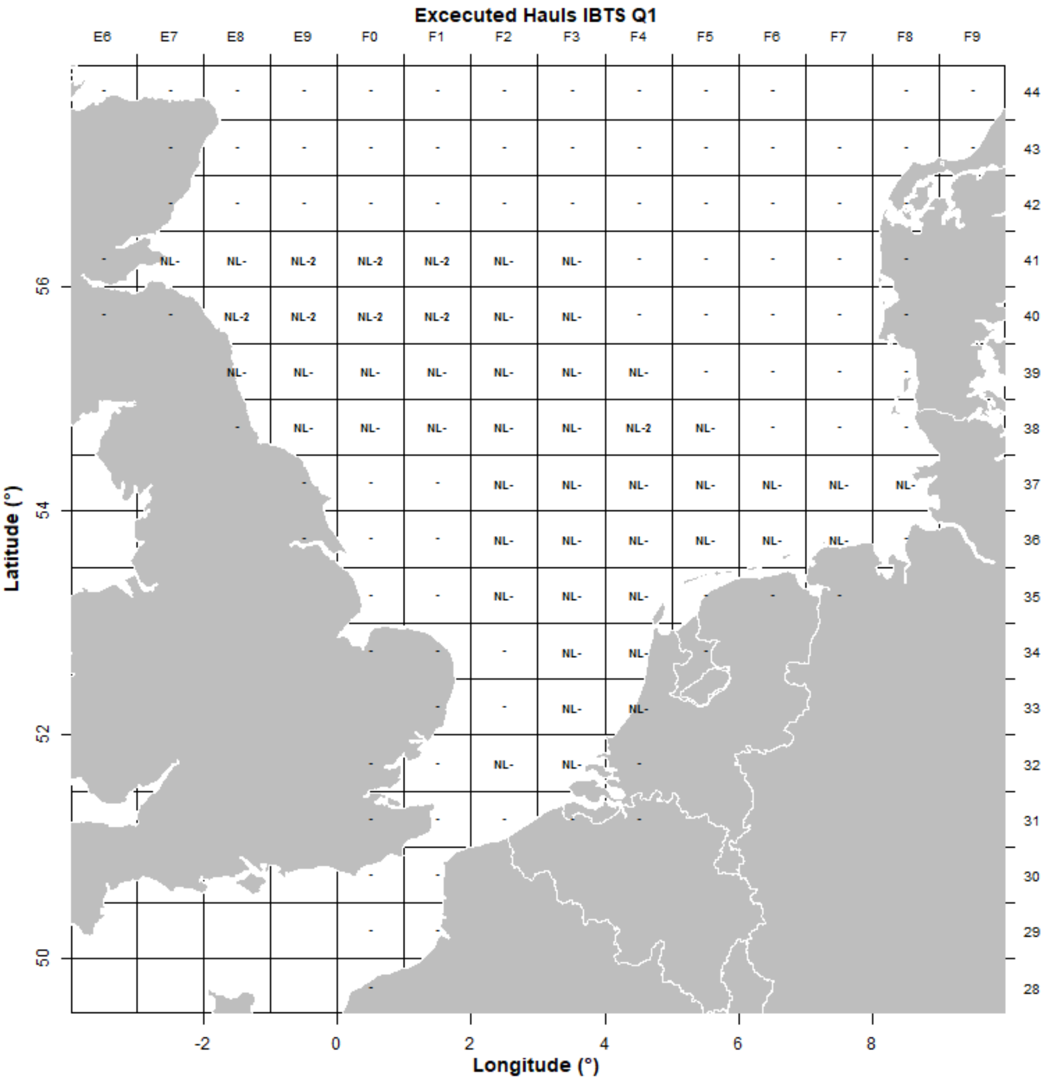


Figure 2.1. Planned ICES rectangles for the Dutch GOV hauls during the 2020 IBTS Q1. Rectangles marked ‘NL-‘ are those that should be covered once by the Netherlands and once by another participating country. Rectangles marked ‘NL-2’ are those that should be covered twice by the Netherlands. The dashes in the adjacent rectangles are those covered by other participating countries.

The sampling gear used for the IBTS is the "Grand Ouverture Verticale" (GOV), a (semi-pelagic) bottom trawl. The mesh size of the net is 100 mm and 10 mm in the codend. The headline of the net lies about 5 m above the seafloor, which is particularly convenient for sampling pelagic fish species and species that dwell just above the bottom. However, as the ground rope of the GOV only touches the bottom, flatfish, benthic organisms and seafloor litter may well go underneath it, and the proportion that escapes the net can be substantial. For example, the proportion of small flatfish (<25 cm) going underneath the ground rope is assumed to be 50% (Piet et al. 2009). Due to the weak ground contact of the GOV, small flatfishes, other small bottom dwelling species and epibenthos are caught by the GOV in a random manner (<5% compared to a beam trawl, e.g. each item has less than 5% chance to be retained in the net), and are thus not representative of what is actually on the seafloor (ICES 2003). This may be the case for seafloor litter as well.

The horizontal opening of the net is determined by the pressure on the two doors (otter boards), one on each side of the net. The horizontal opening of the net varies with depth. The width between the doors (door spread) is therefore measured continuously during each haul. The doors are connected to the net by a 10 m back strop and a 50 m sweep. This sweep moves over the seafloor creating a dust cloud, herding fish towards the actual net opening. The actual net opening (wingspread) varies with depth as well. The wingspread is considered relevant for seafloor litter as it is not expected that seafloor litter is herded towards the net by the dust cloud created by the sweeps. The standard haul duration is 30 minutes, with a fishing speed of 4 knots (7.4 km/h) and trawling is only carried out during daylight hours.

The Netherlands uses the research vessel Tridens II for the IBTS each year. In 2015 and 2016, due to a refit of the Tridens, the English research vessel CEFAS Endeavour was hired. Since the refit of the Tridens, the Dutch GOV-net and otter boards, as well as a new SIMRAD net-geometry system attached to the doors have been used.

Table 2.1. Classification of marine litter items (2018a). The table presents six categories of litter (A-F) and their respective subcategories, as well as size categories (A-F) used in the categorisation of seafloor litter items caught during the IBTS.

Litter overview			
A: Plastic	**B: Metals**		**Related size category**
A1. Bottle	**B1.** Cans (food)		**A:** <5*5 cm= 25 cm^2
A2. Sheet	**B2.** Cans (beverage)		**B:** <10*10 cm= 100 cm^2
A3. Bag	**B3.** Fishing related		**C:** <20*20 cm= 400 cm^2
A4. Caps/ lids	**B4.** Drums		**D:** <50*50 cm= 2500 cm^2
A5. Monofilament	**B5.** Appliances		**E:** <100*100 cm= 10000 cm^2= 1 m^2
A6. Entangled filaments	**B6.** Car parts		**F:** >100*100 cm = 10000 cm2= 1 m2
A7. Synthetic rope	**B7.** Cables		
A8. Fishing net	**B8.** Other		
A9. Cable ties			
A10. Strapping band			
A11. Crates and containers			
A12. Diapers			
A13. Sanitary towel/tampon			
A14. Other			
C: Rubber	**D: Glass/ Ceramics**	**E: Natural products**	**F: Miscellaneous**
C1. Boots	**D1.** Jar	**E1.** Wood (processed)	**F1.** Clothing/ rags
C2. Balloons	**D2.** Bottle	**E2.** Rope	**F2.** Shoes
C3. Bobbins (fishing)	**D3.** Piece	**E3.** Paper/ cardboard	**F3.** Other
C4. Tyre	**D4.** Other	**E4.** Pallets	
C5. Glove		**E5.** Other	
C6. Other			

2.2 Sampling litter

The IBTS manual states that litter has to be collected each haul. Additional guidelines are available, the CEMP Guidelines on Litter on the Seafloor (EIHA 17/9/1 Annex 12. https://www.ospar.org/work-areas/cross-cutting-issues/cemp) and most recent the WGML guidelines (ICES 2018a) including a classification (Table 2.1) marginally adjusted from the one in the IBTS manual. The WGML guidelines and the preliminary picture guide have largely improved on how to handle and classify items.

On the Tridens the complete net is hoisted on board and only a part of the ground rope is left hanging over the side. The net is inspected and cleaned as far as possible after each haul. Litter items in the net and in the catch are collected. Each litter item is classified, weighed, the size is estimated, photographed (Annex 2), and in case of linear objects the length is measured. In case similar items are found in a single haul, these are recorded as a single category, weighed together and the number of individual items is registered (Annex 1, Table 2.1). When organisms are attached to litter items, the different kind of species are recorded as well. Moreover, a more detailed description of the litter item is given to facilitate analysis post-survey (Annex 1).

2.3 Area surveyed

Seafloor litter is presented as number of items per km^2. To get to items per km^2 the surveyed area is required, e.g. the total swept area needs to be known. The swept area of the GOV is variable, and depends on the depth and the amount of fishing line used. For fish, two swept areas are calculated: one based on door spread and the other on wingspread. The door spread is the area between the doors (otter boards) of the gear, which is relevant for fish that are herded into the net. The wingspread is the area between the wings, which is considered to be the actual net opening. We assume that marine litter is not herded into the net by the doors and cables, and thus wingspread is considered the relevant measure for seafloor litter.

The SIMRAD net geometry system records the door spread only, and as such wingspread needs to be calculated based on this data. In some cases, door spread is not recorded properly, and in these cases door spread is estimated instead. The formulas are based on (1) the data of multiple years for the door spread recorded during the Dutch IBTS on the research vessel Tridens II and (2) the information gathered during the two years the Dutch IBTS was executed using the English vessel Endeavour using the English wingspread sensors.

The formula for door spread in case door spread is not recorded properly is as follows:

(1) Door spread= 14.2 * LOG(Depth) + 16.72 * LOG(Warp length) + 18.49

Whereby Depth is de depth in meters and Warp length the length (m) of fishing line used. Once the door spread is known, wingspread (m) can be derived via the following formula:

(2) Wingspread= Door spread * 0.18870 + 5.87280

To get the number of litter items per km^2, the number of items per haul need to be divided by the swept area, and is calculated as:

(3) Number of litter items per km^2 = Litter items / (Wingspread (km)* Distance trawled (km))

It should be noted that these formulas are the same as those used in the reports since 2016, but differ from those used in earlier years. As a result of this, values from reports prior to 2016 differ. For this report, all data from these years were recalculated using the new formulas, thus allowing for comparison between years.

2.4 Litter data analysis

The litter data are presented as figures showing the composition of the litter by categories A-F (**Figure 3.2**), for plastics, the major category, by subcategories A1-A14 (**Figure 3.3**) and by size for categories A-F (**Figure 3.4**). Only litter items caught in valid hauls were used to create the figures for the composition of the litter. These figures are followed by a summarizing table, where absolute numbers of litter items and numbers of litter items per km^2 per haul are summarised by the minimum, maximum, mean and median values. Thereafter, the spatial distribution in numbers per km^2 per haul (**Figure 3.5**) and numbers per km^2 per ICES rectangle (**Figure 3.8**) is shown. The numbers of litter items per km^2 were calculated for all the valid hauls and can only be calculated if all the variables of formula (3) are known, e.g. if distance trawled is not recorded properly the corresponding haul was not used for this analysis. In the last section of the analysis there is a comparison with earlier years. In the appendix the complete trawl list (**Annex 1a**) and litter list (**Annex 1b**), including pictures of the litter items per haul (**Annex 2**), can be found.

3 Results

The Dutch IBTS 2020 Q1 performed 47 valid hauls of the 48 trawl hauls that were conducted. The invalid haul is included in the analysis. During this haul, the top part of the GOV net got completely ripped. This affected the catches of fish but did not have an effect on the catches of seafloor litter, so all 48 hauls were included in the analysis. All hauls lasted the standard 30 minutes.

As shown in **figure 2.1**, the planned area for 2020 remained unchanged compared to that of 2019. However, the area covered by the IBTS 2020 was not as planned and deviates from the covered area in 2019 (**Figure 3.1**). Owing to permit issues of the Germans within UK-waters, the Dutch performed their hauls in eight rectangles in UK-waters, while the Germans covered hauls in eight of the planned Dutch rectangles in German waters. In addition to that, less trawl hauls were conducted than planned due to extremely bad weather conditions and technical problems with the engines of the research vessel Tridens. First, at the start of the third sampling week, two of the three engines of the Tridens broke down whereby RWS gave order to travel back to Scheveningen for repair work. As a consequence of this, only two hauls were conducted in the third sampling week. On top of that, during the fourth and fifth sampling weeks, the survey area was faced by two consecutive storms: Ciara (week 4) and Dennis (week 5). Due to these storms several sampling days had to be cancelled or the number of hauls per day was reduced. As a consequence, not all Dutch allocated rectangles could be sampled.

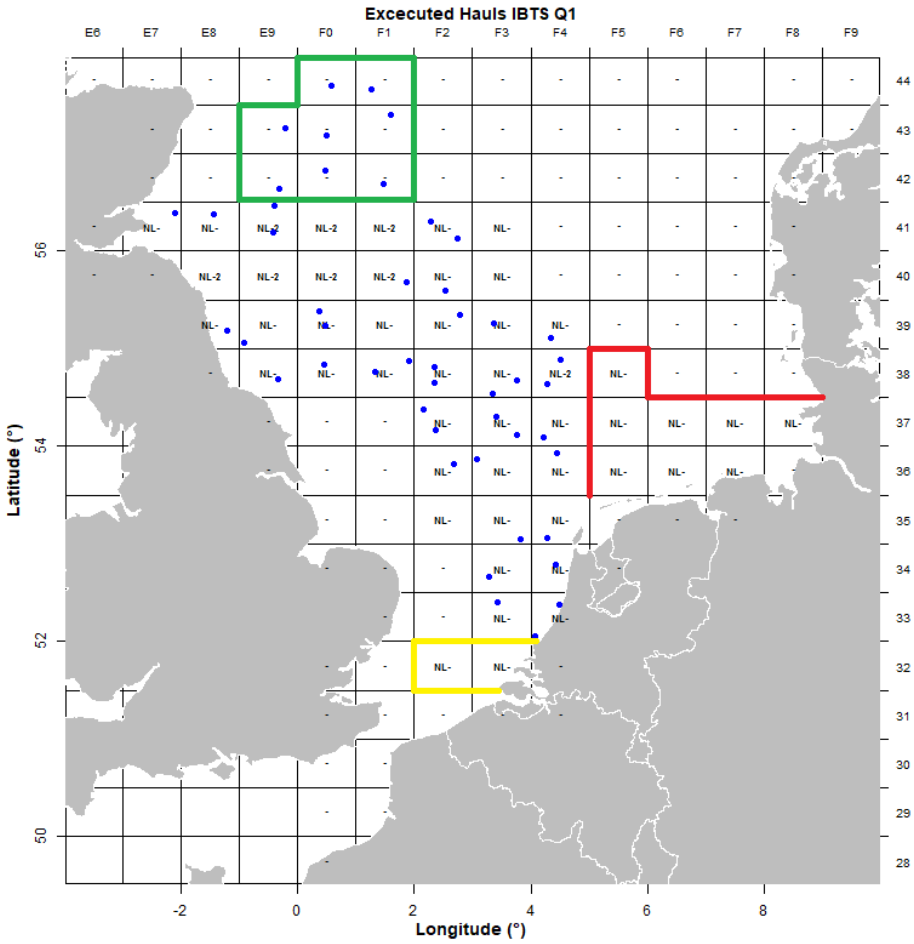


Figure 3.1. Executed Dutch GOV hauls during the 2020 IBTS. The blue points indicate the starting locations of the valid GOV-hauls in 2020. The text (‘NL-‘ or ‘NL-2’) indicates the official 2020 Dutch IBTS planning, deviations of this plan are shown by hauls (blue points) in rectangles without ‘NL’, and the lack of hauls in rectangles with ‘NL-’. Note that in some rectangles, more hauls were executed than planned. The green rectangles were taken over from the Germans, the red rectangles were taken over by the Germans and the yellow rectangles were executed by the French.

3.1 Composition of the litter caught in the IBTS 2020

3.1.1 General litter composition

Plastic is by far the most frequent category of seafloor litter with 143 (92.3 %) of the in total 155 items that were caught in the IBTS Q1 2020 (**Figure 3.2**). This is followed by rubber and natural products, of both categories four items (2.6 %) were caught. Two items (1.3 %) were caught for glass/ceramics as well as for miscellaneous, metal items were not caught at all.

