Monitoring of Seafloor Litter on the Dutch Continental Shelf

International Bottom Trawl Survey 2023,
Dutch Beam Trawl Survey 2022

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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 status 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. The Dutch monitoring program for Marine Litter (Descriptor 10) includes the collection of data on the abundance, composition 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 Grand Ouverture Verticale (GOV) fishing net as part of the International Bottom Trawl Survey (IBTS), which is carried out yearly in the North Sea.

Anthropogenic pollution of the oceans, including marine litter, threatens wildlife, hinders human activities and reduces the recreational value of our coasts. Marine litter affects all groups of marine wildlife through effects such as entanglement and ingestion. Various initiatives to reduce litter in the (marine) environment are running or are currently under discussion. Despite management measures to decrease the input of litter and to remove litter from the environment, litter is still found in monitoring of the seafloor.

This report presents the seafloor litter composition, abundance and spatial distribution based upon catches of the regular fish surveys, the IBTS and the Dutch Beam Trawl Survey (BTS). Only the catches on the Dutch Continental Shelf (DCS) are used for data analysis. To assess the status of seafloor litter on the DCS, the Dutch data are supplemented with those from international partners surveying the DCS within the IBTS.

The seafloor litter catches on the DCS consisted mainly of plastic items: 90% (IBTS) and 89% (BTS) of the litter items found were made of plastic. Monofilaments, plastic sheets and various types of (plastic) ropes/lines were the most commonly caught litter types. A mean density of 74 litter items per km^2 over the years 2021-2023 was calculated for the IBTS on the DCS, whereby for the BTS a mean density of 185 litter items per km^2 over the last two years (2020-2022) was calculated on the DCS. It should be noted that the nets used during the IBTS (GOV) and BTS (beam trawl) are not designed to catch litter. For the GOV, the catchability of many benthic species (e.g. *Asteroidea*) is assumed to be less than 5% compared to a beam trawl (Piet et al., 2009), therefore the chance of catching a litter item when it is present in the trawl path is likely to be even smaller than 5%. The fact that these items are caught despite the suggested low catchability thus indicates that it is plausible that there are many more litter items in the trawl path and that current values are a large underestimation of the actual amount of litter present. In a recent study from Wageningen University, the beam trawl appears to catch seven times more litter than the GOV net at the North Sea level (Van Rossum & Boer, 2023). This is reflected by the fact that hardly any (small) single-use plastics, such as cutleries, straws and stirrers, were caught while these items are commonly found on beaches (Boonstra & Hougee, 2021). The inclusion of the BTS data in recent years has improved the picture of the litter types present on the seafloor. The BTS catches a wider range of litter types and roughly three times more items per swept area then the IBTS according to the data presented in this report. Yet, the abundance and density estimations of seafloor litter presented in this report have to be considered as a very low estimation of the total amount of a selection of litter types present on the DCS, rather than its actual status. This has been demonstrated in a new Dutch study using a benthic dredge for seafloor litter sampling (Roos et al., 2023), which shows much higher seafloor litter densities.

1 Introduction

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 status 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. The Dutch monitoring program for Marine Litter (Descriptor 10) includes the collection of data on the presence, abundance and distribution of macro litter on the seafloor.

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 threatening wildlife, hindering human activities and reducing the recreational value of our coasts (Fleet et al. 2009; Rangel-Buitrago et al. 2022). 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). Via a complex web of ocean pathways land-based litter from the source country can end up in waters of another country far apart from each other (Chassignet et al. 2021). Shipping, fisheries, aquaculture, offshore installations and illegal dumping all constitute some of the sources of sea-based marine litter (Skirtun et al. 2022; Viega et al. 2016).

Plastics represent the majority of marine litter (Galgani et al. 2015; Rangel-Buitrago et al. 2022). According to Meijer et al. (2021) between 0.8 to 2.7 million metric tonnes of post-consumer plastics enter the oceans solely by rivers every year. This has an impact on all groups of marine wildlife through effects such as ingestion, entanglement and interactions (Valderrama-Herrera et al. 2023; Kühn et al. 2022; Solomando et al. 2022; Freitas et al. 2023). 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 or 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). Additionally, 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; Hasegawa & Nakaoka 2021). 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). At last, marine litter can act as suitable substrate for macrozoobenthic fauna whereby via displacement (wind, currents e.g.) it can introduce and spread some non-indigenous species (De La Torre et al. 2023; Mancini et al. 2021; Mantelatto et al. 2020).

Various initiatives to reduce litter in the environment have been started or are currently under discussion. Nationally, on the first of July 2021 a deposit regulation for small plastic bottles (0.5 L) was put in force by the Dutch government, and since July 3rd 2021 single use plastics like cutleries, plates, straws, stirrers and cotton bud sticks are banned. Most recently, a deposit regulation for metal beverage cans was put in force from the first of April 2023 on. The taxation of single-use plastic carrier bags introduced in 2016 is a good example which led to a significant reduction on an European level of single-use carrier bags in litter. As part of the "European Green Deal" a new vision of the EU legislation on Packaging and Packaging Waste is proposed and has three main objectives: reduce the quantity of packaging, make all packaging on the EU marker recyclable and increase the use of recycled plastics. The awareness of plastic pollution is also globally growing. Recently, the United Nations Environmental Assembly (UNEA) decided during an environmental summit in Nairobi (Kenya) in 2022 that within two years there will be a global binding treaty to reduce plastic pollution. During the summit the UNEA member states unanimously chose the most ambitious options and because of that this upcoming treaty is seen as (one of) the most important "green deal" since the 2015 Paris climate agreement.

The measures described above can help towards achieving GES for Marine Litter that is dictated by the European Marine Strategy Framework Directive (MSFD 2008/56/EC) to its EU member states. Top-down EU policies (e.g. MSFD) are seen as the most influential pieces of legislation (Frantzi et al. 2021). In addition, the MSFD requires 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. The requirements for monitoring are divided in a number of categories: monitoring litter deposited onto the beach (Boonstra & Hougee, 2021), in the water column and biota, and deposited on the seafloor. The beach litter monitoring conducted in the North Sea indicates that a large part of the North Sea litter washes ashore on beaches near the Skagerrak. This is also modelled by Chassignet et al. (2021) whereby a large part of plastic waste of the Netherlands is displaced to Germany, Denmark and Norway by currents. Monitoring of litter washed ashore results in the indicator on "Beach litter" (OSPAR commission 2010; Schulz et al. 2017; Schulz et al. 2019) while the monitoring in biota results in the indicator on "Plastic particles in fulmar stomachs" (Van Franeker et al. 2021; Kühn et al. 2022). In addition to these two indicators, there is a "Seabed litter" indicator describing 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 deposited on the seafloor, marine litter degradation leads to the formation of microplastics. These microplastics degrade very slowly, since degradation occurs primarily through temperature-dependent solar UV-radiation, and therefore accumulate on the seafloor (Andrady 2015).

This report describes the methods used and presents and discusses the data collected in 2022-2023 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 to get recruitment indices of the fish community, focussing on cod, haddock, Norway pout, saithe, whiting, mackerel, herring and sprat. Despite the fact that the sampling gear is not optimal for sampling litter, the IBTS provides a good platform for internationally collected litter data. Data collection on board follows the CEMP Guidelines of Litter on the Seafloor (OSPAR, n.d.) and the most recent Working Group on Marine Litter (WGML) guidelines which are included in the IBTS survey manual (ICES 2022). All international partners of the IBTS should follow these guidelines for seafloor litter collection, enabling the combination of the Dutch seafloor litter data from fishing hauls with those from the other partners on the Dutch continental Shelf (DCS). To get a better insight in the composition and amount of marine litter on the DCS, data collection of the Dutch Beam Trawl Survey (BTS) is following the same guidelines (protocol). This report provides insight in and summarises the seafloor litter composition, abundance and spatial distribution on the DCS.

The current focus on the DCS is a result of the way the MSFD is organised. Each European member state is only responsible for their part of the continental shelf and is obliged to report on their own part. Although excluded from this report, Dutch litter data collected by Wageningen Marine Research (WMR) in 2023 but outside the DCS are reported to the ICES DATRAS database, and are used for the OSPAR North Sea wide seafloor litter assessments.

Aims

Since 2013, IBTS data on seafloor litter have been collected by WMR, provided to RWS and stored in the ICES DATRAS database. Including the data collected in 2023, data for a total time span of ten years is available. RWS requested WMR to report on the current status of seafloor litter on the DCS, including litter data of international IBTS partners on the DCS and the Dutch BTS data. The core of this report presents the seafloor litter data collected on the DCS of the IBTS in quarter 1 (Q1) of 2023. Additionally, the data collected during the latest BTS in quarter 3 (Q3) of 2022 are reported. The objectives of this report are to:

- Provide insight into the composition and abundance of seafloor litter on the Dutch continental shelf.
- Assess the spatial distribution of seafloor litter on the Dutch continental shelf.
- Compare the results of the IBTS and the BTS to provide a more detailed insight of the state of seafloor litter on the Dutch continental shelf.

2 Methods

2.1 International Bottom Trawl Survey

2.1.1 Dutch IBTS Q1

The International Bottom Trawl Survey quarter 1 (IBTS Q1) is carried out annually in January and February, and is performed by France, Scotland, Germany, Sweden, Norway, Denmark and the Netherlands whereby all participating members follow the same guidelines (ICES, 2022). The survey design divides the North Sea 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 results in the majority of rectangles being sampled once by two different countries. The planned area for 2023 (**Figure 2.1**) remained nearly unchanged since the 2019 survey (van Hal, 2019). The only difference compared to the 2022 planning is that rectangle 32F2 is now included in the French planning, instead rectangle 37F7 has to be sampled twice by the Netherlands.

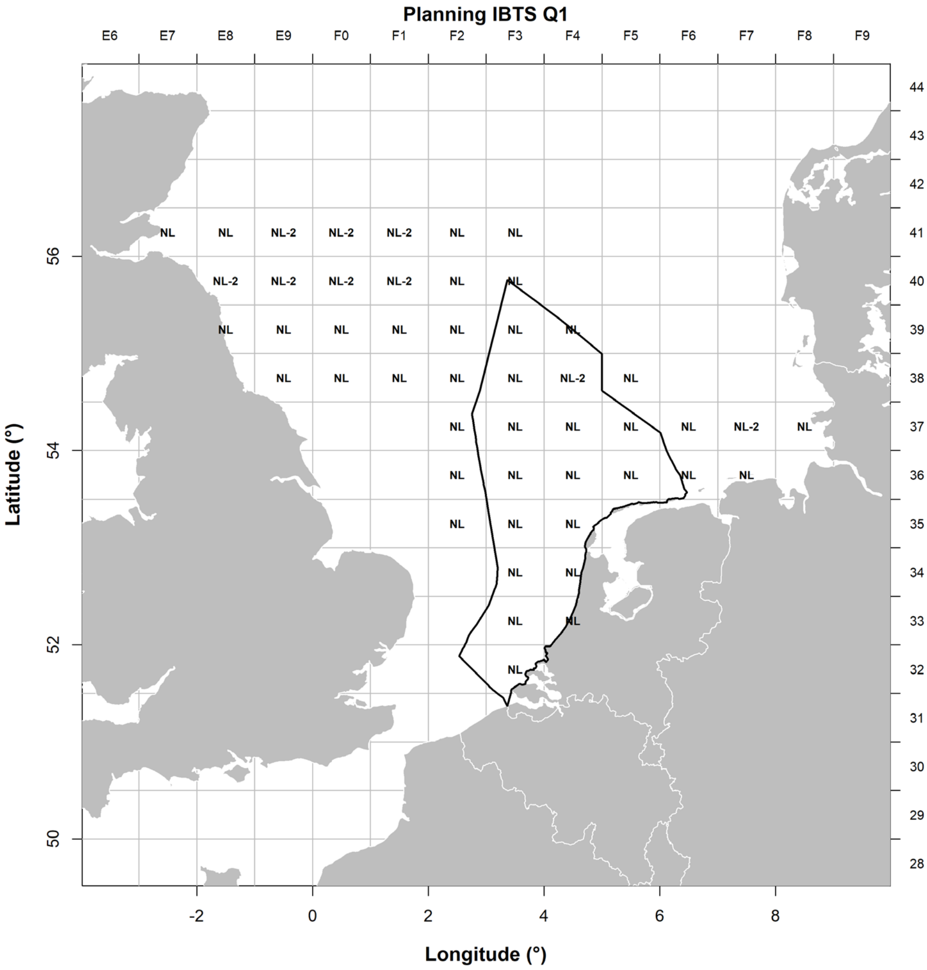

Figure 2.1. Planned ICES rectangles for the Dutch GOV hauls during the 2023 IBTS Q1. Rectangles marked with "NL" are those that should be covered once by the Netherlands and once by another participating country. Rectangles marked "NL-2" are those that should be covered twice by the Netherlands. Empty rectangles are covered by other participating countries. Thick black line indicate the outline of the DCS.

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 cod-end. 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 flatfish, other small bottom dwelling species and epibenthos are caught by the GOV in a rather 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 present on the seafloor (ICES 2003; Piet et al. 2009). This is also likely to apply to the majority of other types of seafloor litter.

Table 2.1. Classification of marine litter items (ICES, 2022). The table presents six categories of litter (A-F) and their respective subcategory (red), as well as size categories (A-F) used in the categorisation of seafloor litter items caught during the IBTS (green).

Litter overview			
A: Plastic	**B: Metals**	**C: Rubber**	**Related size category**
A1. Bottle	B1. Cans (food)	C1. Boots	A: < 5*5 cm = 25 cm^2
A2. Sheet	B2. Cans (beverage)	C2. Balloons	B: < 10*10 cm = 100 cm^2
A3. Bag	B3. Fishing related	C3. Bobbins (fishing)	C: < 20*20 cm = 400 cm^2
A4. Caps & Lids	B4. Drums	C4. Tyre	D: < 50*50 cm = 2500 cm^2
A5. Monofilament	B5. Appliances	C5. Glove	E: < 100*100 cm = 1 m^2
A6. Entangled filaments	B6. Car parts	C6. Other	F: > 100*100 cm = 1 m^2
A7. Synthetic rope	B7. Cables		
A8. Fishing net	B8. Other		
A9. Cable ties			
A10. Strapping band			
A11. Crates and containers	**D: Glass/Ceramics**	**E: Natural products**	**F: Miscellaneous**
A12. Diapers	D1. Jar	E1. Wood (processed)	F1. Clothing and rags
A13. Sanitary towel/tampon	D2. Bottle	E2. Rope	F2. Shoes
A14. Other	D3. Piece	E3. Paper and cardboard	F3. Other
A15. Medical masks	D4. Other	E4. Pallets	
A16. Other fishing related plastic		E5. Other	

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 (wing spread) varies with depth as well (van Hal, 2023; for more information about the net geometry). The wing spread is considered most 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 approximately 4 knots (7.4 km/h). Trawling is only carried out during daylight hours.

The Netherlands uses the research vessel Tridens II (Tridens) 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 for the IBTS.

2.1.2 Sampling Litter

The IBTS manual for sampling seafloor litter data collection states that litter has to be collected in every haul (ICES 2022). On the Tridens the complete net is hoisted on board however a (part) of the ground rope is left hanging over the side and thus cannot be checked for the presence of litter. The net is inspected and cleaned as much as possible after each haul by an assigned person. Since the ground rope is hanging over the side of the vessel, it is only inspected and cleaned once on board in case of maintenance or reparations. Litter items in the net and in the catch are collected after each haul. Each litter item is then classified (**Table 2.1**), weighed, its size is estimated, photographed (can be used to check the data in case of odd recordings), 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. When organisms are attached to litter items, the different kind of species are recorded as well. Moreover, a more detailed description of the litter items is given for each haul. The latter in combination with the photos taken facilitate a post-survey quality check of the data.

2.1.3 Area Surveyed

Seafloor litter is presented as number of items per km^2. To be able to calculate items per km^2, knowledge on the surveyed area (total swept area) is required. The swept area of the GOV is variable, and depends on the depth and the amount of fishing line used. For fish calculations, 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 together 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. Therefore, wingspread needs to be calculated based on this data. In some cases door spread is not recorded properly, and in these cases depth and line length are used to estimate door spread instead. The formulas are based on (1) recorded door spread during the Dutch IBTS on the research vessel Tridens in previous years, and (2) the information gathered during the two years the Dutch IBTS was executed using the CEFAS Endeavour using the English wingspread sensors.

The equation for door spread in case door spread is not recorded properly is fitted to data recordings as follows:

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

Where Depth is the 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 equation:

(2) Wingspread = Door spread * 0.18870 + 5.87280

To calculate the number of litter items per km^2, the number of items per haul needs to be divided by the swept area as follows:

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

The above described data processing was done for the most recent (2023) Dutch litter data to obtain the number of litter items per km^2. Litter data from other IBTS partners from 2013 onwards were processed in the same way. However, the fitted constants in their formulas might slightly differ from the above mentioned values (ICES, n.d.).

2.1.4 Data Analysis

The data analysis is done in two parts: (1) the Dutch IBTS 2023 Q1, and (2) the status of seafloor litter on the DCS (international data). The litter data of the Dutch IBTS 2023 Q1 is shown as the spatial distribution of litter items per km^2. To focus on the Dutch continental shelf, further analyses were done with DCS data, including the data of the international IBTS partners on the DCS. Litter data of the international IBTS partners performed on the DCS was downloaded from ICES DATRAS database from 2013 onwards (Annex 1). However, not all available data could be used for the litter DCS data analysis due to inconsistencies in the counting of items. For some years, only the presence of seafloor litter and litter items was recorded. While the Netherlands started to count litter items from 2013 onwards (except A5 "Monofilaments", from 2014 onwards), most countries started to count single litter items a couple of years later. For example, France only started to count A2 "Sheets" in 2015 and Germany in 2018. An overview of the seafloor litter data used for this analysis is shown in **Table 2.2** and the quality control for the available data on the DCS can be found in Annex 2.

Table 2.2. International seafloor litter data on the DCS. The table shows the seafloor litter data (number of hauls) per country per year on the DCS of which count data is available.

Country	Institute	2015	2016	2017	2018	2019	2020	2021	2022	2023
Denmark*	DTU-AQUA							3	4	4
France	IFREMER	19	19	13	17	17	13	14	12	12
Germany**	vTI					3				
The Netherlands	WMR	12	12	19	18	17	17	16	19	19

**Denmark only started to count marine seafloor litter in 2021.*

***Germany only executed three hauls on the DCS in 2019 as they swapped area with Denmark that year.*

To average out year-to-year variances, the DCS litter data of the three most recent years (2021-2023) are presented as figures showing the composition of the seafloor litter by categories A-F and the Top-10 most commonly caught litter types. To calculate the percentage per litter category or litter type, mean values per km^2 were taken based on all individual hauls executed on the DCS for the period 2021 – 2023. Spatial distribution of number of litter items per km^2 per ICES rectangle was shown by taking the mean value of total litter count per ICES rectangle. Densities per ICES rectangle were only based on hauls executed on the DCS, even if an ICES rectangle partly overlapped the DCS. To define hauls that were executed on the DCS, the outline of the DCS as shown in **Figure 2.1** was used.