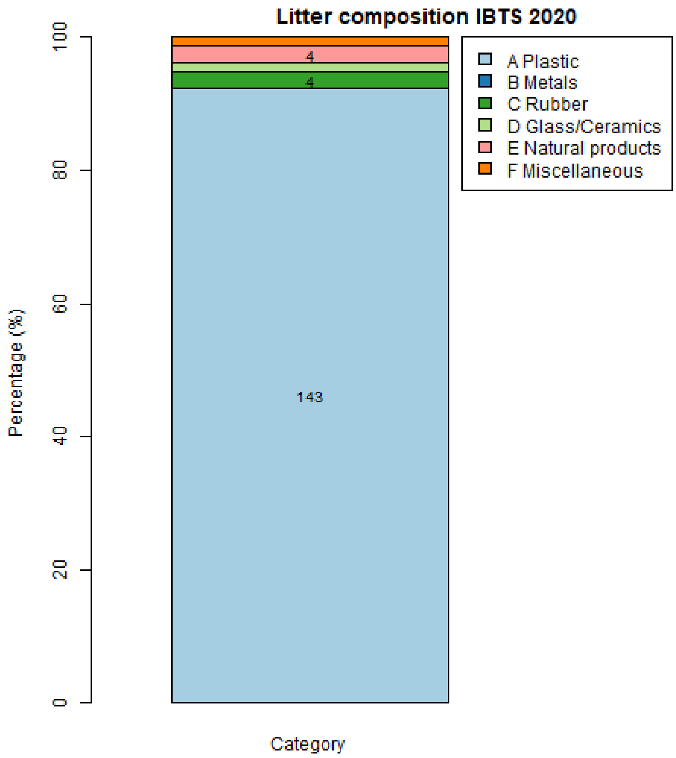


Figure 3.2. Composition of the seafloor litter in the catches of the Dutch IBTS Q1 2020. Values in the graph represent the absolute number of items per category for the categories containing more than 2% of the total items counted.

3.1.2 Plastic composition

The largest category, plastic, contains 14 subcategories (**tabel 2.1**). The most dominant subcategory is A5 Monofilament representing 44 (31 %) of the 143 plastic items caught, followed by the subcategories A2 sheet and A7 Synthetic rope with respectively 41 (29 %) and 36 (25 %) items. The other subcategories are clearly lower in contribution, whereby the subcategories A4 Caps/lids, A11 Crates and containers, A12 Diapers and A13 Sanitary towel/tampon were not caught at all (**Figure 3.3).**

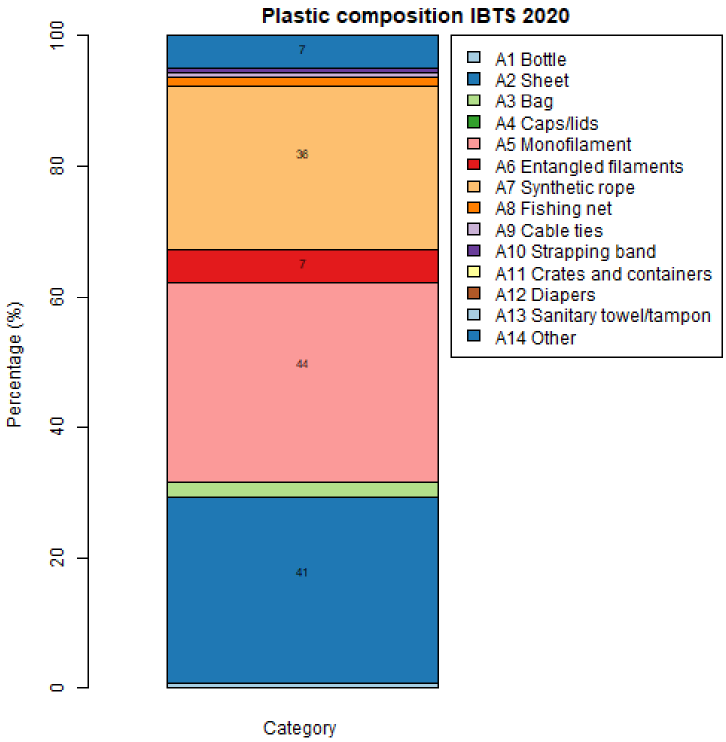


Figure 3.3. Composition of the seafloor litter category A plastic in the catches of the Dutch IBTS Q1 2020. Values in the graph represent the absolute number of items per subcategory for the subcategories containing more than 2.5% of the total items counted.

3.1.3 Size composition

All litter items were assigned a size category based on an estimation of the surface. Most of the items (106; 68 %) were classified as size category A (< 25 cm^2). In general, except for size category D, the number of items decreases as the size category increases: 20 items (13 %) in category B; 12 items (8 %) in category C; and 13 items (9 %) in category D. The larger categories contained three and one items for respectively category E and F (**Figure 3.4**).

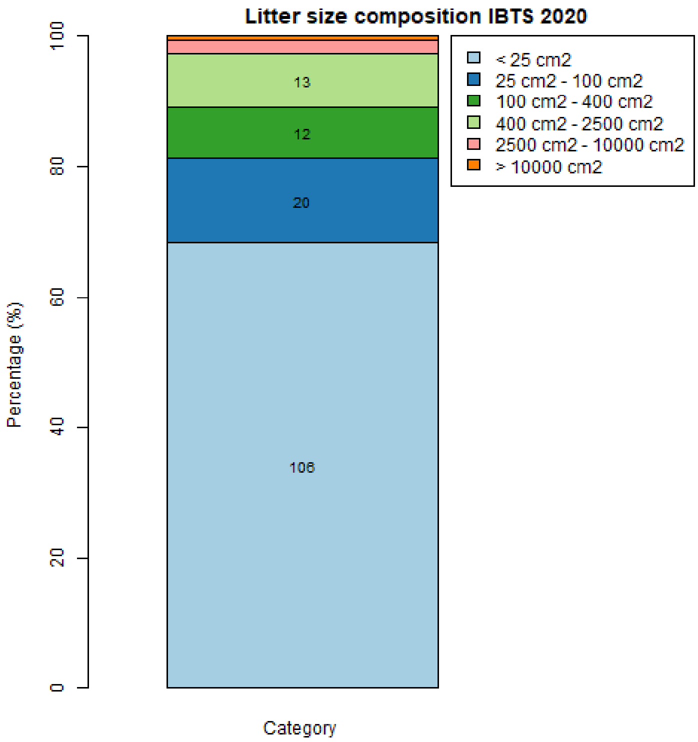


Figure 3.4. Size composition of the seafloor litter in the catches of the Dutch IBTS Q1 2020. Values in the graph represent the absolute number of items per category for the categories containing more than 3% of the total items counted.

Weighting was done consistently for every single item, however many items weighted less than one gram (e.g. monofilaments and single synthetic rope) for which no weight is recorded. The heaviest item was a black mesh, which was classified as A14, with a weight of around two kg (**Annex 1.b; haul 3400004**), followed by a synthetic rope (A7) of 1.5 kg and a rubber boot (C1) of 1.2 kg. Thus, the distribution of weight is skewed, as seen in the difference between mean weight (259.9 g) and the median weight (51 g) (tabel 3.1), while the items < 1 g were not included.

Table 3.1. Summary data of the Dutch 2020 IBTS litter catches. Each parameter is presented with its minimum, maximum, mean and median value.

	min	max	mean	median
Items per trawl	0	19	3.30	2
Surface trawled (km2)	0.0502	0.0910	0.0695	0.0692
Items per km2	0	316.32	48.10	30.65
Weight per item (g)*	1	2020	252.8	50.5

** For the parameter "Weight", empty hauls and hauls that contained only items < 1 g were left out of the analysis, so the weight summary only presents data on the hauls with weighted items.*

3.2 Abundance and distribution of marine seafloor litter

At least one litter item was found in 40 of the hauls meaning that 8 hauls (17 %) contained no marine litter. Plastic, as the largest category, was found in 39 of the hauls meaning that 19% of the hauls contained no plastic items. The spatial distribution of litter caught during the IBTS 2020 is presented in **figure 3.5**. The smallest circle represents hauls without litter items in the catch, empty hauls. Of the eight empty hauls, six were located close to each other in the central part of the area surveyed, while two were in the northern part. No empty hauls were located close to the Dutch coast.

The ranges presented by the bubbles in the plots are the same as those used in the earlier reports (van der Sluis & van Hal 2014, van Hal 2015, 2017a, b, 2019, O'Donoghue & van Hal 2018). The maximum in 2020 is 316 items per km^2 which is located near the Dogger bank and corresponds to 19 items reported from the catch. The median number of items is 30.65 items per km^2 corresponding to 2 items in the catch (**Table 3.1**). There is no pattern observed in the spatial distribution of the litter items for the Dutch IBTS.

Table 3.2 Comparison between Dutch IBTS litter results for the period 2013 – 2020. The minimum, maximum, mean, median, standard deviation and median absolute deviation (MAD) values for items per haul are presented for comparison of the years 2013 – 2020.

	Number of hauls	min	max	mean	median	std	MAD
2013*	58	0	11	4.02	4	2.46	2.97
2014	56	0	21	6.36	5	4.92	4.45
2015	45	0	23	8.00	7	5.73	5.93
2016	51	0	21	7.00	6	5.05	4.45
2017	55	0	33	6.38	4	6.46	4.45
2018	56	0	20	2.89	2	3.40	1.48
2019	63	0	27	3.84	2	4.80	2.97
2020	48	0	19	3.23	2	3.36	2.97

**Individual ropes were not counted, clusters of ropes were not disentangled. If multiple (dolly) ropes were present these were most of the time registered as a single item. From 2013 onwards, clusters of ropes were disentangled and counted individually.*

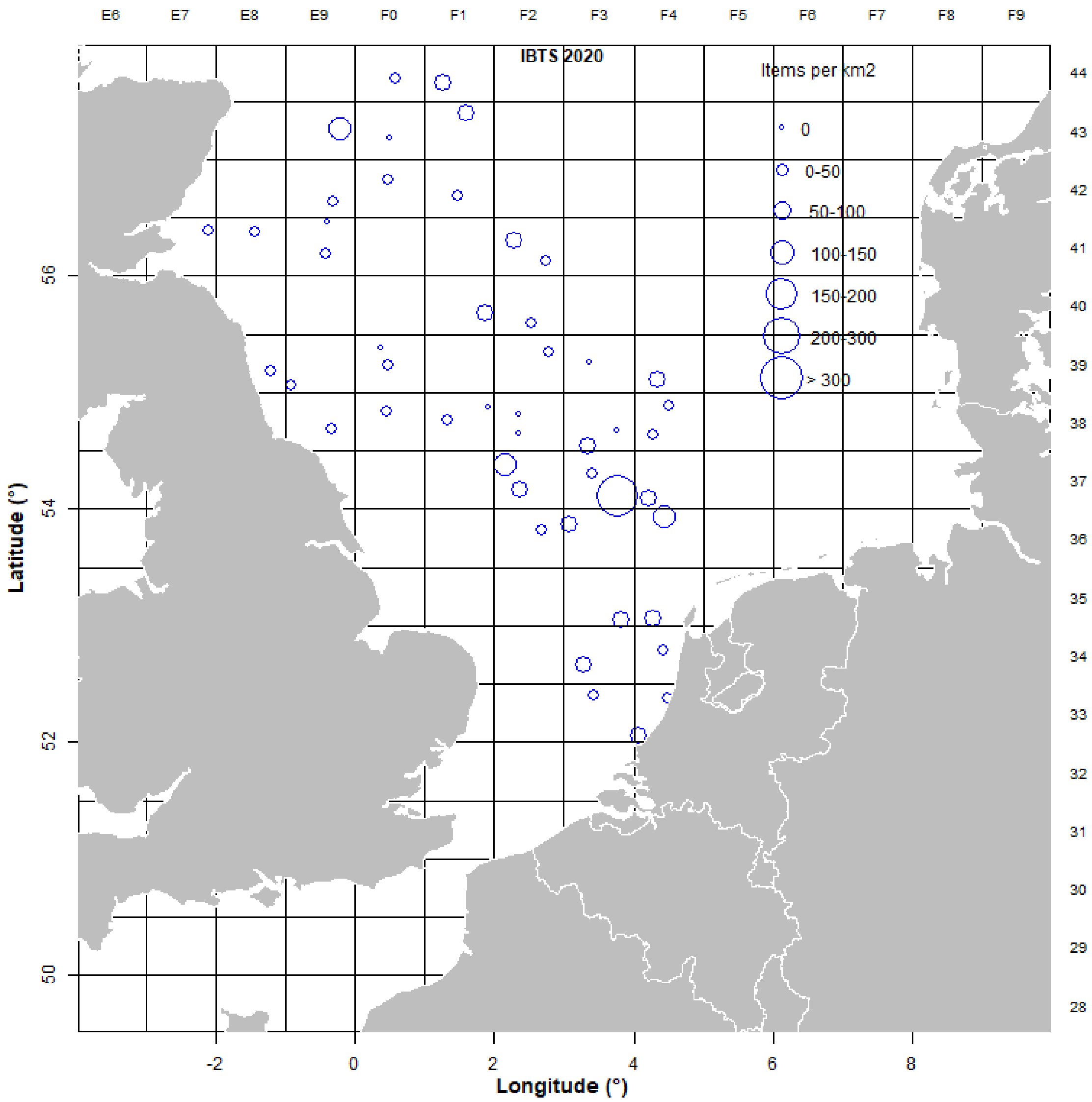


Figure 3.5. Density of litter items per haul per km^2 for the Dutch IBTS Q1 2020. The circles represent the starting position of the trawls and thus determine the ICES rectangle sampled.

3.3 Comparison with earlier years

Information on the abundance and distribution of seafloor litter can be provided for the locations of the GOV trawls only. Owing to the redistribution of rectangles in 2017, the swap of rectangles with France last year and the swap of rectangles with Germany this year, the spatial coverage of the Dutch IBTS changed over the years and is in none of the years exactly the same. In total only five ICES rectangles (36F2, 37F4, 40F1, 40F2, 41F2) are covered each year since 2013 within the Dutch IBTS. Besides that, the exact locations of the trawl hauls also vary between years, as the fishing positions are chosen semi-randomly within an ICES rectangle. This creates variation in the actual depth and seafloor structure of the trawl hauls between years. A one-to-one comparison of the trawl hauls between years is therefore complicated. Experience of the years in which litter data were collected gives the impression that the amount of litter varies between different habitats within the same rectangle. The impression is that areas with lots of structure, e.g. Sabellaria reefs or kelp areas, tend to contain more litter items than sandy areas. As a result catches of litter can vary a lot even over small distances.

In all years, the seafloor litter was dominated by plastics, with 83 - 92% of the total number of items caught. As in 2016 and 2019, the largest plastic category this year was A5 (Monofilament). The guidelines of WGML 2018 made the distinction between A5 and A7 (Synthetic rope) clearer, which likely will make the categorisation more consistent. As a result, A5 will most likely be the largest category followed by A2 (Sheet) if categorisation would have followed the current guidelines. Despite the guidelines, counting the number of individual pieces of rope/sheet correctly and in a consistent way is still difficult. The guideline states that if items are entangled but recognisable as separate items they should be counted as separate items. **Photo 1** shows such an entangled item, where e.g. blue monofilaments and orange monofilaments are entangled with the black netting material. Hereby, the black netting material was recorded as one item and all the blue and orange monofilaments as 13 separate items since they are recognisable as separate items. However, it seems that more items (transparent monofilaments) are entangled with the black netting material but these are so heavily entangled that they are hardly recognisable as separate items.

Photo 1. Example of entangled litter items. The blue and orange monofilaments were all recorded as separate items since they are recognisable as separate items while the black netting material was recorded as one item since this is heavily entangled and not separately recognisable. In total, 19 litter items were recorded for this haul (3400045*, 19-feb-2020). *note that the haul number on the picture is incorrect.

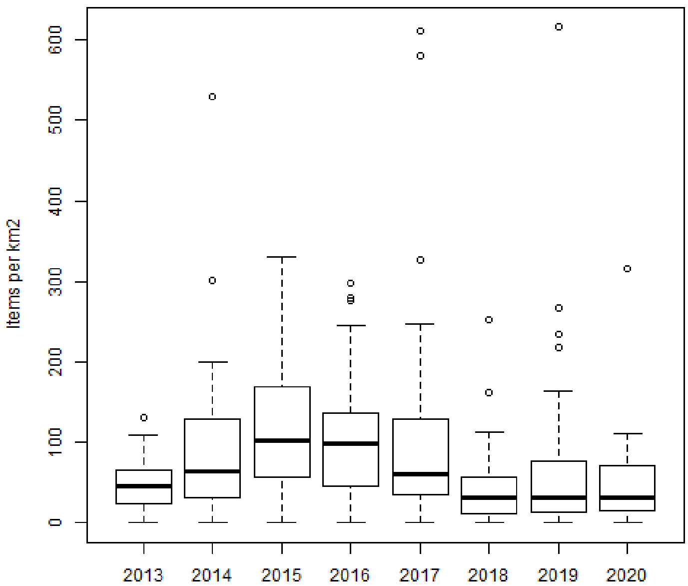


Figure 3.6. Boxplot of the items per km^2 for all the valid hauls in each year (2013 – 2020). The black horizontal line represents the median. NB: the geographical coverage differs between years.

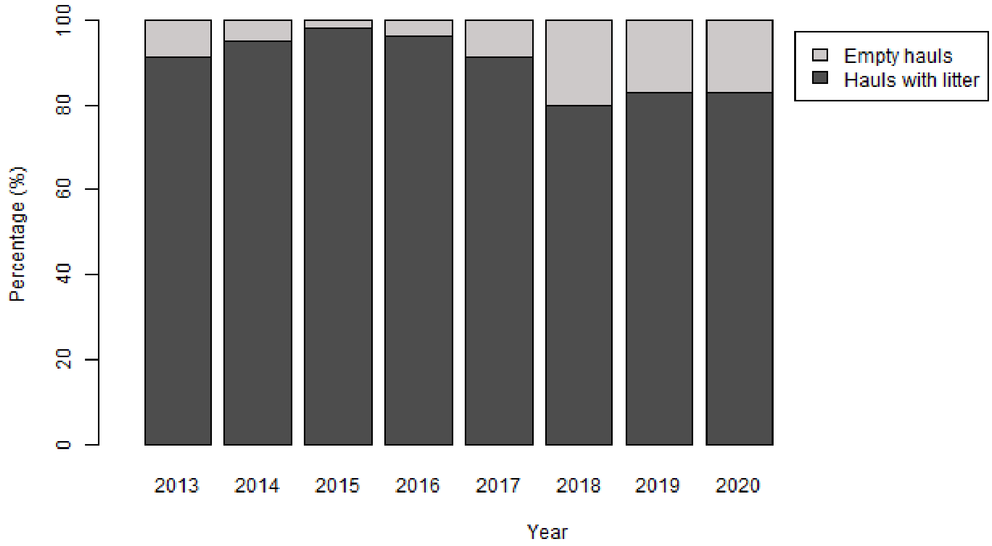


Figure 3.7. Barplot of the percentage of empty hauls in each year (2013 – 2020) of the Dutch IBTS. Empty hauls are hauls that contained no litter item, while in the other hauls at least one litter item was found.

Overall, the mean values in 2020 are some of the lowest since recording began in 2013, as well as the hauls without a single litter item, and are nearly the same as in 2019 (**Table 3.2, Figure 3.6 & 3.7**). However, this comparison has to be interpreted with caution since in 2020 considerably less hauls (48 versus 63) were executed. The spatial distribution is difficult to compare, especially using the maps presenting single hauls since exact fishing positions differ per year and are semi-randomly chosen. Comparing the 2020 map with those of earlier years indicates that the distribution of litter seems as random as in previous years. Following the survey design in which a haul is representative for the whole ICES rectangle, or if the average of multiple hauls is a representation of that rectangle, spatial maps were created (**Figure 3.8 & 3.9**). These maps are somewhat easier to compare, but do not provide a clear pattern of hotspots of litter over the years. Neither do they indicate clear differences between years. ICES rectangles that were sampled each year since 2013 show large yearly variations whereby no indications of a trend over the years is seen (**Figure 3.8 & 3.9**).

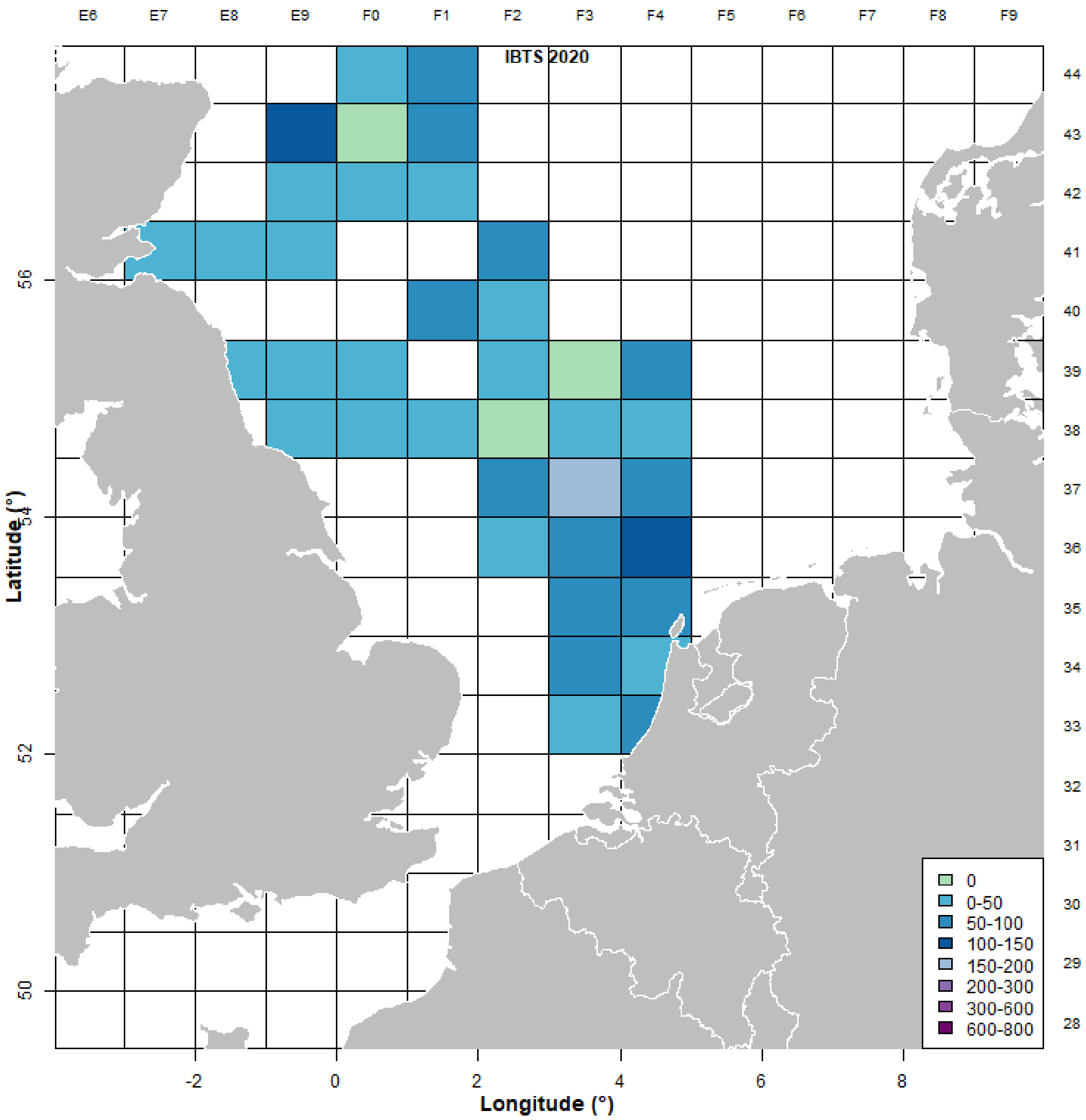
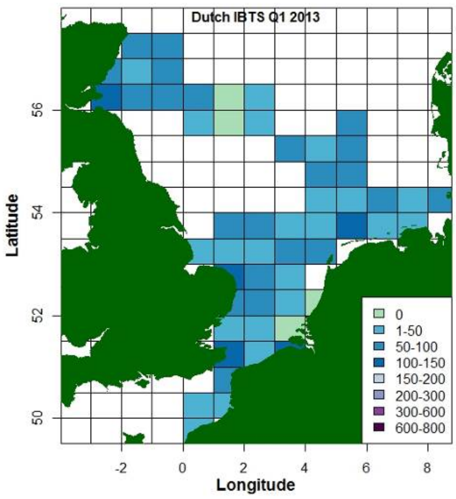
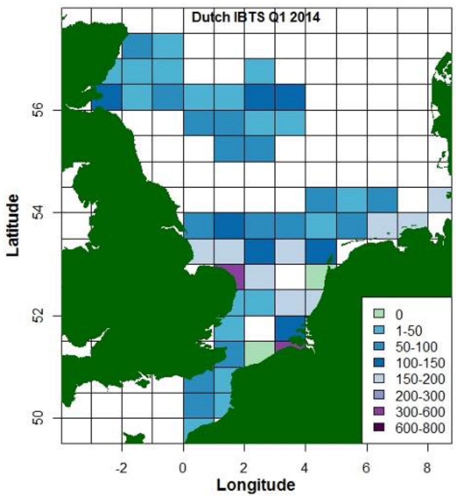


Figure 3.8. Density of litter items per km² for the Dutch IBTS Q1 2020. For rectangles in which two hauls were carried out, the average of the density of litter items per haul per km² is used. The white rectangles are not sampled by the Dutch survey.





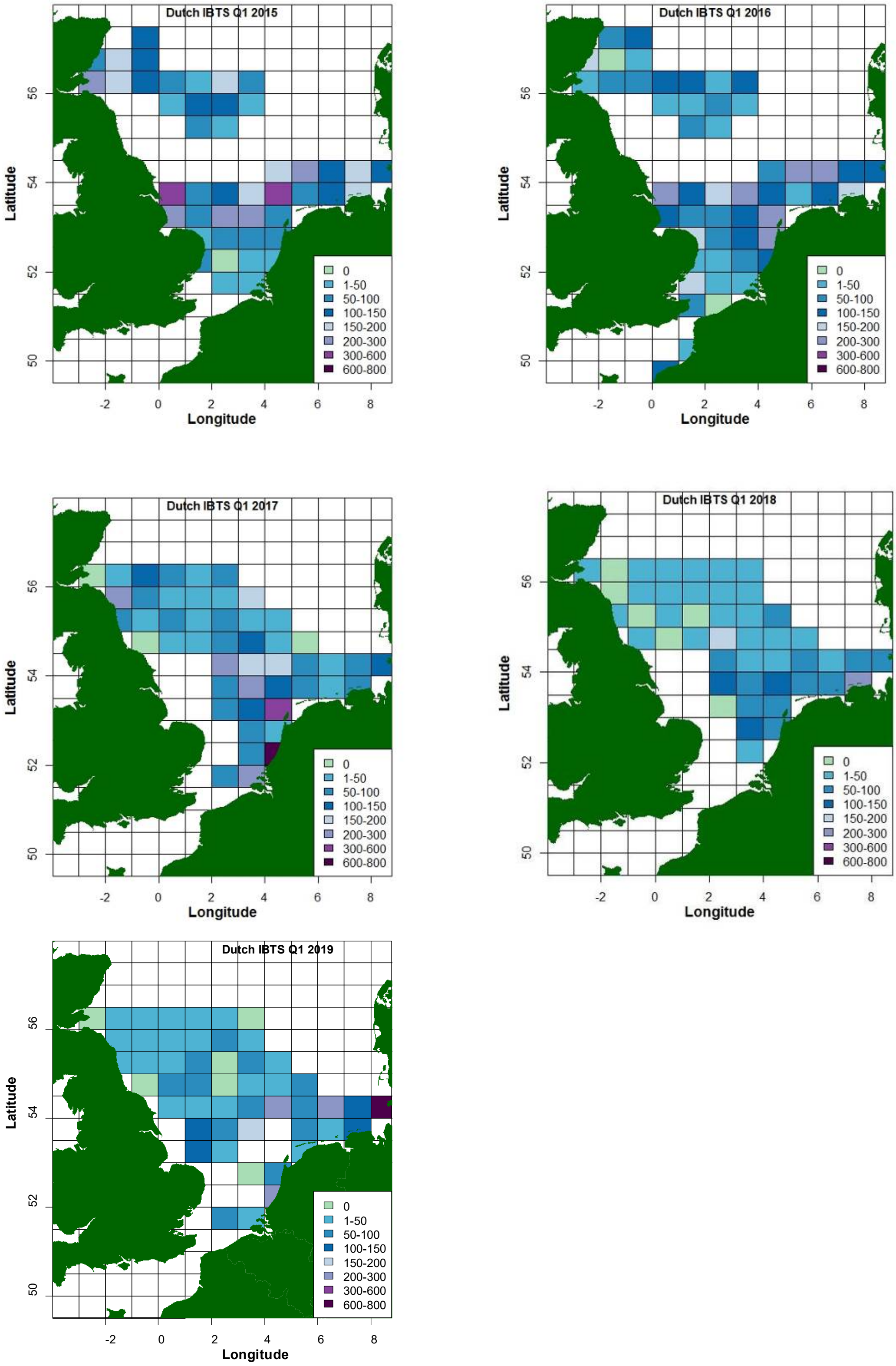


Figure 3.9. Density of litter items per km² for the Dutch IBTS Q1 2013-2019. The colour range is the same in all maps to allow for comparison across years. For rectangles in which two hauls were carried out, the average of the density of litter items per haul per km² is used. The white rectangles are not sampled by the Dutch survey for the corresponding year.

4 Discussion and conclusions

The abundance and composition of seafloor litter in 2020 are in line with those of previous years. The seafloor litter from the catches of the Dutch IBTS Q1 2020 contained mostly plastic items: 92.3 % of the total number of litter items found. Moreover, the composition of the litter itself is comparable among the years, consisting mainly of monofilaments, plastic sheets and various types of ropes/lines. The differences in composition found between years are most likely related to inconsistencies in recordings rather than to an actual change in the types of litter. Differences in values between years may be attributed to inconsistencies in the categorisation of items.

The decision on how to categorise an item has been an issue in latest years. A clearer guideline has recently been provided by the ICES WGML (ICES 2018a) solving a number of the classification issues. An ongoing issue is still the way to count items in case of entanglement. The guideline states: "*If an item is made up of two or more objects that have become entangled, and all items are recognisable, all items should be accounted for separately.*" In Photo 1, an example of this issue is given. The black netting material in the picture is counted as one item, which might be more if the transparent lines (monofilaments) are separated as well. Fully disentangled it might result in a large number of separated monofilament lines, potentially making this haul even a larger catch of litter than has currently been reported. Fully disentangling all litter would cost a lot of effort and is not possible in all cases. Usually, monofilaments that are recognisable as separate items are counted as separate items, while heavily entangled items that are not separately recognisable are counted as one. This thus leaves some arbitrary choices in counting the number of litter items.

Spatially, the difference in the amount of litter items between years is most likely a chance effect and related to differences in fishing location, rather than to actual differences in the amount of litter present in the North Sea. It is widely accepted that with the GOV, which is not designed to catch litter, the probability of catching a litter item when it is present in the trawl path is low. The probability varies with litter type and size. The majority of the items that are caught is small (**Figure 3.4**), even smaller than most fish for which a catchability of less than 5% is assumed, e.g. being caught randomly rather than representatively (ICES 2003, Fraser et al. 2007, Piet et al. 2009). Therefore, the probability of catching these small items is assumed to be low and random. Thus, the fact that these items are caught indicates that it is likely that there are many more items in the trawl path and that current values are a large underestimation of the actual litter present on the seafloor. Even when the international data of the IBTS are combined, as the UK has done for the second OSPAR Intermediate assessment, the issue of the low catchability of litter of the GOV used in the IBTS is of concern. Due to the low catchability there is a large chance that the zeros (no litter in a GOV-haul) are actually false zeros (no litter caught, while there were multiple items of litter on the seafloor). Earlier power-analyses, without taking this issue into consideration, showed that a large number of sampling stations is required to detect a 10 to 30% change in the amount of litter over time (Maes et al. 2014). The issue of a large chance of having false zeros increases the number of sampling stations or reduces the change in litter that can be detected. Consequently, the degree of litter pollution in the North Sea is probably much larger than presented in this report. In order to improve the litter estimates, a correction factor for GOV litter recovery is currently being developed for the upcoming OSPAR intermediate assessment, based on comparative Spanish data between GOV and beam trawl fishing nets. However, since substrate seems to effect the litter catchability, it is likely that a conversion factor based on Spanish data will not be suitable for the North Sea. In addition, even if the recovery is relatively low, relative spatial differences and trends can be detected, provided that a large number of North Sea survey data are available which are all counted comparably.