2.2 Beam Trawl Survey

In addition to the IBTS data, the BTS (Q3) is included in the marine seafloor litter report to expand the dataset and to get better insights in the amount of marine litter on the DCS. The BTS is carried out annually from July until September. The survey design is similar to the IBTS, except that this survey is only performed by the Dutch and that not all ICES rectangles need to be sampled twice a year (**Figure 2.2**). Instead, in the south-eastern North Sea and in the German Bight a minimum of two and a maximum of four hauls has to be performed per rectangle. The research vessel Tridens is also used for the BTS each year, where a beam trawl of 8 m with a 40 mm cod-end mesh size is used. This gear has better bottom contact and is therefore assumed to have higher catches of seafloor litter than the GOV used in the IBTS (Van der Sluis & van Hal 2014). Despite the better bottom contact of the beam trawl there might be on the other hand a higher escapement of small litter items since the cod-end mesh size of the beam trawl is larger compared to the GOV (12 mm). Like for the GOV, only a selection of the types of litter items present retain in the net. Litter items are recorded following the same methodology to that of the IBTS. Seafloor litter caught with the beam trawl is also presented as number of items per km^2, the net width of the beam trawl is fixed and the surveyed area is therefore calculated by making use of the following equation:

(1) Number of litter items per km^2 = Litter items / (Beam trawl width (km) * Distance trawled (km))

Data analysis for the DCS is performed in a similar way as described for the IBTS (section 2.1.4), except that it is exclusively based on Dutch hauls since it is only performed by the Dutch. In addition, only the data of 2020-2022 was used since the recording of marine litter during the BTS started to be done consistently in 2020.

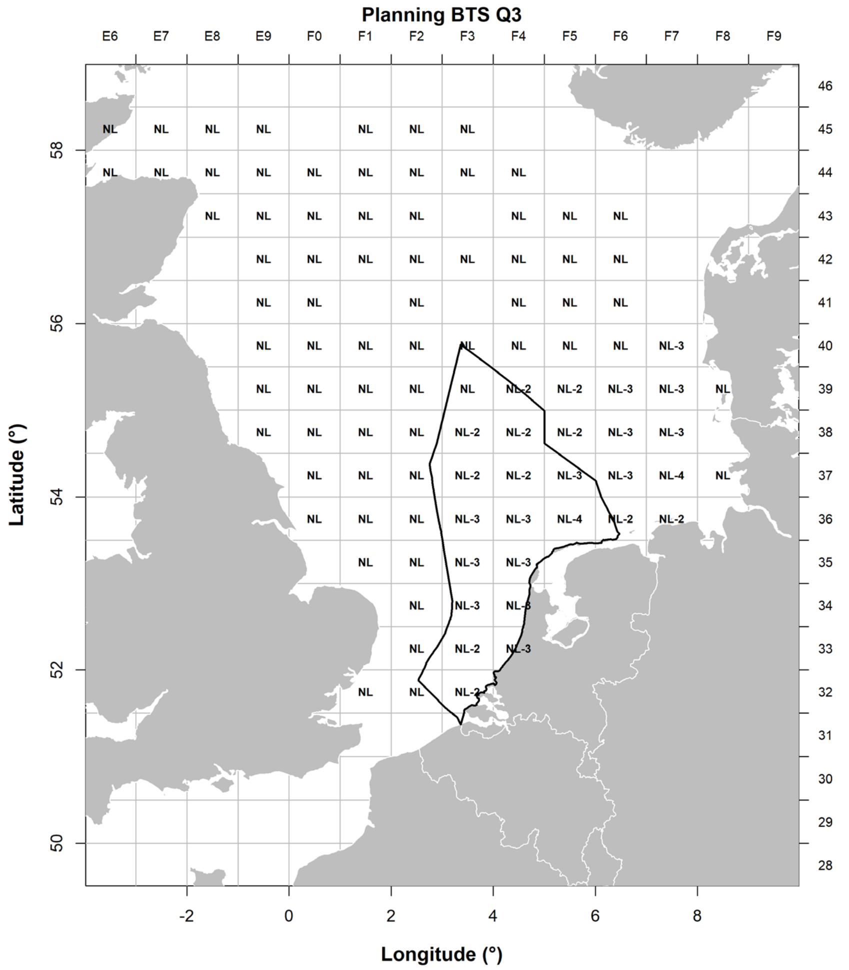

Figure 2.2. Planned ICES rectangles for the Dutch bottom trawl hauls during the 2022 BTS Q3. Rectangles marked "NL" are those that should be covered once, rectangles marked "NL-2" should be covered twice, etc. Empty rectangles are those that are not covered at all. The thick black line indicates the outline of the DCS.

3 Results

3.1 International Bottom Trawl Survey

3.1.1 Dutch IBTS Q1 2023

The Dutch IBTS 2023 Q1 performed 57 valid hauls, of which 19 were conducted on the Dutch continental shelf. Almost all hauls lasted the standard 30 minutes. The planned survey area for 2023 remained nearly unchanged from the surveyed area of previous years. All hauls were executed as planned due to good weather conditions considering the time of year during the survey. All the available GOV-data are presented in the file: RWS_dataformat_GOV_data_NCP_2013_2023.xls (on request).

The spatial distribution of litter caught during the Dutch IBTS 2023 is presented in **Figure 3.1**. The small crosses represents hauls without litter items in the catch, empty hauls. There were four empty hauls (0 items/km^2) located on the DCS, nine in British waters (central part) and one in German waters. The haul with the highest amount of items per km^2 was located in the German Bight close to the coast of Germany (37F8), with 206 litter items per km^2.

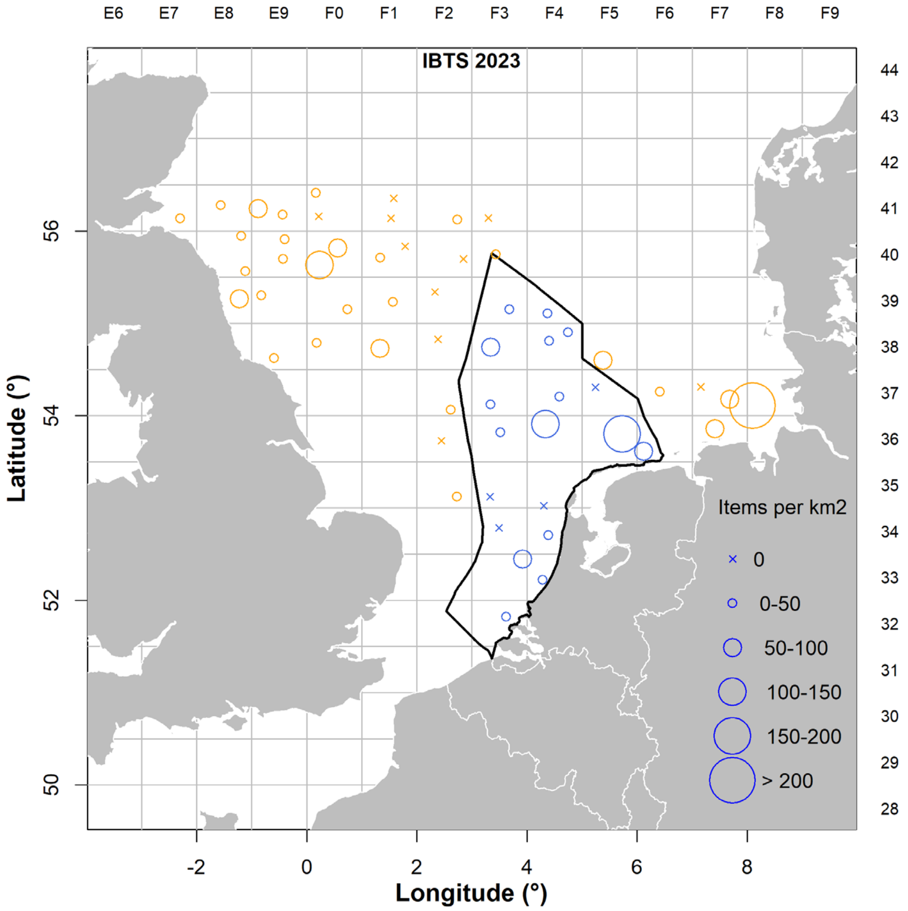

Figure 3.1. Executed Dutch GOV hauls and total counts per km^2 during the 2023 IBTS. GOV-hauls executed on the DCS (blue) and GOV-hauls executed by the Netherlands (WMR) outside the DCS (orange) The size of the circles indicates the number of items caught per km^2. The small crosses represents hauls without litter items in the catch, empty hauls.

3.1.2 Seafloor litter on the Dutch Continental Shelf

The analyses in this section is performed using all available and usable seafloor litter data for the Dutch continental shelf for the three most recent years, 2021-2023. A total of 103 hauls were conducted on the Dutch continental shelf for these three years during the IBTS by Denmark, France and the Netherlands, covering a swept area of 6.1 km^2. The general composition of seafloor litter and the Top-10 litter types were calculated by mean values. Since the dataset contains a large amount of zero values, the median might give a biased (zero) outcome. Therefore, mean values are used.

3.1.2.1 Material composition

Plastic was the most dominant category of seafloor litter on the DCS in the IBTS, accounting for 90% of the caught litter items (**Figure 3.2**). "Natural products" and metals were the second and third most dominant litter categories, responsible for 5% and 3% of all litter items caught, respectively. Rubber, glass and miscellaneous were each representing 1% or less of the litter items.

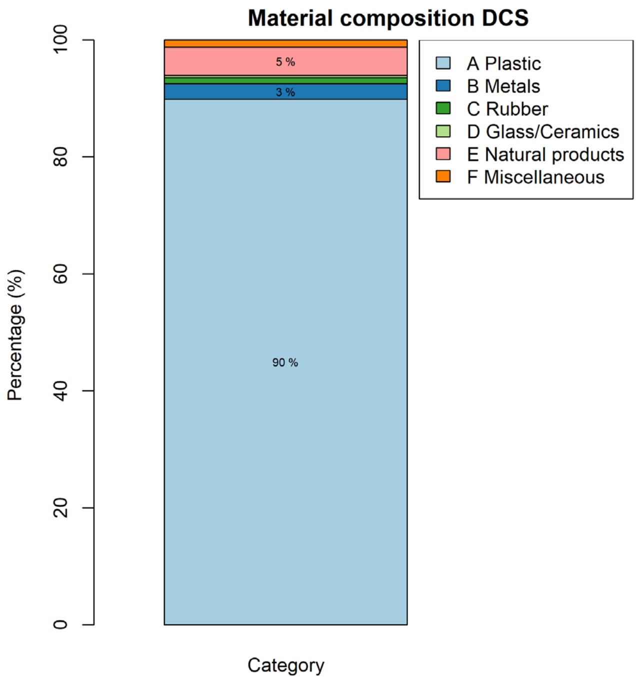

Figure 3.2. Material composition of the seafloor litter in the catches of the IBTS on the DCS in 2021-2023. The percentages are based on mean values per km^2 per litter category. The litter categories for which no percentages are indicated are: C – Rubber (1%), D – Glass/Ceramics (0.4%) and F – Miscellaneous (1%).