Additional seafloor litter monitoring was conducted in the North Sea as a response to the accident that happened in January 2019, north of the Dutch Wadden Sea Islands, when the container vessel MSC Zoe lost 342 containers (Volwater & van Hal 2019). Litter items were collected and recorded during the Dutch Beam Trawl survey (BTS) of 2019 Q3 following the manual for collection marine litter of the

IBTS. In this survey fishing was done with a beam trawl, a gear having better bottom contact and considered to have higher catches of seafloor litter than the GOV (Van der Sluis & van Hal, 2014). The beam trawl clearly catches more litter than the GOV, with on average 382 litter items per km^2 (compared to 48 items per km^2), while the composition of the litter is similar, with a plastic proportion of 90 – 96% of the total amount of litter items. The presence-absence of litter items, 99% of the total 142 valid Dutch BTS hauls contained at least one litter item, indicates that the Dutch BTS gear has a higher chance of catching litter. On top of that, the fished area of a haul of the IBTS covers more seafloor than that of a haul of the Dutch BTS (Volwater & van Hal 2019). However, since the covered area, habitats and timing of the surveys (season) differ, caution should be taken when drawing conclusions out of these results. An additional comparison between beam trawl litter catches can be found in annex 3.

Seafloor litter studies are difficult to compare due to differences in fishing gear and categorisation, however, seafloor litter monitoring similar to the IBTS was done in the northern Mediterranean and North West Atlantic Ocean (Flemish Pass). Plastic was by far the most dominant category (Carcia-Alegre et al. 2020; Spedicato et al. 2019). The abundance of litter items on the seafloor ranged from 32 to 534 items per km^2, while 90% of the hauls in the northern Mediterranean contained litter (Spedicato et al. 2019). In the Flemish Pass the presence-absence indices were found to be considerably lower than in the IBTS, 8.3% of the hauls contained at least one litter item while a mean abundance of 1.4 items per km^2 was found (Carcia-Alegre et al. 2020). Some closely related studies made use of the same IBTS protocol and fishing was done in the North Sea and the bordering Baltic Sea (Kammann et al. 2019; Zablotski et al. 2019). In the North Sea, 16.8 litter items per km^2 were caught on average with a GOV net similar to the net used for the IBTS, while 68% of the hauls contained litter (Kammann et al. 2019). In the Baltic Sea an even lower percentage of hauls containing litter was recorded, 53% of the hauls contained at least one litter item with natural products as the most abundant category (Zablotski et al. 2019). Whether the above mentioned differences are due to natural variations or due to e.g. the use of different fishing gear is rather difficult to say.

The actual fishing locations are semi-randomly chosen within a rectangle for the IBTS and differ between years. Based on personal observation of the catches, it is hypothesised that the amount of litter items is determined by type of seafloor structures in the trawl path. This is likely related to the amount of litter retained by the seafloor structures, but also the effect of habitat on the catchability of the litter items. The difference on small local scale is exemplified by empty hauls close to larger catches on the Dutch continental shelf. This year, differences on small local scale are shown for the ICES rectangles 37F3 and 38F3 (**Figure 3.5**). A method to gain insight in the effect of substrate on the accumulation of marine litter was applied in the Bay of Fundy, eastern Canada. Seafloor litter was detected simultaneously with the habitat characteristics by making use of a drop camera system. Most litter was detected on sandy substrates, in contrast with the hypothesis that more litter accumulate on harder/coarser benthic substrates (Goodman et al. 2020). The assessment in the Bay of Fundy is the first of its kind and did not included structures like sabellaria and kelp reefs. Unfortunately, habitat characteristics are not recorded in the IBTS (e.g. by side-scan sonar or multibeam) but could be approximated on the basis of the fish catches or existing habitat or sediment maps. As this knowledge is currently not available, habitat type cannot be incorporated in the analysis and the effect of sampling different habitats between years cannot be disentangled from the differences in the amount of seafloor litter.

Currently, the combination of a low number of trawl hauls, a low number of items found per sampling station, a low probability of catching an item when it is present in the trawl path and the spatial differences in the surveys between years, make it difficult to draw conclusions on the absolute amounts of litter found and to use these data in trend analysis. An improved analysis can be carried out when the data in this report are combined with the international IBTS data, although at this moment the international data were inconsistent due to the lack of standardisation in the collection process, as also stated by Moriarty et al. (2016) and WGML. WGML confirmed our analysis for the OSPAR assessment in 2017, where we reported that not all countries actually counted each litter item. Some of the countries only record the subcategory as presence-absence, rather than the number of items under that subcategory. WGML concluded that this hampers the compilation of North Sea data.

At this moment, only presence-absence analyses seem feasible based on the data up to 2018. Therefore, UK (the OSPAR lead country for the seafloor litter indicator) has recently developed a presence-absence analysis of seafloor litter, and has applied this new method in the second OSPAR Intermediate assessment (EIHA 19/07/19-Add.1). This new assessment method is regarded as useful by The Netherlands and other OSPAR North Sea countries. Since 2016 more and more countries are counting the number of litter items per (sub-) category in a more consistent way. With the international IBTS data combined, an improved analysis of the total abundance will be attempted in 2020.

The definition of Good Environmental Status (GES) for marine litter is that "The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment." (COMMISSION DECISION (EU) 2017/848 of 17 May 2017). It is not yet defined what these levels are and the current approach is to try to reduce of the amount of litter in the environment. It is clear (Maes et al. 2018, Urban-Malinga et al. 2018), also from the results presented here, that despite the management measures to decrease the input of litter and to remove the litter from the environment, there is still litter on the seafloor. A situation with no litter in the environment has not been realized yet and it is unlikely to be realized within a short timeframe. The indicators proposed for the MSFD should be able to detect a reduction in litter related to management measures when it occurs.

As the catchability issue with the GOV net is hard to solve and difficult to incorporate in the analyses, it might be worthwhile to find or develop other methods for detecting a change in the amount of litter on the seafloor. A dedicated survey, possibly focused at areas where litter is likely to be gathered by the dominant currents, could assist in providing trend information of fixed locations. However, it remains to be proven that these "hotspots" actually exist, or that these shift through time, which seems to be suggested by the draft second OSPAR intermediate assessment (EIHA 19/07/19-Add.1). A study such as conducted in the Bay of Fundy, with a drop down camera system, can possibly identify hotspots of seafloor litter in the North Sea. Another option might be, to use the beam trawl surveys in the Dutch coastal areas. The Netherlands performs three regular beam trawl surveys covering the coastal areas and the Wadden Sea (Beam Trawl Survey (BTS), Sole Net Survey (SNS), Demersal Fish Survey (DFS)), covering a substantial area of the North Sea. The RWS-project related to the MSC Zoe collected the litter from the catches of two of these surveys (BTS and DFS) following the WGML-protocol. The higher catchability (99% of the hauls contained at least one litter item) of litter items with the beam trawl for especially the Dutch BTS is clear (also shown in **Annex 3**). In contrast, many hauls (72%) with the DFS gear contained no litter at all (Volwater & van Hal, 2019). Yet, this might be a good start for the longer term collection of litter from these surveys. Such a time series would at least be based on a gear that is likely better equipped for sampling seafloor litter than the GOV.

5 Recommendations

- Follow the progress of the data collection of seafloor litter in the Dutch beam trawl surveys as performed in the RWS project related to the MSC Zoe. Explore the possibilities to extend this data collection to create a time series.
- Participate in the UK development of analyses on the international dataset.
- Further investigate the differences in seafloor litter catch efficiency of the GOV and beam trawl gears, and establish a correction factor that takes substrate into account. Also take the OSPAR ICGML action for establishing a correction factor between GOV and beam trawl fishing gear into account.

6 Quality Assurance

Wageningen Marine Research utilises an ISO 9001:2015 certified quality management system. This certificate is valid until 15 December 2021. The organisation has been certified since 27 February 2001. The certification was issued by DNV GL.

References

Andrady, A. L. (2015). Persistence of plastic litter in the oceans. In Marine anthropogenic litter (pp. 57-72): Springer, Cham.

Costanza, R. (1999). The ecological, economic, and social importance of the oceans. Ecological economics, 31(2), 199-213.

Fleet D, van Franeker J, Dagevos J, Hougee M. 2009. Marine Litter. Thematic Report No. 3.8. In: (Eds), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Fraser, H. M., Greenstreet, S. P., & Piet, G. J. (2007). Taking account of catchability in groundfish survey trawls: implications for estimating demersal fish biomass. ICES Journal of Marine Science, 64(9), 1800-1819.

Galgani, F., Hanke, G., & Maes, T. (2015). Global distribution, composition and abundance of marine litter. In Marine anthropogenic litter (pp. 29-56): Springer, Cham.

García-Alegre, A., Román-Marcote, E., Gago, J., González-Nuevo, G., Sacau, M., & Muñoz, P. D. (2020). Seabed litter distribution in the high seas of the Flemish Pass area (NW Atlantic). Scientia Marina, 84(1), 93-101.

Goodman, A. J., Walker, T. R., Brown, C. J., Wilson, B. R., Gazzola, V., & Sameoto, J. A. (2020). Benthic marine debris in the Bay of Fundy, eastern Canada: Spatial distribution and categorization using seafloor video footage. Marine pollution bulletin, 150, 110722.

ICES. 2003. Study Group on Survey Trawl Gear for the IBTS Western and Southern Areas ICES, Copenhagen.

ICES. 2015. Manual for the International Bottom Trawl Surveys. ICES, Copenhagen, Denmark.

ICES. 2018a. Interim Report of the Working Group on Marine Litter (WGML) 23-27 April 2018. ICES, ICES Headquarters, Copenhagen, Denmark.

ICES. 2018b. Report of the International Bottom Trawl Survey Working Group (IBTSWG) 19 - 23 March 2018 Oranmore, Ireland.

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., . . . Law, K. L. (2015). Plastic waste inputs from land into the ocean. Science, 347(6223), 768-771.

Kammann, U., Aust, M.-O., Bahl, H., & Lang, T. (2018). Marine litter at the seafloor–Abundance and composition in the North Sea and the Baltic Sea. Marine pollution bulletin, 127, 774-780.

Kühn, S., Rebolledo, E. L. B., & van Franeker, J. A. (2015). Deleterious effects of litter on marine life. In Marine anthropogenic litter (pp. 75-116): Springer, Cham.

Maes, T., Barry, J., Leslie, H., Vethaak, A., Nicolaus, E., Law, R., . . . Thain, J. (2018). Below the surface: Twenty-five years of seafloor litter monitoring in coastal seas of North West Europe (1992–2017). Science of the Total Environment, 630, 790-798.

Maes T, Nicolaus M, Van Der Molen J, Barry J, Kral F. 2014. Marine Litter Monitoring, Defra project ME5415. CEFAS, Lowestoft.

Moriarty M, Pedreschi D, Stokes D, Dransfeld L, Reid DG (2016) Spatial and temporal analysis of litter in the Celtic Sea from Groundfish Survey data: Lessons for monitoring. Marine Pollution Bulletin 103:195-205

Nelms, S. E., Galloway, T. S., Godley, B. J., Jarvis, D. S., & Lindeque, P. K. (2018). Investigating microplastic trophic transfer in marine top predators. Environmental Pollution, 238, 999-1007.

Ospar commission. 2010. OSPAR Commission. Guideline for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area. 90-3631-973.

Ospar commission. 2017. OSPAR Intermediate Assessment 2017: Composition and Spatial Distribution of Litter on the Seafloor. OSPAR Intermediate Assessment Portal (OAP). https://oap.ospar.org/ (Printable pdf Abstract: https://oap-cloudfront.ospar.org/media/filer_public/82/19/8219c6d3-7270-400a-9466-149903d7e2ba/seabed_litter.pdf).

Ospar commission. 2017. OSPAR Commission. Guidelines on Litter on the Seafloor. EIHA 17/9/1 Annex 12.

Pham, C. K., Ramirez-Llodra, E., Alt, C. H., Amaro, T., Bergmann, M., Canals, M., . . . Galgani, F. (2014). Marine litter distribution and density in European seas, from the shelves to deep basins. PloS one, 9(4).

Piet, G., Van Hal, R., & Greenstreet, S. (2009). Modelling the direct impact of bottom trawling on the North Sea fish community to derive estimates of fishing mortality for non-target fish species. ICES Journal of Marine Science, 66(9), 1985-1998.

Rochman, C. M. (2015). The complex mixture, fate and toxicity of chemicals associated with plastic debris in the marine environment. In Marine anthropogenic litter (pp. 117-140): Springer, Cham.

Schulz, M., van Loon, W., Fleet, D. M., Baggelaar, P., & van der Meulen, E. (2017). OSPAR standard method and software for statistical analysis of beach litter data. Marine pollution bulletin, 122(1-2), 166-175.

Spedicato, M. T., Zupa, W., Carbonara, P., Fiorentino, F., Follesa, M. C., Galgani, F., . . . Lazarakis, G. (2020). Spatial distribution of marine macro-litter on the seafloor in the northern Mediterranean Sea: the MEDITS initiative. Scientia Marina, 83(S1), 257-270.

Thompson, R. C. (2015). Microplastics in the marine environment: sources, consequences and solutions. In Marine anthropogenic litter (pp. 185-200): Springer, Cham.

Urban-Malinga, B., Wodzinowski, T., Witalis, B., Zalewski, M., Radtke, K., & Grygiel, W. (2018). Marine litter on the seafloor of the southern Baltic. Marine pollution bulletin, 127, 612-617.

van Damme C, Bolle L, de Boois I, Burggraaf D, Couperus B, van Hal R, Pasterkamp T. 2019. Handboek en protocollen voor bestandsopnamen en routinematige bemonsteringen op zee en in estuaria. CVO.

van der Sluis MT, van Hal R. 2014. Collecting marine litter during regular fish surveys. Report number C065/14, IMARES, IJmuiden.

Van Franeker J, Ospar, Oosterbaan L, Loon WMGM (2017) OSPAR 2017. OSPAR Intermediate Assessment 2017: Plastic Particles in Fulmar Stomachs in the North Sea.. OSPAR Intermediate Assessment Portal (OAP) Online Document: Printable pdf Abstract of online document: https://oap-cloudfront.ospar.org/media/filer_public/f4/34/f434a292-3fad-466c-9e89-c2ff09dc9e9d/fulmar.pdf

van Hal R, de Vries M. 2013. Pilot: collecting Marine litter during regular fish surveys. IMARES, IJmuiden.

Van Hal R. 2019. Dutch Seafloor Litter Monitoring in the North Sea. Report C052/18, Wageningen Marine Research, Ijmuiden.

Viega JM, Fleet D, Kinsey S, Nilsson P, Vlachogianni T, Wener S, Galgani F, Thompson RC, Dagevos J, Gago J, Sobral P, Cronin R. 2016. Indentifying Sources of Marine Litter, MSFD GES TG Marine Litter Thematic Report, JRC Techincal Report, EUR 28309, doi: 10.2788/018068.

Volwater J, van Hal R. 2019. Monitoring zeebodemafval in de Noordzee en Waddenzee naar aanleiding van de containerramp met de MSC Zoe. Report C102/19, Wageningen Marine Research, IJmuiden.

Zablotski, Y., & Kraak, S. B. (2019). Marine litter on the Baltic seafloor collected by the international fish-trawl survey. Marine pollution bulletin, 141, 448-461.