3.1.2.2 Top-10 litter types

Based on the mean values per litter type, a Top-10 of most dominant litter types caught in the IBTS on the DCS was compiled (**Figure 3.3**). The Top-10 are dominated by plastic litter types and these 10 litter types account for 92% of the total litter items caught. Only three litter types were made of other materials, respectively "Rope" (E2), "Wood" (E1) and "Metal - Other" (B8). The most dominant litter type was "Monofilament" (A5), representing 29% of the litter items caught. Followed by "Sheet" (A2), "Synthetic rope" (A7) and "Bag" (A3), accounting for 26%, 14% and 7% of the litter items caught. The other litter types in the Top-10 list were each responsible for 5% or less of the litter items caught on the DCS.

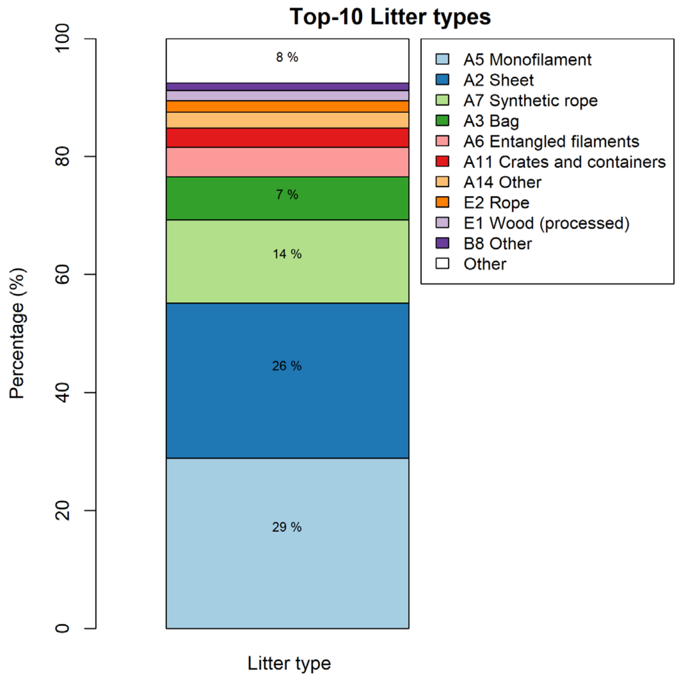

Figure 3.3. Top-10 list of litter items in the catches of the IBTS on the DCS in 2021-2023. The percentages are based on mean values per km^2 per litter type. The Top-10 litter types for which no percentages are indicated are: A6 – Entangled filaments (5%), A11 – Crates and Containers (3%), A14 – Other (3%), E2 – Rope (1%), E1 – Wood (1%) and B8 Other (1%).

3.1.2.3 Abundance and spatial distribution of seafloor litter

Litter was found in 90% of the IBTS hauls on the DCS in the period between 2021 and 2023 (**Table 3.1**). The maximum recorded amount was 391 litter items per km^2 (total count), this number was dominated by “Monofilaments” (A5) and recorded by France.

Table 3.1. IBTS summary table of the densities of seafloor litter on the DCS in the period 2021-2023. The minimum (Min), median, weighted mean per ICES rectangle, mean, 90th percentile, maximum (Max), percentage of total count and the percentage of hauls with at least one item present shown for total count, the different litter categories and the Top-10 litter types. Statistics are based on a total of 103 hauls.

Items per km2	Min	Median	Weighted mean	Mean	90th percentile	Max	% of Total Count	% of hauls with >0 item(s) present
Total count	0	52	71	74	158	391		90
Litter categories								
A - Plastic	0	47	65	66	144	355	90	87
B - Metals	0	0	2	2	0	57	3	8
C - Rubber	0	0	1	1	0	18	1	5
D - Glass	0	0	0	0	0	18	0	2
E - Natural	0	0	3	4	11	113	5	11
F - Miscellaneous	0	0	1	1	0	24	1	5
Top - 10 Litter types								
A2_Sheet	0	16	19	19	53	193	26	60
A3_Bag	0	0	5	5	17	86	7	21
A5_Monofilament	0	0	22	21	64	266	29	47
A6_Entangled filaments	0	0	3	4	14	123	5	16
A7_Synthetic rope	0	0	10	10	35	202	14	33
A11_Crates and containers	0	0	2	2	0	116	3	5
A14_Other	0	0	2	2	13	21	3	12
B8_Other	0	0	1	1	0	22	1	5
E1_Wood (processed)	0	0	1	1	0	85	2	3
E2_Rope	0	0	1	1	0	38	2	6

The ratio of the mean and median values in **Table 3.1** do not indicate that these high international (French) values influence the overall mean result significantly. Despite the WGML guidelines, the best way to count the number of individual monofilaments or sheets correctly and in a consistent way is still under discussion. The guideline states that if items are entangled but recognisable as separate items, they should be counted as separate items. **Annex 3** shows some examples of entangled monofilaments and synthetic rope. Where the Netherlands counted all of these examples as "Entangled items" (A6), some international partners might have separated some of these items and counted them as multiple litter items ("Monofilaments" (A5) and/or "Synthetic rope" (A7)).

The spatial distribution on the Dutch continental shelf based on the IBTS is presented as litter items per km^2 per ICES rectangle, with light colours (green) representing low number of items and dark (purple) colours representing high numbers of litter items. The amount of litter items per ICES rectangle is shown as the mean number of litter items per km^2 over the last three years (2021-2023). Highest densities were recorded in the 36F3 rectangle near the Cleaver Bank (Klaverbank). However, the spatial distribution of litter seems more or less random, no clear pattern or litter hotspot can be distinguished (**Figure 3.4**). Likewise, no strong pattern is identifiable when comparing the total count of litter items on the DCS over time (2015 – 2023), however total count of litter items tend to be lower in the most recent years (**Figure 3.5**).

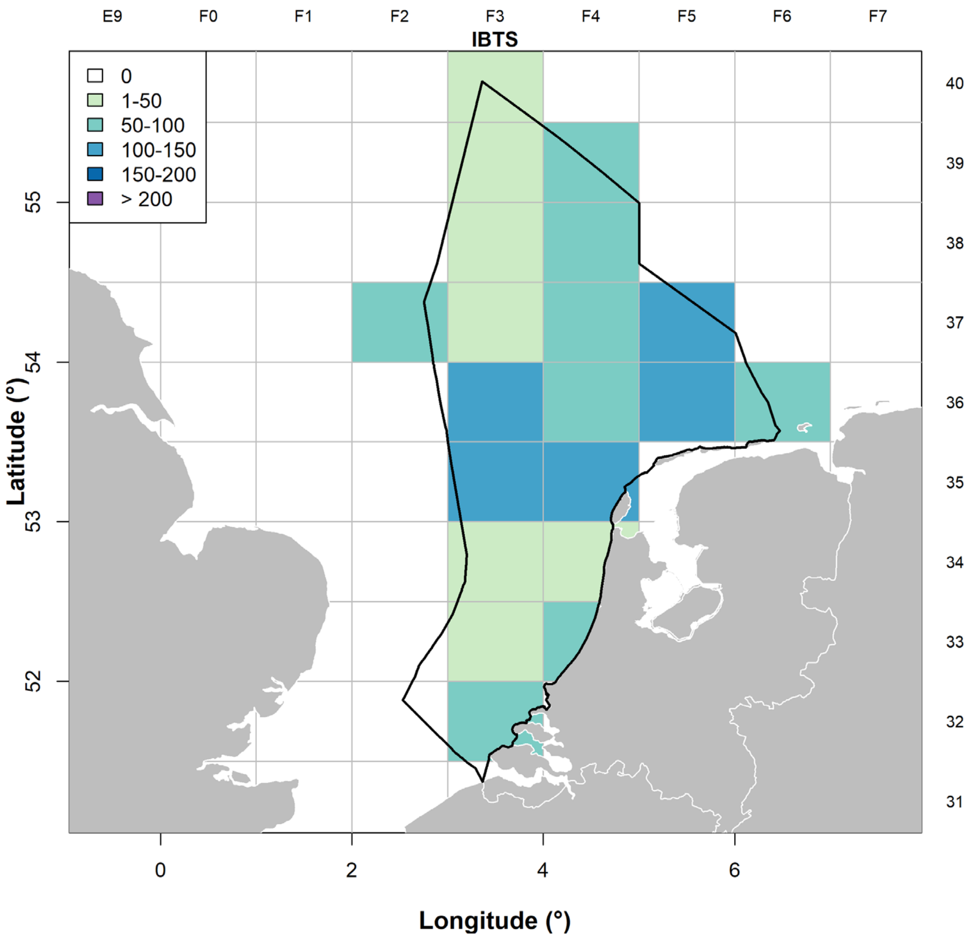

Figure 3.4. Density of litter items per km² per ICES rectangle in the IBTS on the DCS. The different colours represent the numbers (total count) of litter items per km^2. This is calculated as the mean value per ICES rectangle for the period 2021-2023.

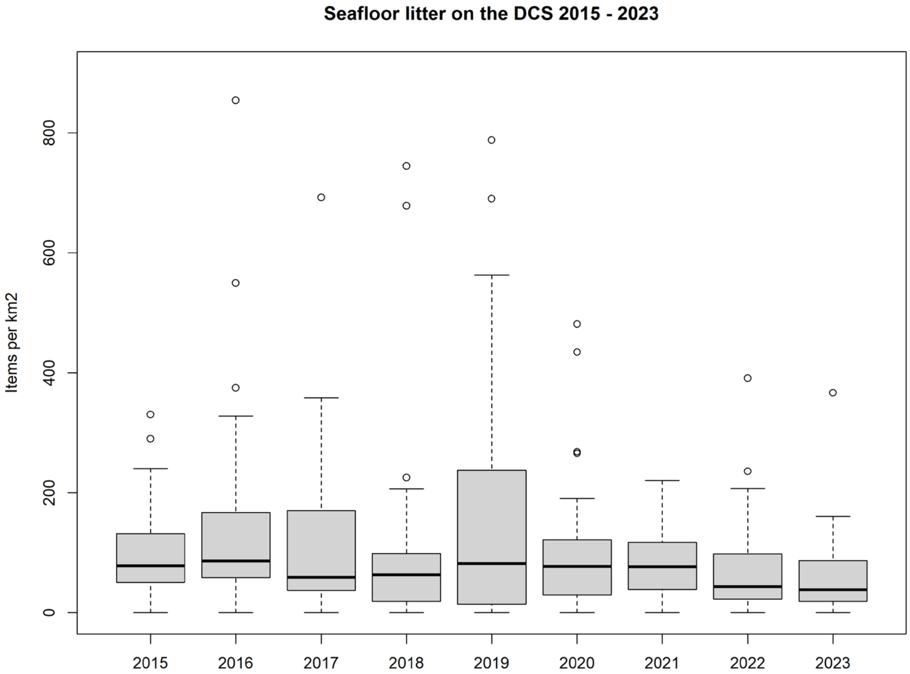

Figure 3.5. Boxplot of the seafloor litter densities for all IBTS hauls conducted on the DCS each year (2015-2023). The data selection as shown in **Table 2.2** was used. From 2015 onwards French data are included and from 2019 on data from Germany and Denmark are also included.

3.2 Beam Trawl Survey

3.2.1 BTS Q3 2022

The Dutch BTS 2022 Q3 performed 140 valid hauls, of which 39 were conducted on the Dutch continental shelf. As presented in **Figure 2.2**, the planned area and amount of hauls per ICES rectangle for 2022 remained unchanged compared to those of previous years (Volwater & van Hal, 2022). The executed hauls and spatial distribution of litter caught during the Dutch BTS 2022 are presented in **Figure 3.6**. There were only five empty hauls (0 items/km^2), two located on the DCS, two east of Aberdeen and one west of the DCS. The hauls with the highest amount of items per km^2 (> 1000 items/km^2) were located in ICES rectangle 40E9 and 43E8 (UK EEZ), both close to the coast and an estuary. The highest amount of litter items recorded on the DCS in the Dutch BTS Q3 2022 was 468 items per km^2 and was found on the Cleaver Bank (Klaverbank) (37F3).

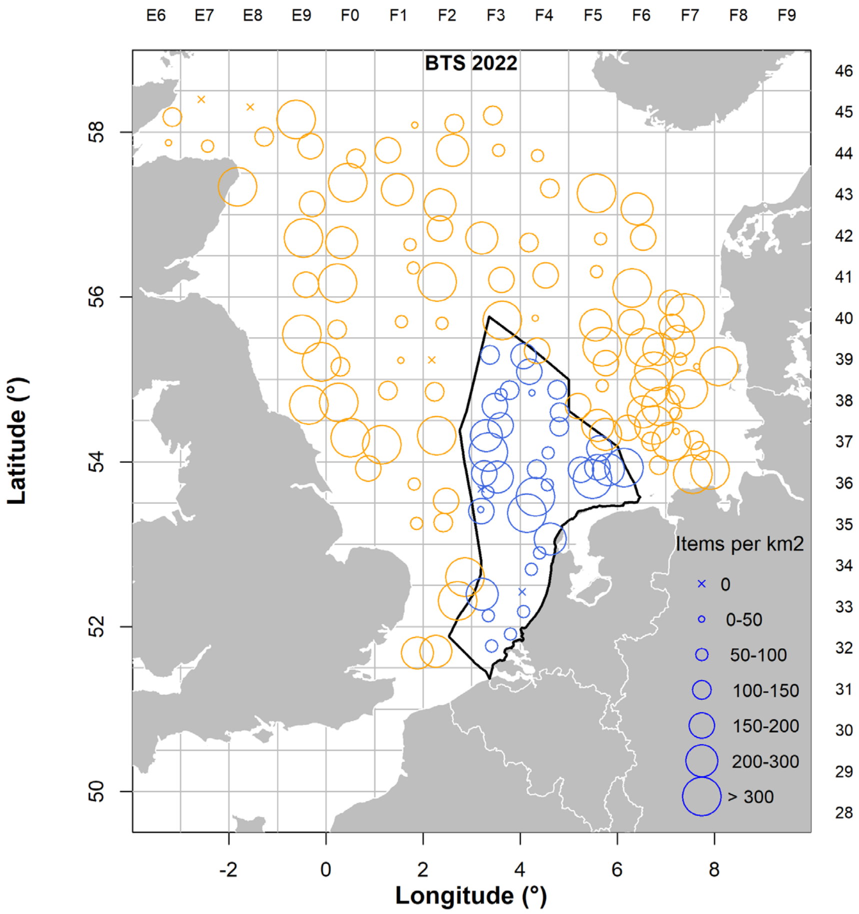

Figure 3.6. Executed beam trawl hauls and total items per km^2 during the 2022 BTS. BTS hauls executed on the DCS (blue) and outside the DCS (orange) are presented. The size of the circles indicates the number of items caught per km^2. The small crosses represents hauls without litter items in the catch, empty hauls.

3.2.2 Seafloor litter on the Dutch Continental Shelf

The analysis in this section is done with all available and usable seafloor litter data on the Dutch continental shelf for the last three years, 2020-2022. In total, 124 hauls were conducted on the Dutch continental shelf for these three years, combined accounting for a swept area of 3.8 km^2. The general composition of seafloor litter and the Top-10 litter types were calculated by mean values. Since the dataset contains a large amount of zero values, the median might give a biased (zero) outcome. Therefore, mean values are used.

3.2.2.1 Material composition

Plastic was the most dominant category of seafloor litter on the DCS in the BTS, accounting for 89% of all litter items (**Figure 3.7**). "Natural products" (E) was the second most dominant category, responsible for 5% of all litter items caught. "Metals" (B), "Rubber" (C) and "Miscellaneous" (F) represented each 2% of the litter items, while "Glass" (D) was representing around 1% of the total litter items.

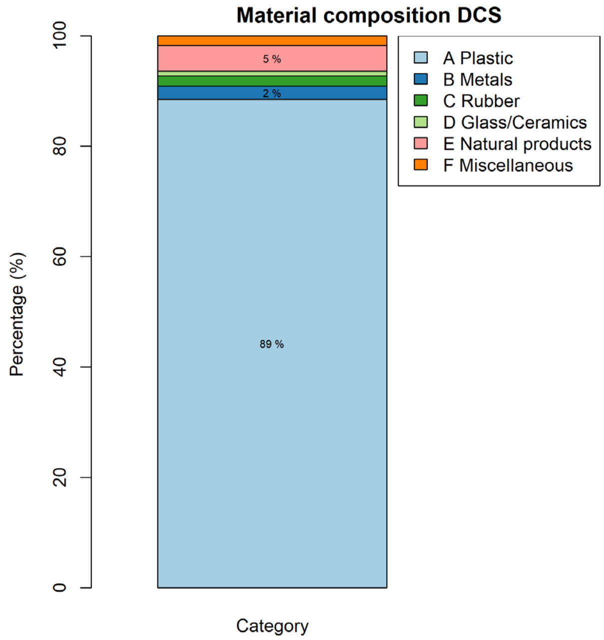

Figure 3.7. Material composition of the seafloor litter in the catches of the BTS on the DCS in 2020-2022. The percentages are based on mean values per km^2 per litter category. The litter categories for which no percentages are indicated are: C – Rubber (2%), D – Glass/Ceramics (1%) and F – Miscellaneous (2%).

3.2.2.2 Top-10 litter types

Based on the mean values per litter type, a Top-10 of most dominant litter types caught in the BTS on the DCS was compiled (**Figure 3.8**). The Top-10 is dominated by plastic litter types, eight out of the ten litter types in this list were made of plastic. Thus, only two litter types were made of other material like natural material and metal, namely "Wood (processed)" (E1) and "Cans (beverage)" (B2). The most dominant litter type was "Monofilament" (A5), accounting for 33% of the litter items caught. This is followed by "Sheet" (A2), "Others" (A14) and "Synthetic rope" (A7), accounting for 24%, 7% and 7% of the litter items caught, respectively. The remaining Top-10 litter types were each responsible for less than 6% of the total litter items caught on the DCS.

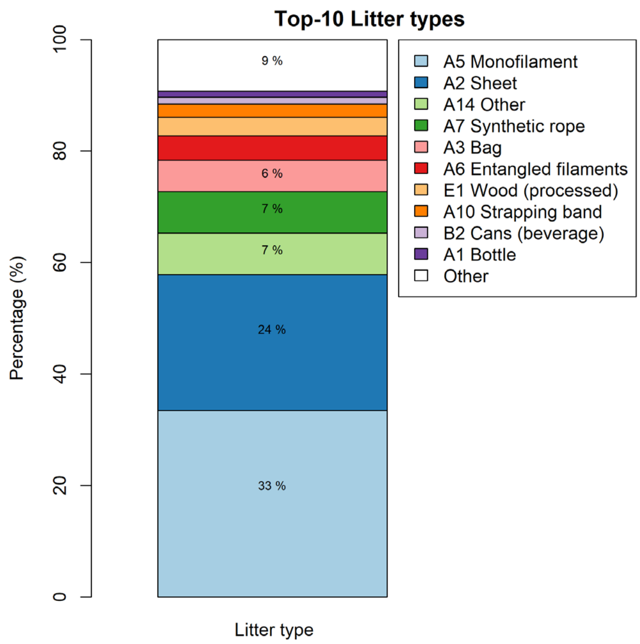

Figure 3.8. Top-10 list of seafloor litter items in the catches of the BTS on the DCS in 2020-2022. The percentages are based on mean values per km^2 per litter type. The Top-10 litter types for which no percentages are indicated are: A6 – Entangled filaments (4%), E1 – Wood (3%), A10 – Strapping band (2%), B2 – Cans (1%) and A1 – Bottle (1%).