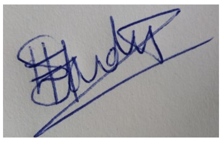
Justification

Report C049/20
Project Number: 4316100081

The scientific quality of this report has been peer reviewed by a colleague scientist and a member of the Management Team of Wageningen Marine Research

Approved: Floor Soudijn
Researcher

Signature:



Date: 4th of June 2020

Approved: Tammo Bult
Director

Signature:

Date: 4th of June 2020

Annex 1 Data tables with sea floor litter monitoring data of Dutch IBTS Q1 2020

Annex 1.a Complete trawl list of valid hauls of the Dutch IBTS Q1 2020, in which the total number of items (Number of items) and the density (Items km^2) per haul are reported. *Sample ID represents the haul number; Latitude and Longitude represent the coordinates at the start of each haul; Items km^2 represent the sum of all litter items divided by the fished surface (Bottom track * Wingspread).*

Sample ID	ICES rectangle	Month	Day	Latitude	Longitude	Water depth (m)	Haul duration (min)	Bottom track (m)	Doorspread (m)	Warp length (m)	Wingspread (km)	Number of items	Items km^2
3400001	33F3	1	20	52.37283	4.48083	15.0	30.0	3933	63	152	0.0177609	3	42.95
3400002	34F4	1	20	52.7835	4.41667	24.5	30.0	3.396	68	150	0.0187044	2	31.49
3400003	39F4	1	21	55.1115	4.33783	49	30.2	2.883	64	240	0.0179496	5	96.62
3400004	38F4	1	21	54.88233	4.50583	46	30.0	3.454	72	240	0.0194592	3	44.63
3400005	38F4	1	21	54.63467	4.272	49.5	30.3	3.567	79	238	0.0207801	2	26.98
3400006	38F3	1	21	54.67267	3.76567	46.2	31.6	3.721	71	241	0.0192705	0	0.00
3400007	41F2	1	22	56.125	2.74867	78.5	30.1	3.345	76	375	0.020214	1	14.79
3400008	41F2	1	22	56.29917	2.28367	78.4	31.2	3.418	84	375	0.0217236	7	94.27
3400009	42F1	1	22	56.68533	1.46967	99.5	30.0	3.227	78	404	0.0205914	3	45.15
3400010	40F1	1	23	55.67567	1.86	73.1	30.0	3.103	68	350	0.0187044	5	86.15
3400011	40F2	1	23	55.5885	2.52817	56.1	30.2	3.811	79	325	0.0207801	1	12.63
3400012	39F2	1	23	55.34267	2.78583	32.8	30.2	3.484	68	200	0.0187044	1	15.35
3400013	39F3	1	23	55.2555	3.36183	31	30.2	3.635	64	175	0.0179496	0	0.00
3400014	33F3	1	27	52.3965	3.41967	34.4	30.1	3.385	63	160	0.0177609	1	16.63
3400015	34F3	1	27	52.66067	3.2815	32.4	30.0	4.675	72	210	0.0194592	6	65.95
3400016	38F1	1	28	54.76833	1.32367	39.1	30.3	3.112	63	233	0.0177609	1	18.09
3400017	38F0	1	28	54.84033	0.44633	80.6	30.0	3.287	80	350	0.0209688	2	29.02
3400018	39F0	1	28	55.23917	0.4665	85.4	30.1	3.488	82	380	0.0213462	3	40.29
3400019	39F0	1	28	55.38583	0.3555	88.2	30.0	3.109	84	392	0.0217236	0	0.00
3400020	44F0	1	29	57.6885	0.57083	100	30.5	3.792	85	425	0.0219123	2	24.07
3400021	44F1	1	29	57.6505	1.26133	90.8	30.6	4.022	85	400	0.0219123	7	79.43
3400022	43F1	1	29	57.39117	1.59183	95.8	30.2	3.488	86	400	0.022101	4	51.89
3400023	42E9	1	30	56.63617	-0.31617	86.3	30.1	3.611	85	400	0.0219123	1	12.64
3400024	41E9	1	30	56.46633	-0.40017	75	30.0	3.477	82	380	0.0213462	0	0.00
3400025	41E9	1	30	56.18917	-0.42483	77.3	30.1	3.329	77	350	0.0204027	3	44.17
3400026	43E9	1	31	57.25533	-0.21	76.7	30.1	3.611	81	400	0.0211575	8	104.71
3400027	43F0	1	31	57.184	0.489	89.2	30.3	5.533	84	425	0.0217236	0	0.00
3400028	42F0	1	31	56.828	0.45967	113.5	30.0	3.607	90	580	0.0228558	2	24.26
3400029	41E7	2	3	56.39	-2.10883	66.7	30.1	3.516	70	280	0.0190818	2	29.81
3400030	41E8	2	3	56.37767	-1.43967	61.5	30.1	3.592	71	300	0.0192705	1	14.45
3400031	38E9	2	12	54.684	-0.3445	69.3	30.1	3.451	77	325	0.0204027	2	28.41
3400032	39E9	2	12	55.06117	-0.92967	81.5	30.2	3.875	85	355	0.0219123	2	23.55
3400033	39E8	2	12	55.18767	-1.2125	93.1	30.1	3.421	78	350	0.0205914	1	14.20
3400034	38F1	2	13	54.86983	1.91483	24.3	30.4	3.325	59	155	0.0170061	0	0.00
3400035	38F2	2	13	54.81	2.343	24.2	30.0	3.384	58	155	0.0168174	0	0.00
3400036	38F2	2	13	54.6465	2.34867	21.4	30.1	3.988	65	150	0.0181383	0	0.00

3400037	37F2	2	13	54.37283	2.15133	33.8	30.3	3.08	67	176	0.0185157	6	105.21
3400038	37F2	2	13	54.16167	2.36283	59.3	30.0	3.374	81	277	0.0211575	4	56.03
3400039	35F4	2	14	53.064	4.278	34.6	30.0	2.859	62	212	0.0175722	3	59.71
3400040	35F3	2	17	53.04833	3.82533	29.8	30.5	3.066	60	175	0.0171948	5	94.84
3400041	36F2	2	18	53.81267	2.68533	57.4	30.0	3.862	80	299	0.0209688	4	49.39
3400042	36F3	2	18	53.87167	3.07467	58.5	30.0	3.722	82	300	0.0213462	6	75.52
3400043	38F3	2	19	54.5425	3.3525	41.6	30.0	3.597	66	225	0.018327	6	91.02
3400044	37F3	2	19	54.2975	3.40917	44.5	30.0	3.339	65	245	0.0181383	1	16.51
3400045	37F3	2	19	54.11067	3.77033	48.6	30.0	3.028	74	249	0.0198366	19	316.32
3400046	37F4	2	19	54.091	4.21017	49.8	30.0	3.688	81	260	0.0211575	7	89.71
3400047	36F4	2	19	53.932	4.457	42.5	30.0	3.91	78	250	0.0205914	9	111.78
3400048	33F4	2	20	52.054	4.06833	13.9	30.0	3.616	63	150	0.0177609	4	62.28

Annex 1.b. Complete litter list of the Dutch IBTS Q1 2019. For every haul, each litter item is categorised per type and size category. *Sample ID represents the haul number; Litter type and Size category represent the subcategory and size class, respectively, assigned to each litter item as per Table 2.1. Additional information such as description, weight (g), length (m) if applicable, and the presence/absence of attached organisms were also recorded.*

Date	Sample ID	Litter type	Description (Label/ Brand)	Size category	Number	Weight (grams)	Length (m)	Attached organisms (yes/no)	Picture
20-01-2020	3400001	A5	orange	A	1	1.00	0.60	no	20200120_182907
20-01-2020	3400001	A7	white	A	1	2.00	195.00	no	20200120_182907
20-01-2020	3400001	A10	grey duct tape	B	1	2.00		no	20200120_182907
20-01-2020	3400002	A5	orange	A	1	1.00	0.25	no	20200120_182938
20-01-2020	3400002	A7	white	A	1	1.00	0.11	no	20200120_182938
21-01-2020	3400003	A6	rope, monofilament	B	1	302.00	1.00	yes	P1010577
21-01-2020	3400003	A14	yellow earplug	A	1	2.00		no	P1010577
21-01-2020	3400003	A5	blue	A	1	1.00	0.53	no	P1010577
21-01-2020	3400003	A5	black	A	1		0.11	yes	P1010577
21-01-2020	3400003	A5	white	A	1		0.10	no	P1010577
21-01-2020	3400004	A5	black	A	1		0.27	no	P1010579
21-01-2020	3400004	A7	white	A	1		0.09	no	P1010579
21-01-2020	3400004	A14	black mesh	F	1	2020.00		yes	P1010578
21-01-2020	3400005	A9	black cable tie	A	1	0.10	0.06	no	P1010580
21-01-2020	3400005	A7	white	A	1	4.00	0.38	no	P1010581
21-01-2020	3400006								
22-01-2020	3400007	A5	blue	A	1		0.74		P1010582
22-01-2020	3400008	A2	sheet white	D	1	40.00	0.50	yes	P1010584
22-01-2020	3400008	A2	plastic bag, blue	C	1	15.00		yes	P1010584
22-01-2020	3400008	A7	blue	A	2		0.46	no	P1010584
22-01-2020	3400008	A5	blue/black	A	2		0.50	no	P1010584
22-01-2020	3400008	A14	red pull-ring	A	1			no	P1010584
22-01-2020	3400009	A7	shoe lace	A	1		0.75	no	P1010585
22-01-2020	3400009	A7	fishing rope	A	1		0.07	no	P1010585
22-01-2020	3400009	A7	blue	A	1		0.13	no	P1010585
23-01-2020	3400010	A2	transparent	B	1	19.00		yes	P1010587
23-01-2020	3400010	A7	blue	A	1	16.00	0.76	yes	P1010587
23-01-2020	3400010	F3	cigarette but	A	1	1.00		no	P1010587
23-01-2020	3400010	A7	nylon	A	1	2.00	0.19	no	P1010587

23-01-2020	3400010	A7	nylon	A	1	12.00	1.06	no	P1010587
23-01-2020	3400011	A2	black garbage bag	D	1	360.00		yes	P1010588
23-01-2020	3400012	A7	nylon white	A	1	5.00	0.17	yes	P1010589
23-01-2020	3400013								
27-01-2020	3400014	A7	white	A	1	42.00	0.67	no	P1010590
27-01-2020	3400015	A2	white	D	1	7.00		yes	P1010591
27-01-2020	3400015	A3	Transparent	C	1	12.00		yes	P1010591
27-01-2020	3400015	A2	Transparant	A	1	1.00		no	P1010591
27-01-2020	3400015	A2	Lolli wrapping (polish)	A	1	1.00		no	P1010591
27-01-2020	3400015	A7	White	A	1	2.00	0.09	no	P1010591
27-01-2020	3400015	E1		A	1	44.00		no	P1010591
28-01-2020	3400016	E1	Processed wood	C	1	1060.00		yes	P1010592
28-01-2020	3400017	A6	orange	A	1	5.00		yes	P1010593
28-01-2020	3400017	A2	black tape	A	1	1.00		no	P1010593
28-01-2020	3400018	A7	Green	A	1	4.00	0.21	No	P1010594
28-01-2020	3400018	A7	Brown	A	1	1.00	0.13	no	P1010594
28-01-2020	3400018	A7	Orange	A	1	0.00	0.36	no	P1010594
28-01-2020	3400019								
29-01-2020	3400020	A7	White	A	1	2.00	0.14	yes	P1010595
29-01-2020	3400020	A14	polyester board	A	1	2.00		yes	P1010595
29-01-2020	3400021	C1	Rubber boot (42)	D	1	1250.00		yes	P1010597
29-01-2020	3400021	A5	Grey	A	1	1.00	0.87	no	P1010597
29-01-2020	3400021	A8	White	A	1	2.00		yes	P1010597
29-01-2020	3400021	A5	Orange	A	1	1.00	0.10	yes	P1010597
29-01-2020	3400021	A5	Black	A	1	1.00	0.39	no	P1010597
29-01-2020	3400021	A2	food packaging	B	1	3.00		no	P1010597
29-01-2020	3400021	A2	food packaging	B	1	2.00		no	P1010597
29-01-2020	3400022	A2	transparent	C	1	10.00		yes	P1010598
29-01-2020	3400022	A2	hula hoops packaging	B	1	2.00		no	P1010598
29-01-2020	3400022	E1		A	1	4.00		no	P1010598
29-01-2020	3400022	C3	black	A	1	62.00		no	P1010598
30-01-2020	3400023	A7	white	A	1	2.00	0.16	yes	P1010600
30-01-2020	3400024								
30-01-2020	3400025	D2	Green bottle	B	1	480.00		no	P1010601
30-01-2020	3400025	D3	Brown glass	B	1	175.00		no	P1010601
30-01-2020	3400025	A2	Black	B	1	1.00		yes	P1010601
31-01-2020	3400026	A3	Plastic bag	D	1	400.00		yes	P1010602
31-01-2020	3400026	A3	Onion net	B	1	30.00		yes	P1010602
31-01-2020	3400026	A5	Orange	A	1	1.00	0.46	yes	P1010602
31-01-2020	3400026	A5	Black	A	1	1.00	0.20	no	P1010602
31-01-2020	3400026	A7	White	A	1	1.00	0.40	no	P1010602
31-01-2020	3400026	A14	White	A	1	1.00		no	P1010602
31-01-2020	3400026	A7	White	B	1		0.82	no	P1010602
31-01-2020	3400026	A7	White	B	1		0.70	no	P1010602
31-01-2020	3400027								
31-01-2020	3400028	A5	blue	A	1	1.00	0.74	no	P1010604
31-01-2020	3400028	A5	white	A	1	1.00	0.18	yes	P1010604
03-02-2020	3400029	A5	Orange	A	1		0.52	no	P1010606