3.2.2.3 Abundance and spatial distribution of seafloor litter

Litter was found in 94% of the BTS hauls on the Dutch continental shelf in the period 2020-2022 (**Table 3.2**). The maximum amount recorded was 1013 litter items per km^2 (total count) and was dominated by "Monofilaments" (A5). Since the number of hauls per ICES rectangle in the BTS is not equally distributed (**Figure 2.2**), the weighted mean for total count, each litter category and the Top-10 litter items is calculated to correct for this.

Table 3.2. BTS summary table of the abundance of seafloor litter on the DCS in the years 2020-2022. The minimum (Min), median, weighted mean per ICES rectangle, mean, 90th percentile, maximum (Max), percentage of total count and the percentage of hauls with at least one item present shown for total count, the different litter categories and the Top-10 litter types. Statistics are based on a total of 124 hauls.

Items per km^2	Min	Median	Weighted mean	Mean	90th percentile	Max	% of Total Count	% of hauls with >0 item(s) present
Total count	0	153	181	185	344	1013		94
Litter categories								
A - Plastic	0	135	159	164	296	1013	89	93
B - Metals	0	0	5	4	28	62	2	12
C - Rubber	0	0	3	4	19	53	2	10
D - Glass	0	0	1	1	0	55	1	4
E - Natural	0	0	9	9	33	161	5	19
F - Miscellaneous	0	0	3	3	0	92	2	6
Top-10 Litter types								
A1_Bottle	0	0	2	2	0	33	1	6
A2_Sheet	0	31	43	45	109	369	24	60
A3_Bag	0	0	9	10	33	96	6	26
A5_Monofilament	0	33	60	62	162	675	33	64
A6_Entangled filaments	0	0	7	8	32	74	4	21
A7_Synthetic rope	0	0	16	14	58	126	7	29
A10_Strapping band	0	0	4	4	21	86	2	10
A14_Other	0	0	13	14	34	222	7	28
B2_Cans (beverage)	0	0	3	2	0	62	1	6
E1_Wood (processed)	0	0	6	6	30	161	3	13

The spatial distribution on the Dutch continental shelf based on the BTS is shown as litter items per km^2 per ICES rectangle, with the same colour legend as in (**Figure 3.4**). The amount of litter items per ICES rectangle is shown as the mean number of litter items per km^2 for the last three years, 2020-2022. No clear pattern or litter hotspot can be identified, but the spatial distribution tends to show higher densities of marine litter closest to the coast and near river mouths/estuaries (**Figure 3.9**). Highest densities were recorded in the 33F3 and 35F4 ICES rectangles with densities of 330 and 317 items per km^2, respectively. No strong pattern is identifiable when comparing the total count of litter items on the DCS over time since only three years of data are available, however total count of litter items tend to be on average slightly lower in the most recent year (**Figure 3.10**).

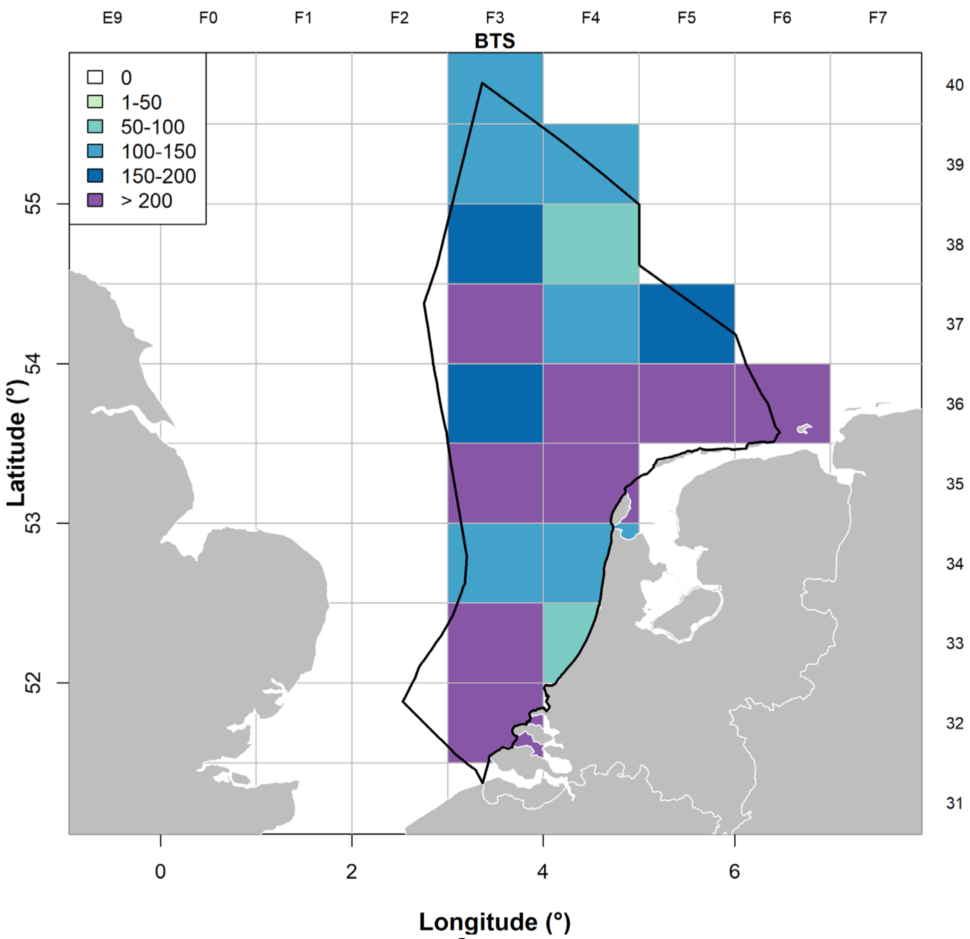

Figure 3.9. Density of litter items per km^2 per ICES rectangle in the BTS on the DCS. The different colours represent the numbers (total count) of litter items per km^2. This is calculated as the mean value per ICES rectangle for the period 2020-2022.

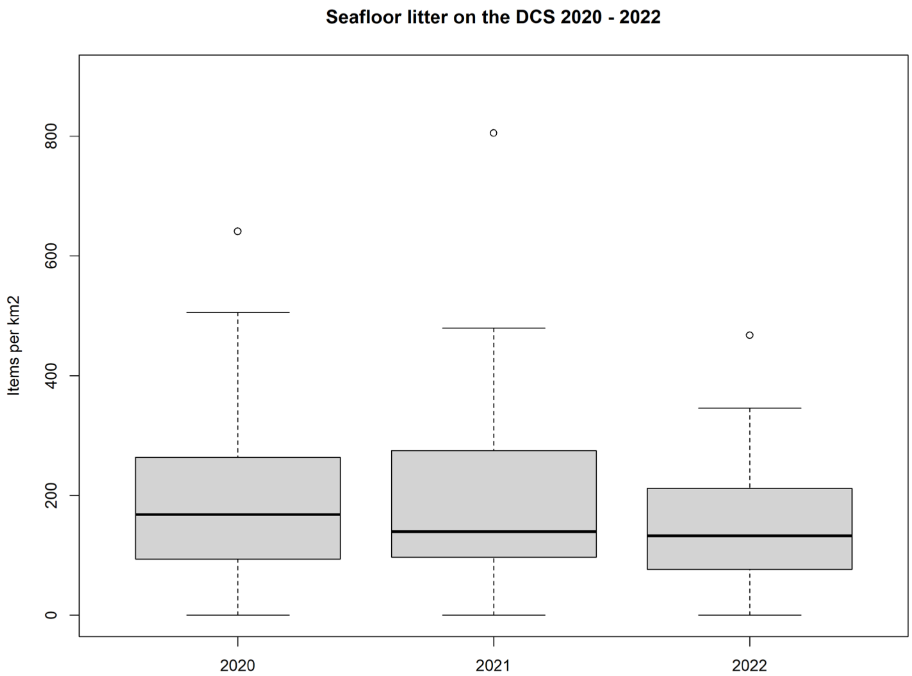

Figure 3.10. Boxplot of the seafloor litter items per km^2 for all BTS hauls conducted on the DCS each year (2020-2022). The number of hauls per year is: 2020, 47; 2021, 38; 2022, 39.

3.3 Comparison IBTS and BTS

The composition of the litter caught on the DCS is generally comparable between the two surveys, whereby plastics accounts in both surveys around 90% of the litter caught (IBTS: 90% & BTS: 89%). Litter categories such as natural products, rubber and metals (that might be partly buried in the top layer of the seafloor) were caught more often in the BTS. The beam trawl used in this survey scrapes the top layer of the seafloor and therefore also catches items that are (partly) buried in this top layer. The Top-10 litter types caught in both surveys is also comparable, although the relative abundances of litter types can differ. “Monofilament” (A5) and “Sheet” (A2) represent about 65% of the litter items caught for both surveys using the mean results. However, using the median results, these two types represent 100% of the litter found on the seafloor. The amount of litter items (Total Count) caught per km^2 is significantly larger in the BTS than in the IBTS (**Figure 3.11**), with respectively an average of 74 and 185 items per km^2. Furthermore, in 94% of the BTS hauls litter was caught on the DCS, while in 90% of the IBTS catches litter was found. The presence-absence of litter items per litter category shows noticeable differences between the BTS and the IBTS (**Table 3.1; Table 3.2**), indicating that the BTS has a higher chance of catching a litter item, despite a BTS haul (± 0.03 km^2) covering approximately half of the area compared to a haul of the IBTS (± 0.06 km^2).