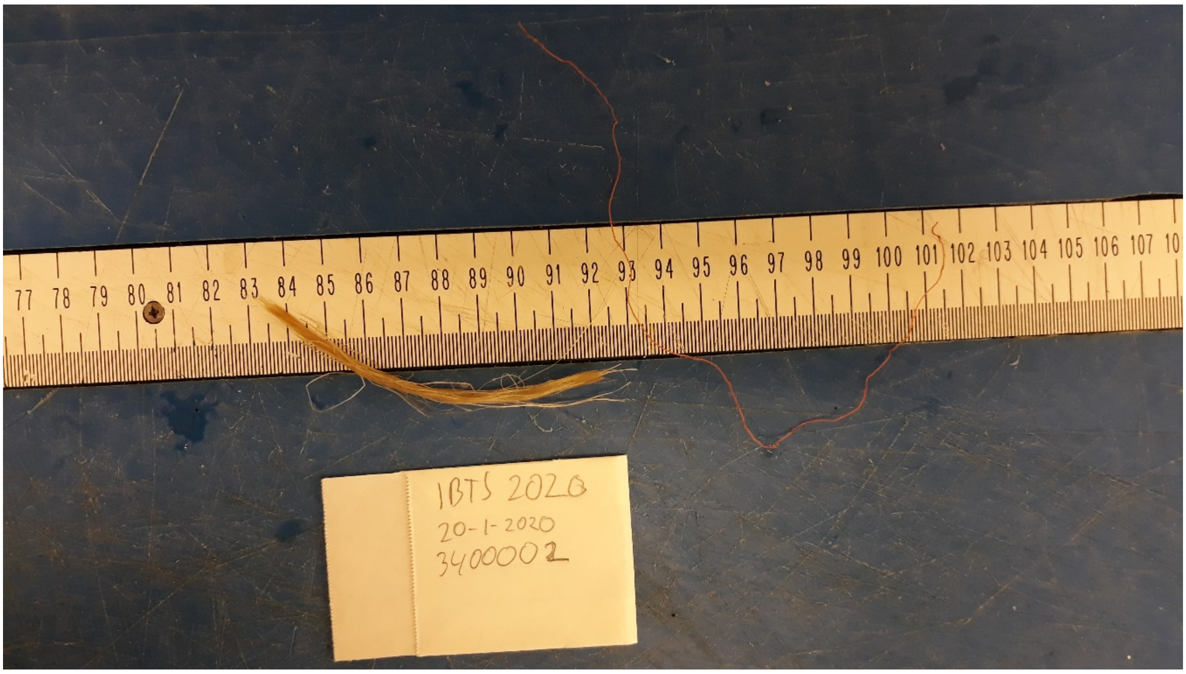
03-02-2020	3400029	A2	White	B	1	2.00		no	P1010606
03-02-2020	3400030	A2	Blue transparent	A	1	1.00		yes	P1010607
12-02-2020	3400031	A2	Green	A	1			no	P1010608
12-02-2020	3400031	A7		A	1			yes	P1010608
12-02-2020	3400032	A1	`Bottle	C	1				P1010610
12-02-2020	3400032	A2	Duct tape sheet	A	1				P1010610
12-02-2020	3400033	A2	white	A	1	1.00		yes	P1010612
13-02-2020	3400034								
13-02-2020	3400035								
13-02-2020	3400036								
13-02-2020	3400037	A2	transparent	A	1	1.00		yes	P1010613
13-02-2020	3400037	A2	white	A	1	1.00		no	P1010613
13-02-2020	3400037	A7		A	1	1.00	0.30	no	P1010613
13-02-2020	3400037	A7		A	1	6.00	0.56	no	P1010613
13-02-2020	3400037	A7		A	1	4.00	0.40	no	P1010613
13-02-2020	3400037	A2	white	D	1	38.00		yes	P1010613
13-02-2020	3400038	A6	blue/orange	B	1	18.00		yes	P1010614
13-02-2020	3400038	F3	entangled fabric/paper	B	1	70.00		yes	P1010614
13-02-2020	3400038	A14	Plastic cup	B	1	16.00		yes	P1010614
13-02-2020	3400038	A7	Synthetic rope	C	1	1508.00	4.00	yes	P1010614
14-02-2020	3400039	A5	Orange	A	1	1.00	0.16	no	P1010616
14-02-2020	3400039	A2	transparent	A	1	1.00		no	P1010616
14-02-2020	3400039	A7	green	A	1	3.00		no	P1010616
17-02-2020	3400040	A14	packaging foil	A	1			no	P1010618
17-02-2020	3400040	A5		A	1		0.92	no	P1010618
17-02-2020	3400040	A5		A	1		1.78	no	P1010618
17-02-2020	3400040	A5		A	1		0.37	no	P1010618
17-02-2020	3400040	A2		D	1	70.00		no	P1010618
18-02-2020	3400041	A2		D	1	8.00		yes	P1010619
18-02-2020	3400041	A2	transparent	C	1	10.00		yes	P1010619
18-02-2020	3400041	A5	blue	A	1		1.34	no	P1010619
18-02-2020	3400041	A5	orange	A	1		0.20	no	P1010619
18-02-2020	3400042	A2	blue	A	1	3.00		yes	
18-02-2020	3400042	A2	white	A	1	1.00		no	
18-02-2020	3400042	A6	blue	A	1	12.00		yes	
18-02-2020	3400042	A6	orange	A	1	1.00		no	
18-02-2020	3400042	A7		A	1	34.00		no	
18-02-2020	3400042	A7	black	A	1	1.00	0.06	no	
19-02-2020	3400043	A2	transparent	B	1	6		yes	P1010620
19-02-2020	3400043	A2	blue	D	1	24		yes	P1010620
19-02-2020	3400043	A6	orange	A	1	20		no	P1010620
19-02-2020	3400043	A7	orange	A	1		0.57	no	P1010620
19-02-2020	3400043	C3	black ring	B	1	88		no	P1010620
19-02-2020	3400043	A7	orange	A	1		0.26	no	P1010620
19-02-2020	3400044	A6	orange	A	1	1.00		no	
19-02-2020	3400045	A5	blue	A	1		1.29	yes	P1010623
19-02-2020	3400045	A5	blue	A	1		1.30	yes	P1010623
19-02-2020	3400045	A5	blue	A	1		0.62	yes	P1010623

19-02-2020	3400045	A5	blue	A	1		0.64	yes	P1010623
19-02-2020	3400045	A5	blue	A	1		0.95	yes	P1010623
19-02-2020	3400045	A5	blue	A	1		0.70	yes	P1010623
19-02-2020	3400045	A5	blue	A	1		1.01	yes	P1010623
19-02-2020	3400045	A5	blue	A	1		0.97	yes	P1010623
19-02-2020	3400045	A5	green	A	1		0.73	yes	P1010623
19-02-2020	3400045	A5	orange	A	1		1.07	yes	P1010623
19-02-2020	3400045	A5	orange	A	1		0.99	yes	P1010623
19-02-2020	3400045	A5	orange	A	1		1.05	yes	P1010623
19-02-2020	3400045	A5	orange	A	1		0.26	yes	P1010623
19-02-2020	3400045	A7		B	1	59.00	0.42	no	P1010623
19-02-2020	3400045	A7	green	A	1	3.00	0.33	no	P1010623
19-02-2020	3400045	A5		A	1	23.00		no	P1010623
19-02-2020	3400045	A2	transparent	C	1	6.00		yes	P1010623
19-02-2020	3400045	A2	white	C	1	7.00		yes	P1010623
19-02-2020	3400045	A8		C	1	203.00		no	P1010623
19-02-2020	3400046	C2	led balloon with battery	E	1	58.00		yes	P1010624
19-02-2020	3400046	A2	transparent	D	2	22.00		yes	P1010624
19-02-2020	3400046	A2	transparent	C	1	2.00		yes	P1010624
19-02-2020	3400046	E5		A	1	6.00		yes	P1010624
19-02-2020	3400046	A5	blue	A	1		0.54	yes	P1010624
19-02-2020	3400046	A5	orange	A	1		0.03	no	P1010624
19-02-2020	3400047	A2	blue	E	1	136.00		yes	P1010628
19-02-2020	3400047	A2	White transparent; balloon with ribbon	E	1	162.00		yes	P1010629
19-02-2020	3400047	A2	white/blue candy wrapping	D	1	6.00		no	P1010629
19-02-2020	3400047	A2	transparent/blue	A	1	2.00		no	P1010630
19-02-2020	3400047	A7		A	1	2.00		yes	P1010630
19-02-2020	3400047	A5	orange	A	1		0.80	no	P1010630
19-02-2020	3400047	A5	black	A	1		0.70	no	P1010630
19-02-2020	3400047	A5	orange	A	1		0.55	no	P1010630
19-02-2020	3400047	A5	orange	A	1		0.49	yes	P1010630
20-02-2020	3400048	A2	transparent	C	1	6.00		yes	P1010631
20-02-2020	3400048	A2	purple	B	1			yes	P1010631
20-02-2020	3400048	A2	black	D	1	26.00		yes	P1010631
20-02-2020	3400048	A5	orange	A	1		1.10	yes	P1010631

Annex 2 Photos of seafloor litter in the Dutch IBTS Q1 2020

Photos are captioned as follows:
Haul number: General description (subcategory) [from left to right and top to bottom]

Haul 3400001: monofilament x1 (A5), synthetic rope x1 (A7) and grey duct tape x1 (A10). Note that this valid was an invalid haul and is not used for further analysis.



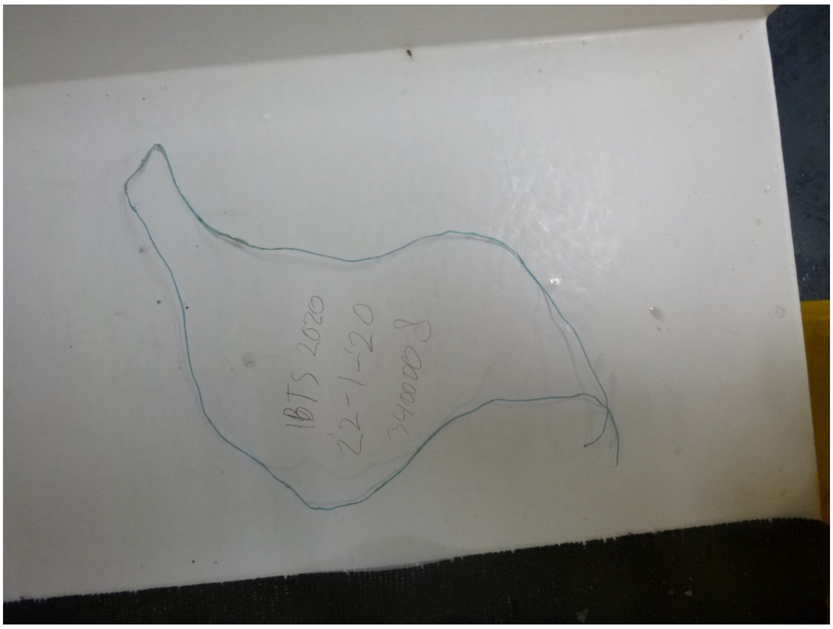
Haul 3400002: monofilament x1 (A5) and synthetic rope x1 (A7)

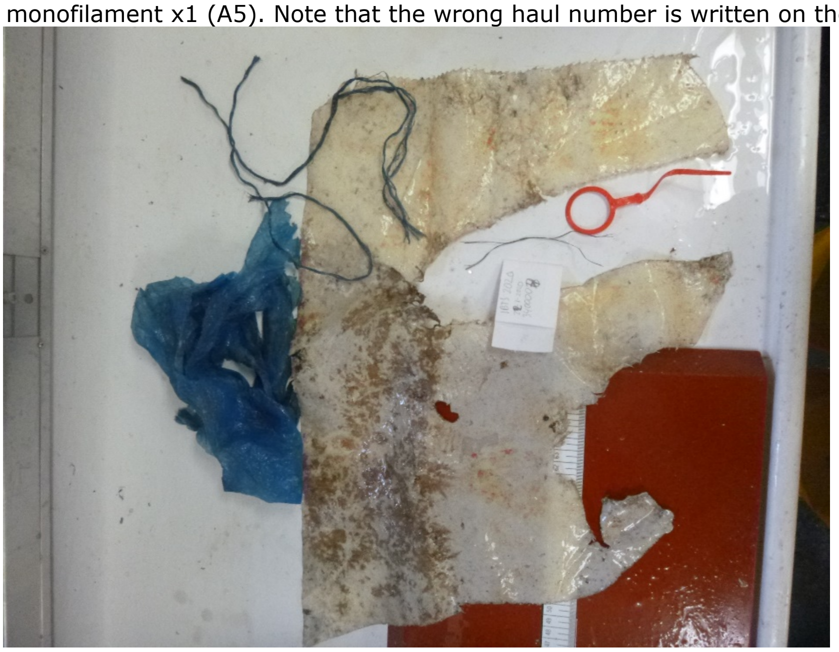
Haul 3400003: monofilament x3 (A5), (entangled) rope x1 (A6) and yellow ear plugs x1 (A14)

Haul 3400004: Black mesh x1 (A14), monofilament x1 (A5) and synthetic rope x1 (A7)

Haul 3400005: synthetic rope x1 (A7), and black cable tie x1 (A9)

Haul 3400006: No litter



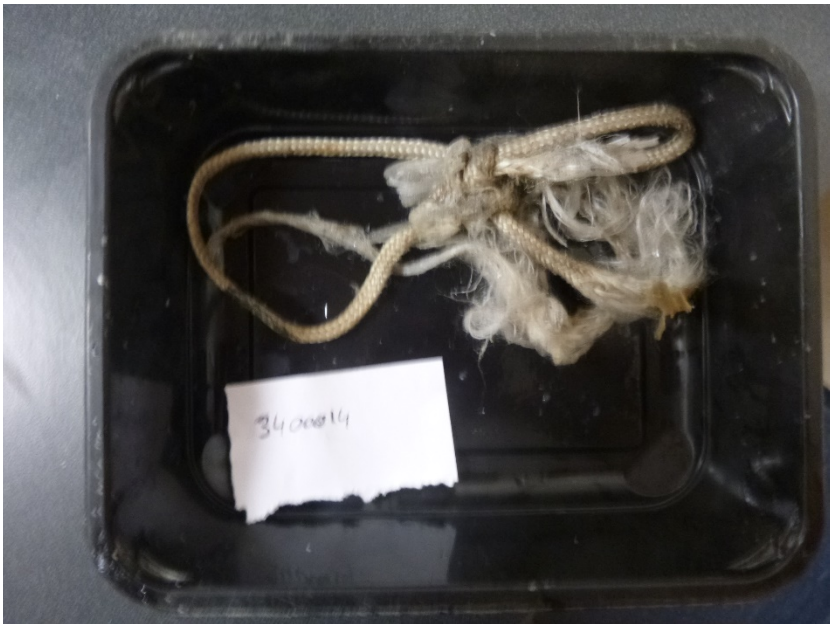
Haul 3400007: monofilament x1 (A5). Note that the wrong haul number is written on the picture.

Haul 3400008: (blue and white) sheet x2 (A2), monofilament x2 (A5), blue synthetic rope x2 (A7) and red pull-ring x1 (A14)


Haul 3400009: synthetic rope (e.g. shoe, fishing) x3 (A7)

Haul 3400010: transparent sheet x1 (A2), synthetic rope x3 (A7) and cigarette filter (F3)

Haul 34000011: black sheet x1 (A2)

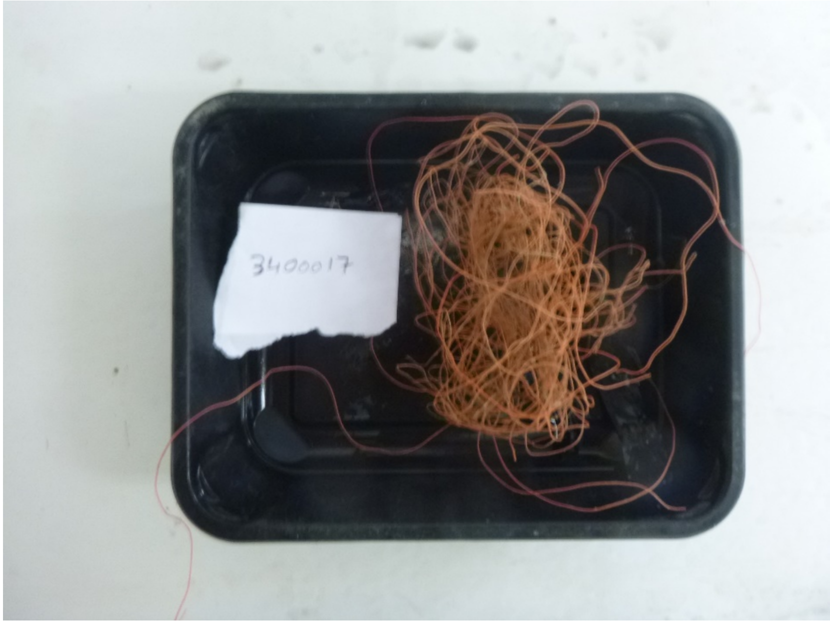

Haul 3400012: white synthetic (nylon) rope x1 (A7)
Haul 3400013: no litter

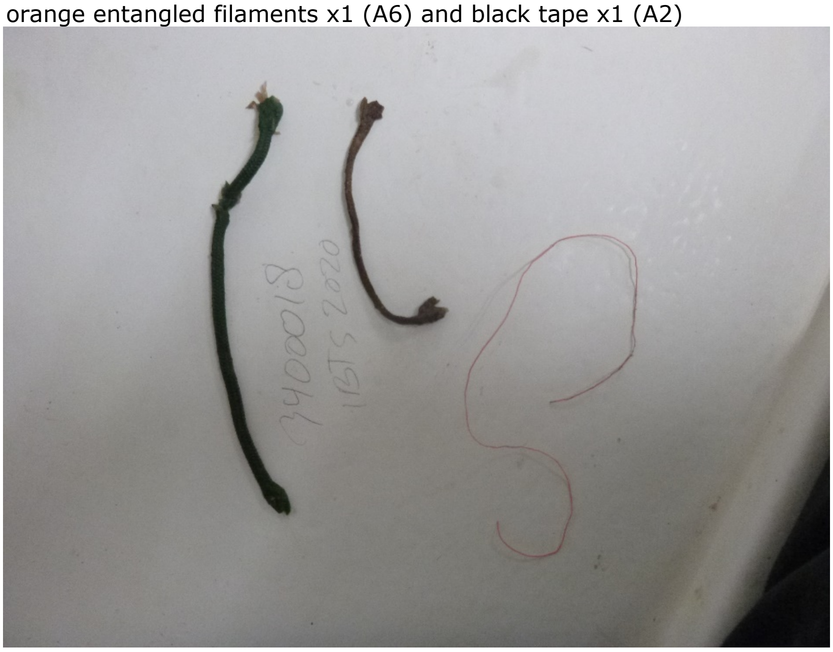


Haul 3400014: white synthetic rope x1 (A7)

Haul 3400015: sheet (e.g. lolly wrapping) x3 (A2), bag x1 (A3), white synthetic rope x1 (A7) and processed wood x1 (E1).