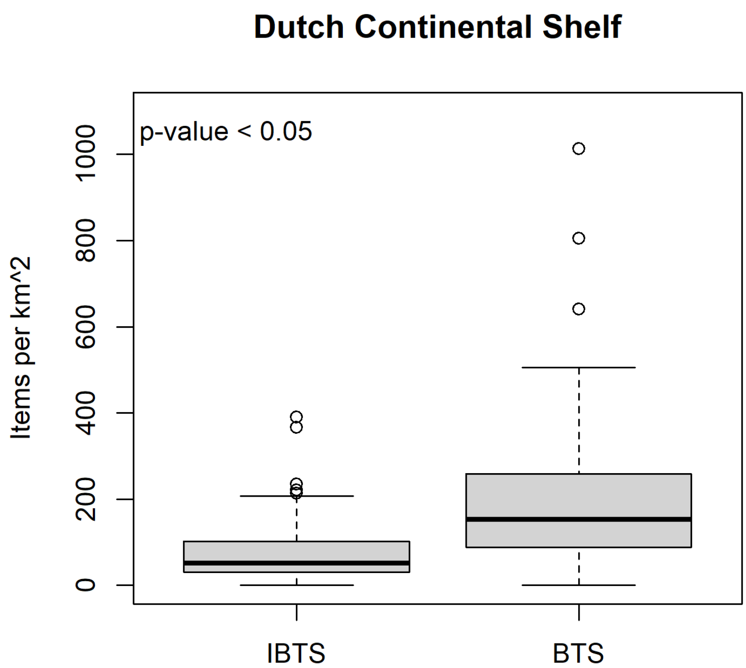

Figure 3.11. Boxplot of the Total Count of litter items per km^2 for the IBTS (left) and the BTS (right). For both surveys the data of the last three years is used, however the selected years are not the same. For the IBTS the years 2021-2023 and for the BTS the years 2020-2022 were used.

4 Discussion and Conclusions

The composition of seafloor litter on the Dutch continental shelf as presented in this report is in line with those of previous years. The seafloor litter catches on the DCS consisted mainly of plastic items, 89% (BTS) and 90% (IBTS) of the litter items found were made of plastic. Monofilaments, plastic sheets and various types of (plastic) ropes/lines were the most commonly caught litter types. Single-use plastics like cups, plates, drink bottles, caps/lids and cigarette butts, which are commonly found on beaches (Boonstra & Hougee, 2021; Scotti et al. 2021), were rarely or not caught by the IBTS and BTS. This could indicate a difference in the spatial distribution of litter items, but for some of these items it is most likely a result of the monitoring method. Drink bottle caps and cigarette butts, for instance, cannot be retained by the mesh size of the cod-end and are therefore not represented in the catches. The very low amount of single-use plastics shows, however, that management measures banning the use of these cannot be evaluated using the data retrieved from the fish surveys.

The observed dominance of plastic items in the survey catches is comparable to most studies on seafloor litter (Alvito et al. 2018; García-Alegre et al. 2020; Kammann et al. 2018; Spedicato et al. 2019; Meyerjürgens et al. 2022). Many studies reported that most of the litter items found on the seafloor originated from the fishing industry, dominated by fishing lines (e.g. Buhl-Mortensen & Buhl-Mortensen 2017; Consoli et al. 2018; Gutow et al. 2018; Pham et al. 2014). It is impossible to discriminate monofilament used by the fishing industry from those used in other sectors, e.g. aquaculture. However, it is very likely that many if not most of the monofilaments and synthetic ropes caught in the IBTS and BTS originate from the fishing industry, predominantly being dolly rope. Experiments are currently carried out to replace the dolly rope with other materials. For instance, an experiment with yak leather as an alternative for dolly rope was carried out in the 2020 BTS (WMR, 2020).

The overall composition of litter on the seafloor is comparable between studies. However, comparing seafloor litter studies in terms of litter presence and density is not straightforward due to the use of different gears and the differences in sampled substrates (Canals et al. 2021). The 90% (IBTS) and 94% (BTS) of hauls on the DCS containing litter are amongst the higher values reported. In other studies, the percentage of hauls including litter items ranges from approx. 8% in the Flemish Pass (Carcia-Alegre et al. 2020) up to 90% in the northern Mediterranean (Spedicato et al. 2019). Studies from areas comparable to the DCS report proportions of 53% in the North and Baltic Seas (Kammann et al. 2018; Zablotski et al. 2019), 63% in the waters surrounding the UK (Maes et al. 2018) and approx. 80% in the German Bight (Meyerjürgens et al. 2022). Furthermore, large differences in litter densities are reported, ranging from a mean number of 1.4 items per km^2 in the Flemish Pass (Carcia-Alegre et al. 2020) up to 1835 items per km^2 in the North and Irish Seas (Maes et al. 2018). The study of Kammann et al. (2018) also used a GOV and identified a litter density of 16.8 litter items per km^2 in the German part of the North Sea. Meanwhile, the use of a bottom trawl net with a mesh size of 5 mm revealed litter densities ranging from 0 to 17,800 items per km^2 (Meyerjürgens et al. 2022).

The decision on how to categorise a litter item has been an issue since the start of the monitoring in 2013. A guideline has been provided by ICES (ICES 2022) and was refined by the WGML in recent years, solving a number of the classification issues. Counting litter items in case of entanglement is still an ongoing issue in the methodology. The guideline states: "If two or more items are heavily entangled, all items should still be counted separately, or, if not possible, estimated, with the exception of entangled monofilaments (category A6). When monofilaments are entangled, each tangle should be counted as being one item". However, this guideline is not yet carried out consistently by the different IBTS partners. In **Annex 3**, examples of this issue are given. Fully disentangling "Entangled filaments" might result in a large number of separated monofilaments, which potentially increase the number (density) of litter items in these hauls than has currently been reported. Disentangling all litter items would cause a disproportionately high effort and is not possible in all cases (**Photo 1 of Annex 3),** and would still lead to arbitrary choices. Usually, monofilaments that are recognisable as separate items are counted as separate items, while heavily entangled items that are not recognisable as separate items are counted as a single item. This same discussion occurs for (degrading) "Synthetic rope" (A7). The question remains whether to record it as a synthetic rope or as multiple monofilaments (**Photo 2 Annex 3**). This becomes even more of a complex issue since most monofilaments originate from the degradation of synthetic rope. Monofilaments and synthetic rope form the majority of the counts of litter items (43% IBTS, 40% BTS). As a consequence, these items determine if a location is seen as litter hotspot, potentially affecting the summary statistics and possible trend analysis. In addition to the described issues in determining the correct number of items and the arbitrary decision making process in the counting method, there is a methodological error impacting the counts. Cleaning the net of the GOV (and beam trawl) is nearly impossible, especially since the person cleaning the net has to be outside on deck during potentially bad weather conditions, particularly during winter months. Monofilament/ropes easily wrap around the fishing net, the ground rope chain and the bobbins. Disentangling each single monofilament from the fishing gear is nearly impossible and is even less likely to be done in bad weather conditions. This results in the accumulation of attached items in the fishing gear. Once accumulated it is only taken out when it becomes a clear entanglement. The entangled items can loosen on rough ground and end up in the cod-end or it can be taken out when parts of the net have to be repaired. Repairing the net has yet another impact and can influence the litter counts. Own (netting) materials (ropes, strapping bands) originating from the vessel used for the (I)BTS can be mixed in with the litter which can have an influence on the results. Based on some photos of the litter items made available by the French surveyors in 2019, own materials clearly impacted the French counts. The actual counts of litter items are thus heavily influenced by methodological aspects rather than by the amount of litter on the seafloor.

The overall data of the two gears used in the surveys indicates a higher catchability of litter items in the beam trawl (BTS) than in the GOV used during the IBTS. Despite that, the beam trawl also catches only a part of the litter present in the trawl path. This is one of the issues in using trawls of fish surveys for monitoring seafloor litter as pointed out by Canals et al. (2021). The data of both gears therefore present an underestimation of the actual amount of litter items present on the seafloor. The underestimation resulting from the IBTS data is larger compared to the underestimation introduced when using BTS data. It is suggested to use a conversion factor to raise the values of the IBTS to the levels of the BTS, to present less underestimated values. However, there are some issues to this approach:

- A straightforward conversion factor cannot be used to raise the hauls without litter (zero haul), despite the fact that it is very likely that there was litter in the trawl path. This is indicated by the higher percentage of BTS hauls containing litter and the fact that a BTS haul covers a smaller area of seafloor than IBTS.
- In the comparison between both surveys, there is a seasonal difference. This might influence the amount of litter accessible (e.g. storms). The season also affects the amount of fish caught, which in turn influences the amount of litter that is retained within the cod-end.
- The two gears cannot always be used to fish on the same sediment and habitat types. It is suggested that this has little impact at the level of the DCS, as here both gears can be used more or less on the same grounds (sand). On the larger spatial scale (North Sea level) of both surveys, however, this could hamper the comparison.

- The higher vertical net opening of the IBTS is likely to result in the retention of higher amounts of floating litter, while simultaneously the larger length of the net and the larger mesh size in the first part of the belly of the net are likely to result in a lower retainment of heavier items. This suggests that a different conversion factor would be required for different litter types caught in the BTS.

The differences in fishing locations between the BTS and the IBTS pose an issue in the comparison of these two gear types. However, the effect of the actual fishing location also influences the comparison of the IBTS catches between years. The actual fishing locations of the IBTS are semi-randomly chosen within a rectangle and therefore differ between years. Litter items can easily be transported from a low-density site by e.g. bottom currents to a site where seafloor structures retain the litter items and form a litter hotspot (Canals et al. 2021). This retainment of litter items is observed in the catches of the IBTS, where in cases that much organic debris (benthos, shells, seaweed e.d.) is retained in the IBTS net, it is more likely to have higher amounts of litter. Unfortunately, habitat characteristics are not recorded in the IBTS (e.g. by side-scan sonar or multibeam), nor are the amounts of debris in the catches thus analyses on this level are not possible. It is known that these habitat characteristics can vary at a small local scale, and with that likely the amount of litter on the sea floor. This might be the explanation for the empty hauls close to larger catches on the Dutch continental shelf in earlier years.