Haul 3400016: processed wood x1 (E1)

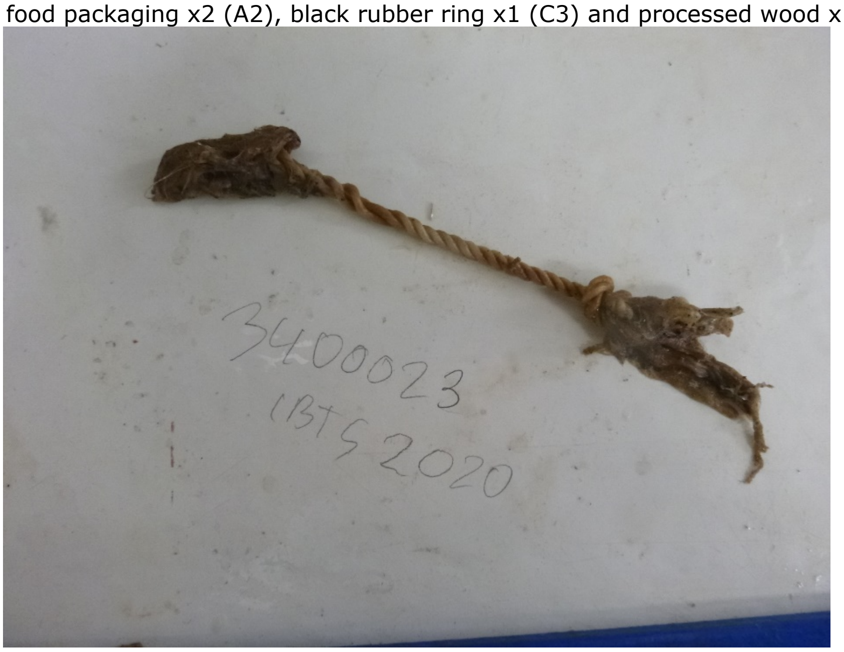


Haul 3400017: orange entangled filaments x1 (A6) and black tape x1 (A2)


Haul 3400018: synthetic rope (brown, green and orange) x3 (A7)
Haul 3400019: no litter


Haul 3400020: white synthetic rope x1 (A7) and polyester board (part) x1 (A14)

Haul 3400021: food packaging x2 (A2), monofilaments x3 (A5), fishing net (part) x1 (A8) and black rubber boot x1 (C1)


Haul 3400022: food packaging x2 (A2), black rubber ring x1 (C3) and processed wood x1 (E1)


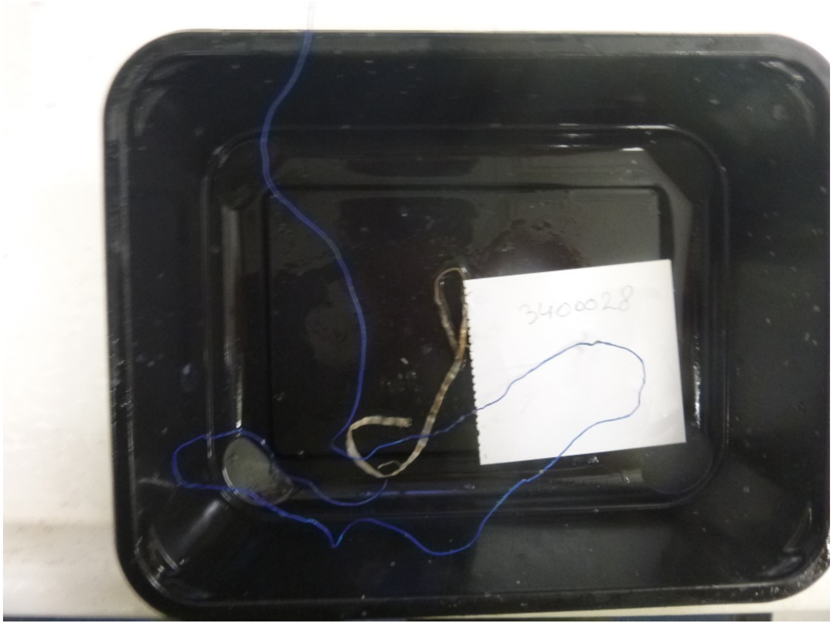
Haul 3400023: white synthetic rope x1 (A7)

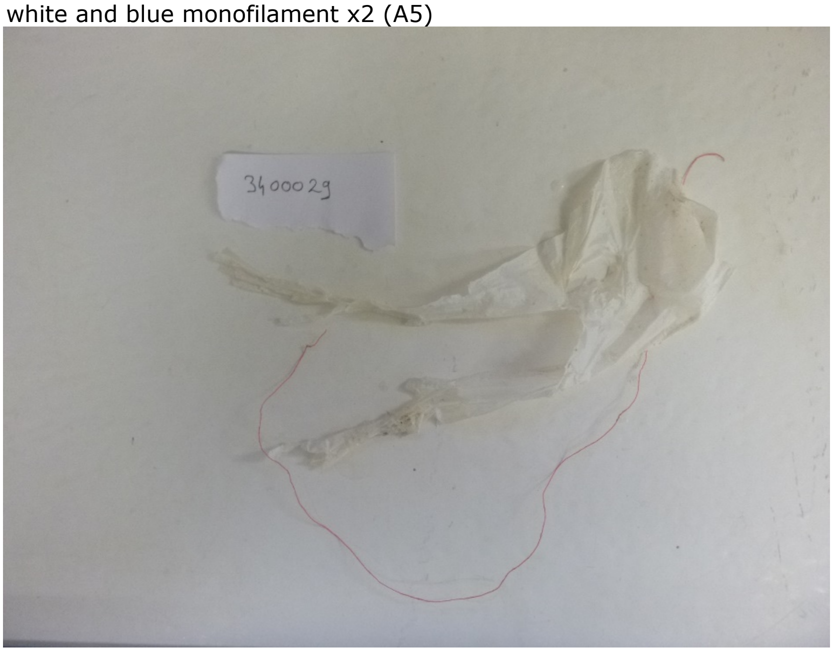
Haul 3400024: no litter

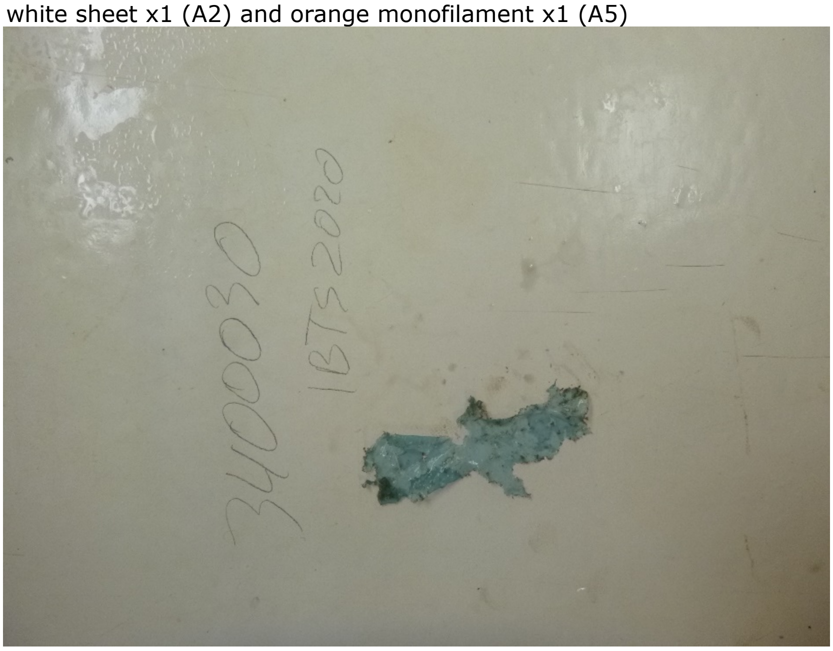
Haul 3400025: black sheet x1 (A2), plastic bag x1 (A3) and brown and green glass bottle x2 (D3). Glass bottle was likely to be as one item on the seafloor and broke into pieces on the transportation belt of the research vessel (Tridens).

Haul 3400026: bag (e.g. onion bag) x2 (A3), monofilaments x2 (A5), white synthetic rope x3 (A7) and white plastic x1 (A14)

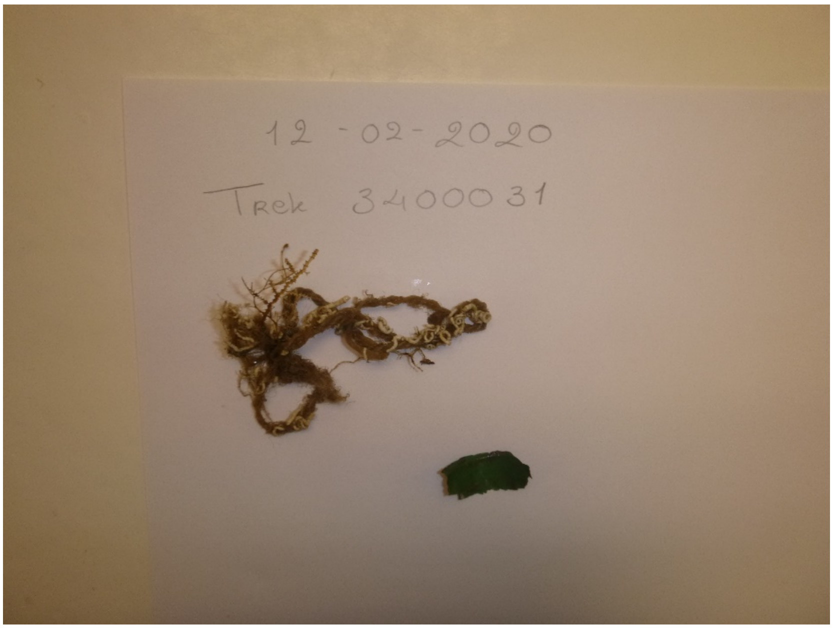
Haul 3400027: no litter

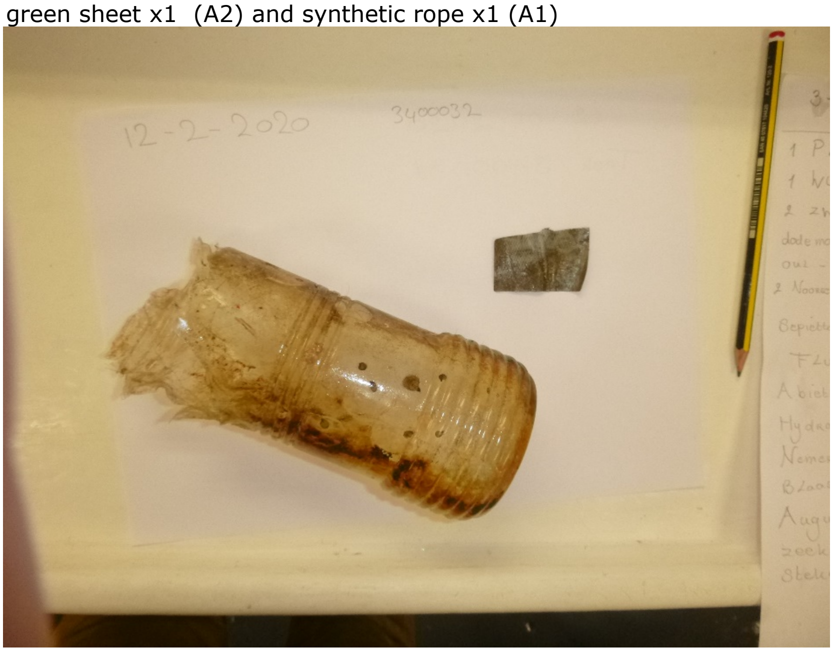


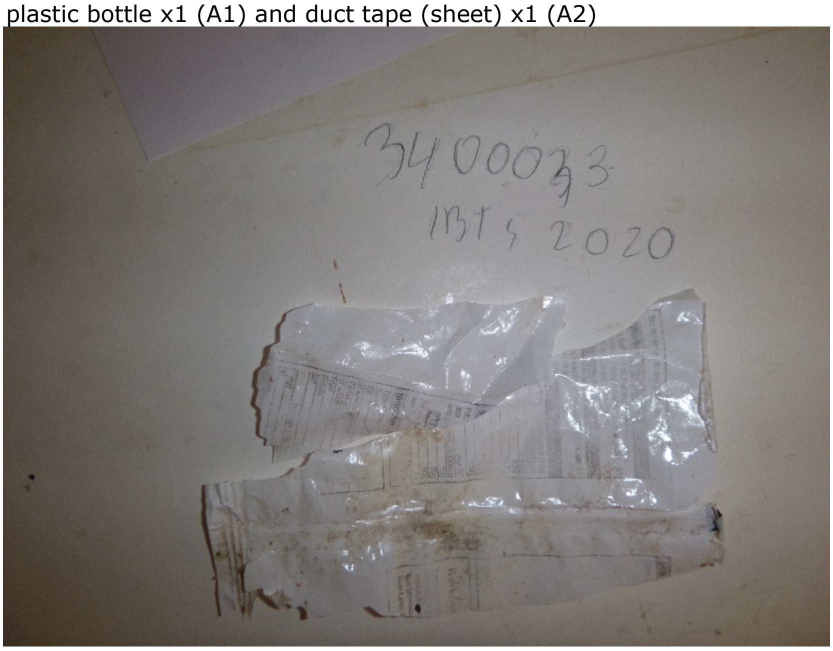
Haul 3400028: white and blue monofilament x2 (A5)


Haul 3400029: white sheet x1 (A2) and orange monofilament x1 (A5)


Haul 3400030: blue transparent sheet x1 (A2)



Haul 3400031: green sheet x1 (A2) and synthetic rope x1 (A1)


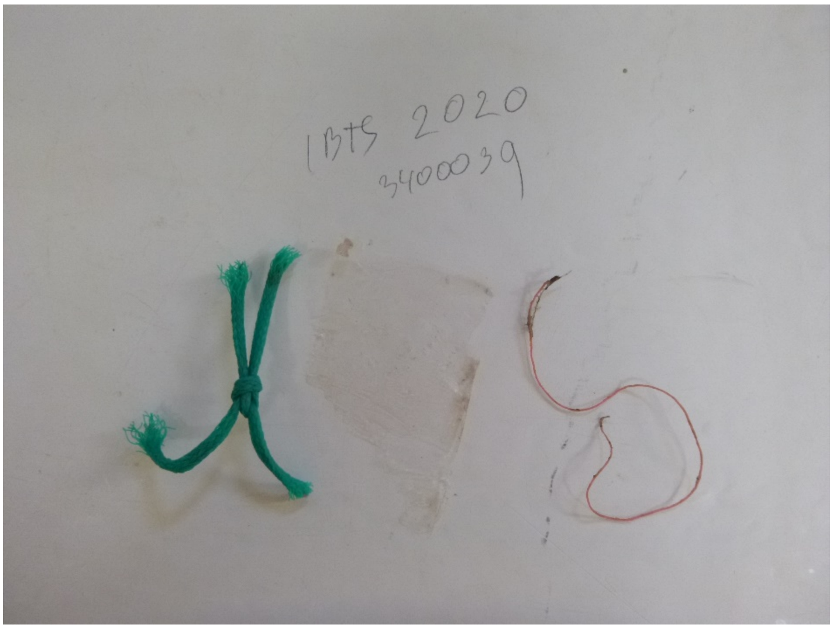
Haul 3400032: plastic bottle x1 (A1) and duct tape (sheet) x1 (A2)


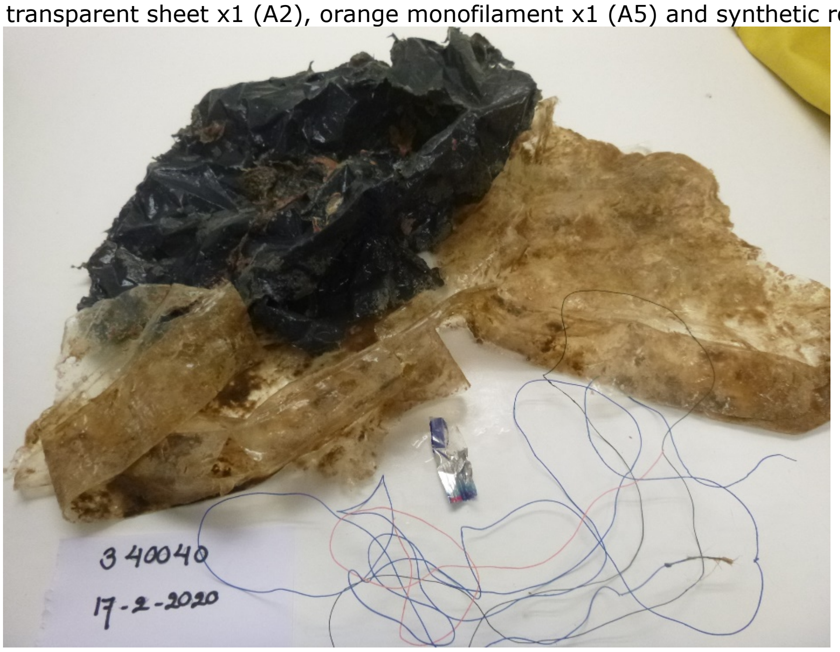
Haul 3400033: white packaging sheet x1 (A2)
Haul 3400034: no litter

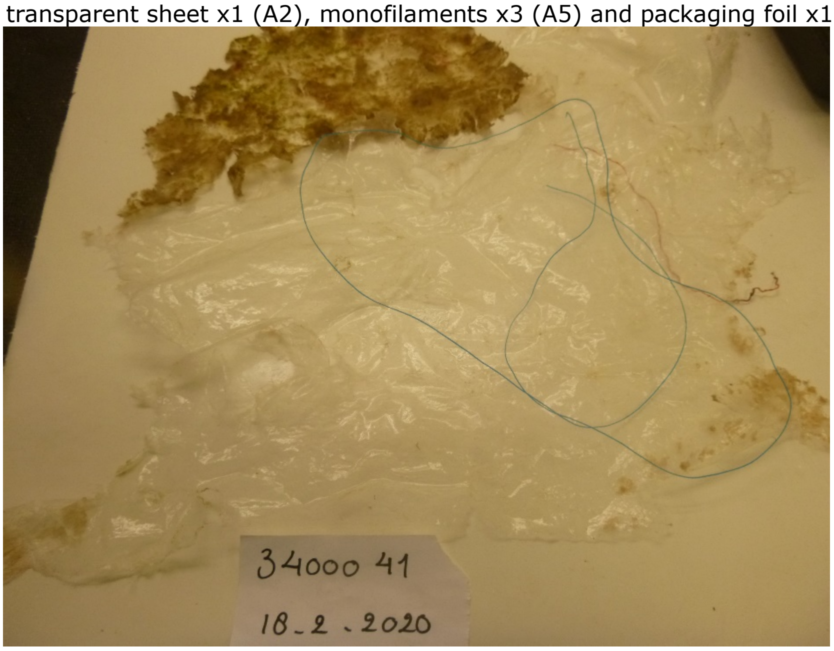
Haul 3400035: no litter
Haul 3400036: no litter

Haul 3400037: white and transparent sheets x3 (A2) and synthetic rope x3 (A7)

Haul 3400038: orange entangled filament x1 (A6), synthetic rope x1 (A7), plastic cup (part) x1 (A14) and entangled paper (fabricated) x1 (F3)



Haul 3400039: transparent sheet x1 (A2), orange monofilament x1 (A5) and synthetic rope x1 (A7)


Haul 3400040: transparent sheet x1 (A2), monofilaments x3 (A5) and packaging foil x1 (A14)


Haul 3400041: sheets x2 (A2) and monofilaments x2 (A5)

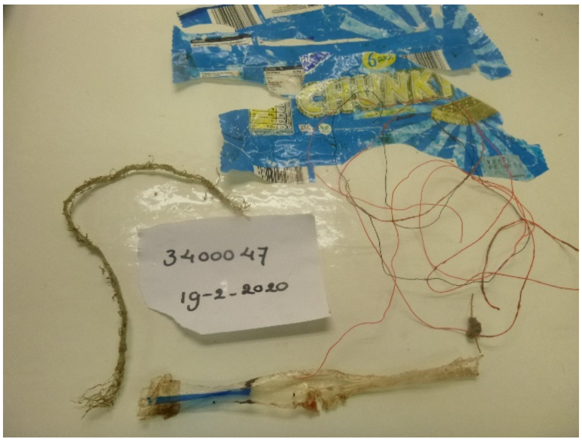
Haul 3400042: No picture available. Blue and white sheet x2 (A2), entangled filaments x2 (A5) and synthetic rope x2 (A7)

Haul 3400043: transparent and blue sheet x2 (A2), entangled filaments x1 (A6), synthetic rope x3 (A7) and black rubber ring x1 (C3)

Haul 3400044: No picture available. Orange entangled filament (A6)

Haul 3400045: monofilaments x14 (A5), transparent and white sheet x2 (A2), synthetic rope x2 (A7) and fishing net (black) x1 (A8)

Haul 3400046: transparent sheets x2 (A2), monofilaments x2 (A5), led balloon x1 (C3) and natural product x1 (E5)



Haul 3400047: sheets (e.g. candy wrapping) x4 (A2), monofilaments x4 (A5) and synthetic rope x1 (A7)

Haul 3400048: sheets x3 (A2) and monofilament x1 (A5)

Annex 3 Comparison with Beam Trawl catches

In the discussion of the report, issues are raised concerning the catchability of litter by the GOV used during the IBTS. The chance of catching litter items present on the seafloor is expected to be low, even to be random (the assumption is that <5% of the items is caught). This is a notable issue to consider when interpreting the amounts of litter caught by, and reported for the IBTS, as these are clearly a large underestimation of the actual amounts present on the seafloor. If the assumption that litter is caught randomly is indeed true, the IBTS can only be used as an indication of the presence of litter items, not as an indicator for absence, nor as an indicator for the amount of litter present.
A gear with both better bottom contact and higher catches of seafloor litter than the GOV is the beam trawl (Van der Sluis & van Hal, 2014). However, the beam trawl also has catchability issues and as such there is an issue with the underestimation of the actual amounts of litter as well. A beam trawl of 8 m with a 40 mm codend mesh size is used during the Dutch Beam Trawl Survey (DBTS), a statutory survey in the North Sea that takes place in the third quarter of every year. During the DBTS, litter items are recorded following a similar methodology to that of the IBTS in the first quarter. Thus methodologically, the amounts could be compared. However, seasonal influences, spatial extent and habitat differences (the beam trawl can be used in other habitats than the GOV) hamper the straightforward comparison of the seafloor litter quantities in both surveys. **Table 1** presents the main differences between the IBTS and DBTS. Despite the aforementioned issues, the beam trawl catches of the 2016 survey are presented as an initial comparison to the catches from the GOV.

Annex 3 table 1. *Main differences between IBTS and DBTS*

	IBTS	**DBTS**
Location	North Sea	North Sea
Time of year	Q1	Q3
Duration of survey	5 weeks	4 weeks
Gear	Grande Ouverture Verticale	Beam Trawl
Gear info	“Semi pelagic” bottom trawl	Beam Trawl
Net width	Variable 15-20m	8m
Codend mesh size	10mm	40mm

The most noticeable difference is the composition of the litter caught by the two gears. Plastic accounts for 83-88% of the seafloor litter caught by the GOV, compared to only 54% of the litter caught during the 2016 DBTS (**Figure 1**). A much larger proportion of the litter in the DBTS is classified as Miscellaneous compared to the IBTS. This indicates that litter types are distributed differently on or in the seafloor. The beam trawl scrapes the top layer of the seafloor and catches items actually buried in this top layer, while the GOV touches the bottom and solely catches the items on top off or floating slightly above the seafloor.
The difference in the amount of litter caught is the other noticeable difference, this is probably mostly due to the type of gear, although the above-mentioned effects should not be neglected. Comparing the absolute values per haul is not particularly relevant as the amount of seafloor covered is higher in the IBTS than in the DBTS. Therefore, only the number of items per km^2 is of interest. Here, the larger catches of the DBTS become clear, with average catches of 296.3 items per km^2 compared to 106.9 items per km^2 in the IBTS (**Table 3**). Thus, the average catch of the DBTS is nearly as high as the maximum catch of the IBTS in 2016.
The presence-absence of litter items indicates that the DBTS has a higher chance of catching a litter item (or fishes in areas with more litter presence). In 2016, only one of the 73 DBTS hauls contained no litter, compared to 2 out of 51 hauls of the IBTS in 2016. As a haul of the IBTS covers more seafloor, this difference is even larger in reality.
The motivation for comparison of these two gears is to derive a conversion factor that can be used to use the amount of litter in the IBTS to estimate the total amount of litter in the North Sea. A conversion factor could also enable the amalgamation of datasets of these two gears in a single

analysis, thus increasing the number of data points and strengthening the analysis. **Table 2** presents the advantages and disadvantages of such a conversion factor.

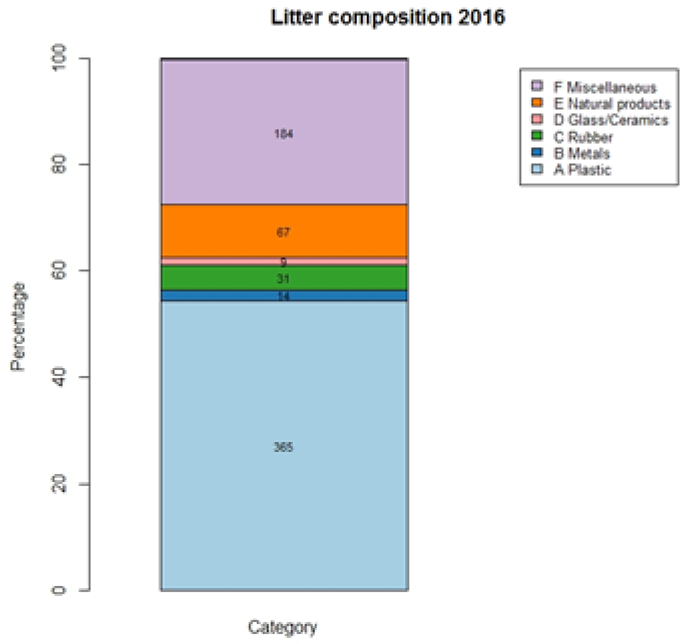
Annex 3 table 2. *A summary of the advantages and disadvantages of a conversion factor*

Advantages	Challenges
- Raising the amounts of litter in the IBTS brings the values closer to actual amounts present on the sea floor. - The higher litter recovery could give more robust results in a statistical analysis. However, the swept area of each haul of the beam trawl is smaller, which could give a larger variation of the results. - A more realistic estimate of litter amounts help to raise awareness. - The expansion of the dataset by combining information of the two surveys could improve statistical power in statistical analysis.	- The calculation of a conversion factor is hampered because the gears are used in different seasons, spatial areas and habitats - A single conversion factor cannot be calculated because the catchability for the various litter types varies for the two gears (larger proportion of plastic in the IBTS) and probably even for items in the same subcategory - Raising the amount of litter in the IBTS will not lead to reliable estimates of the amounts of litter in the North Sea as the DBTS has its own catchability issues - Raising the amounts of litter in the IBTS will not correct for the empty hauls of the IBTS. The presence-absence data of the DBTS indicate that the empty hauls in the IBTS are unlikely to represent areas without litter - Raising the IBTS data will not affect the trend analyses based on these data only (except that the empty hauls will have a different influence as these cannot be corrected for)

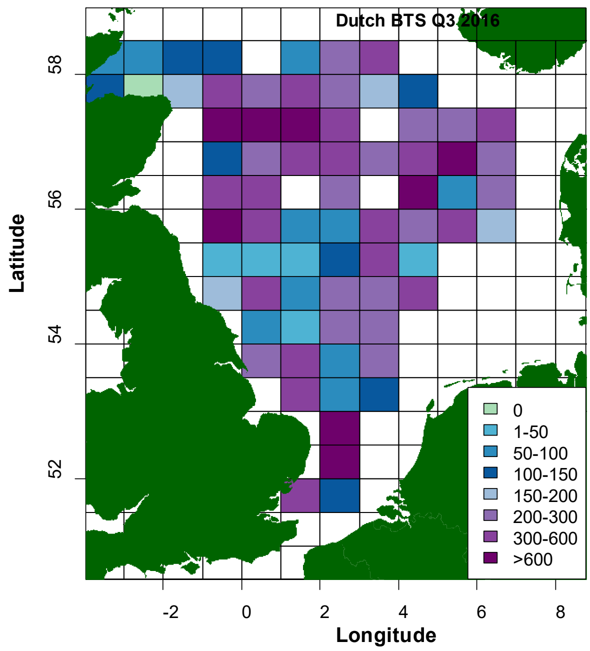
Due to the challenges, we do not advocate for the use of a conversion factor. However, there are statistical techniques that could be used to combine the different datasets in a single analysis. WGML (ICES 2018) has been considering these techniques, but these require absence of collinear factors. Collinearity is a problem for the two Dutch datasets, as different areas, habitats and seasons all vary collinearly with the difference in gears. WGML has reviewed the international data and has concluded that there is overlap between the International IBTS Q3 and the DBTS at least with respect to area and season, although habitats might still differ. WGML hasn't carried out combined analyses as of yet, as there were still a large number of data issues to be solved. This type of combined analysis is one of the terms of reference for WGML for the years to come.

Annex 3 table 3. Summary data of the Dutch 2016 BTS (beam trawl) litter catches in comparison of the Dutch 2016 IBTS (GOV) litter catches. *Each parameter is presented with its minimum, maximum, mean, median and median absolute deviation values*

2016	min	max	mean	median
Beam trawl items per haul	0	36	9.1	7
GOV items per trawl	0	21	7.0	6
Beam trawl items per km^2	0	1286.8	296.3	247.2
GOV items per km^2	0	298.1	106.9	99.4



Annex 3 figure 1. Composition of the seafloor litter in the catches of the Dutch BTS Q3 2016. *Values in the graph represent the absolute number of items for the categories containing more than 1% of the total items counted. Plastic represents the largest category with 365 items (54.4 %) of the 670 litter items caught.*



Annex 3 figure 2. Density of litter items per km² for the DBTS Q3 2016*. The highest density in 2016 (1286 items per km²) was observed east of the Scottish coast (Aberdeen), situated in the middle of the three purple rectangles. The only rectangle in which no litter was caught was located in the Moray Firth. For rectangles in which two hauls were carried out, the average of the density of litter items per haul per km² was used. The white rectangles were not sampled by the Dutch survey.*

Annex 4 Litter data in DATRAS

The ICES Database of Trawl Surveys (DATRAS) is the international database in which the results of the North Sea IBTS, but also a large number of other surveys in the North Sea and other ICES regions are stored and made publicly available. The data of the fish surveys is made publicly available as raw data (Exchange format) and in a large variety of data-products depending on the survey (for example indices, Age-Length-keys, CPUE by length or by age, etc.)

Since a couple of years DATRAS also contains the international litter data of the trawl surveys and makes these publicly available. The Dutch data is provided to DATRAS every year after the survey, with a deadline of providing the data prior to WGML.

DATRAS makes the litter data available as raw data and as a data-product, being the latest OSPAR litter assessment output.

DATRAS can be accessed via: datras.ices.dk
On the right side of the page you can select the download page and the DATRAS documents page. The last contains all the relevant documents with, amongst others, the survey manuals and the Litter format. Via the download page all the data and data products can be downloaded.

- First select the preferred data product, in case of litter the options are:
    - Litter Exchange data (raw data)
    - Litter Assessment output (the OSPAR product).
- Then select the preferred survey, relevant for the North Sea:
    - NS-IBTS
    - BTS (beam trawl survey)
- Select the preferred quarter and year (or all)
- Submit
- Accept the download policies
- A zip-file is downloaded, including a disclaimer, a pdf met metadata and references to the headers, and a csv-file with the data.
- The first column of this file is the RecordType: HH (haul information) and LT (litter data). Based upon year, country and StNo the HH and LT can be combined to get all the haul information added to the litter information.

Issues with these downloads should be communicated directly to the ICES data centre. Advice on improvements to the data products should be communicated to the IBTSWG-chair(s) and the ICES data centre.

Wageningen Marine Research
T +31 (0)317 48 09 00
E: marine-research@wur.nl
www.wur.eu/marine-research

Visitors' address
- Ankerpark 27 1781 AG Den Helder
- Korringaweg 7, 4401 NT Yerseke
- Haringkade 1, 1976 CP IJmuiden

With knowledge, independent scientific research and advice, **Wageningen Marine Research** substantially contributes to more sustainable and more careful management, use and protection of natural riches in marine, coastal and freshwater areas.