Usually, a trend analysis of the abundance of seafloor litter would be common practice. The package "litteR" is designed for this kind of analysis (Walvoort & van Loon 2018). However, there are several limitations to this approach that would not add valuable/reliable information to this report and is therefore not presented in this report. The goal of a trend analysis is to get statistical support for a potential trend in the amount of litter on the seafloor, or at least of a consistent part of the litter on the seafloor. 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 and varies with litter type and size. The GOV is designed to avoid retainment of larger object (stones) by hopping over these, otherwise the gear gets ripped and the haul becomes invalid. As a result, the bottom contact of the gear is minimal, and earlier analysis indicated that the catchability of the GOV for many benthic species was less than 5% (ICES 2003). Therefore, the probability of catching small items on the seafloor is assumed to be random and low. The fact that most items caught are relatively small 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. This was shown clearly when the GOV was used to fish in the area where the container vessel MSC Zoe lost its cargo in 2019. While beam trawls were catching large amounts of items from the cargo, only three items were caught in the two hauls with the GOV (extended in duration) (van Hal 2019).
This issue is recognized in the second OSPAR intermediate assessment (EIHA 19/07/19-Add.1). 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). As a consequence of these limitations it was decided to not present a trend analysis of the GOV data on the DCS within this report. However, beam trawl data, which is assumed to give a better picture of litter types and counts on the seafloor, can be used in the future for trend analysis. Currently only three years of BTS data are available which is insufficient for trend analysis.

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 the amount of litter in the environment. From previous studies (Maes et al. 2018; Urban-Malinga et al. 2018) and from the results presented in this report it is evident that, despite the management measures to decrease the input of litter and to remove the litter from the environment, there still is litter on the seafloor. The indicators proposed for the MSFD should be able to detect a reduction in litter related to management measures. A situation with a relatively low amount of (or without) litter in the marine environment has not been realized yet and it is unlikely to be realized within a short timeframe (van Loon et al. 2020). Despite the fact that there still is litter in the marine environment there are some hopeful indications towards a North Sea with less litter. A long term trend analysis of beach litter shows that the amount of litter items on the Dutch beaches is significantly decreasing over a 20 year period, as a consequence of effective policy (Boonstra et al. 2021).

To conclude, a relatively low number of litter items found per haul, a low probability of catching an item when it is present in the trawl path and the spatial differences in fishing location (habitat, seafloor structures) make it difficult to draw conclusions on the absolute amounts of litter on the seafloor of the Dutch continental shelf. Since 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 the abundance of litter on the seafloor. Incorporating litter data of the BTS indicates that seafloor litter is more abundant than IBTS data indicate, as was found already in a previous study (O'Donoghue & van Hal, 2018). A recent study by Van Rossum & Boer (2023) confirmed these findings and found that the beam trawl appears to catch seven times more litter than the GOV net at the North Sea level. However, it is assumed that even the BTS beam trawl gives an underestimation of the actual litter present on the seafloor. Therefore, the use of additional methods to collect seafloor litter might give a better understanding of the actual amount and composition of litter on the DCS. Recently, Roos et al. (2023) published a pilot seafloor litter study whereby a benthic dredge was used. This pilot study demonstrated that the amounts of seafloor litter <20 cm is much higher than found with the GOV (IBTS) and beam trawl (IBTS). Dedicated video surveys, possibly focused on areas where litter is likely to be gathered by dominant currents (hotspots) and marine protected areas, could provide complementary seafloor litter data, as currently discussed in the EU Task Group for Marine Litter. However, it remains to be proven that these "hotspots" actually exist, and whether these hotspots shift over time, which seems to be suggested by the second OSPAR intermediate assessment. For now, the here reported abundances of litter on the DCS are an underestimation of the amount of litter items presented on the seafloor and thus the Dutch continental shelf.

5 Recommendations

- Reconsidering the goals and purpose of the monitoring of litter. The use of the IBTS as monitoring platform only provides indicative results of a small part of the litter composition. For the evaluation of specific management measures the IBTS data is questionable and it is also unsuitable to produce a good estimation of the litter present on the seafloor. Its best use, other than to raise awareness, would most likely be as an indication of very large changes in the litter part caught by the IBTS, in this case being a large change in the amount of monofilament and synthetic rope in the marine environment.
- Experiences from WMR, and a recent Dutch comparative study (Van Rossum et al., 2023) confirm that BTS data are more suitable to be used for a Dutch trend analysis of seafloor litter on the DCS in the future than GOV data.
- Following the progress of alternative methods of collecting seafloor litter data and explore the application of alternative methods on the DCS, for example the use of benthos dredge sampling. The use of additional methods to collect seafloor litter might give a better understanding of the actual amount and distribution of litter items on the Dutch continental shelf.

6 Quality Assurance

Wageningen Marine Research utilises an ISO 9001:2015 certified quality management system. The organisation has been certified since 27 February 2001. The certification was issued by DNV.

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Justification

Report C060/23
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: Jorn School
Researcher

Signature:

Date: 4th of October 2023

Approved: Cas Wiebinga
MT member

Signature:

Date: 5th of Octber 2023

Annex 1 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 (e.g. indices, Age-Length-keys, CPUE (Catch Per Unit Effort) 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 the 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 the download page and the DATRAS documents page can be selected. The latter 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.

Annex 2 Quality – Outlier check

2.1 IBTS

Marine litter data from the international IBTS partners was obtained from ICES DATRAS or directly from the partners (IFREMER). A data analyses determining the data to be used was done in Volwater & van Hal (2021). It was concluded that Dutch count data was available from 2013 on, French and German count data from 2015 and Danish count data only from 2021 on. Other IBTS partner countries did not conduct hauls on the DCS within the period 2013-2023.

Before conducting the analyses in section 3.1.2, a quality check of the last three years of data on the DCS was done to check whether litter recordings are true outliers. To do so, boxplots were prepared for the three most commonly caught litter types and for the total count to visualise potential outliers. The boxplots show multiple hauls with (very) high litter recordings. All these hauls were double checked for potential inconsistencies whereby for most hauls pictures were available to verify the recordings. There were no inconsistencies and the recordings were all correct. The high recordings were mostly done by France but spread over the three years (2021-2023). This may be caused by a different counting of France of "entangled filaments (A6)", using de-entangling. The idea was to level out high recordings and year-to-year variance in the IBTS litter analysis by combining data of the three most recent years, including the international data on the DCS, as requested by RWS. Instead, large variance in number of items per km^2 arose between the French data and other IBTS (Dutch) data due to structural higher recordings by France for especially plastic "Sheets" (A2), "Monofilaments" (A5) and "Synthetic ropes" (A7).

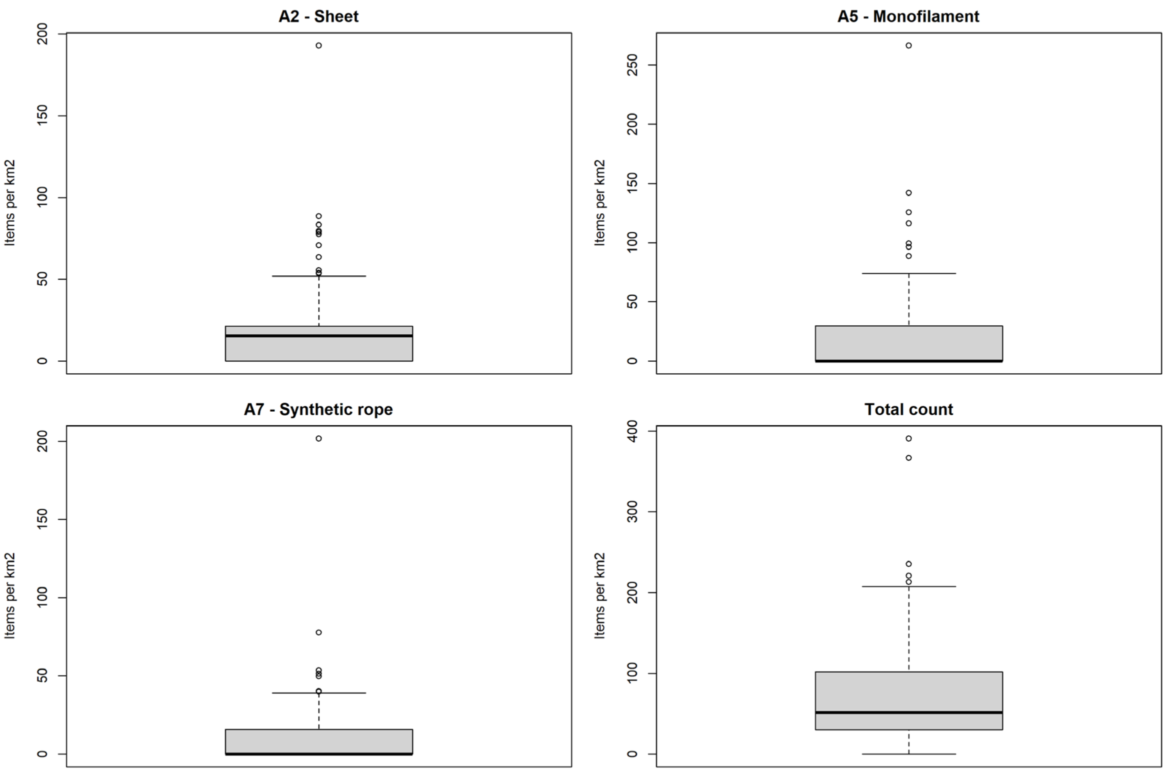


Figure B 1. Boxplots of the mean amount of A2 - Sheet, A5 – Monofilament, A7 – Synthetic rope and Total count litter items per km^2 of the IBTS on the DCS between 2021 and 2023.

Comparing the high recordings of the IBTS with those of the BTS, it appears that many of those recordings would not even be considered as an outlier. The probability of catching (small) litter items is assumed to be low and random whereby the litter recordings are an underestimation of the actual litter present. The high recordings are rather an actual representation of litter items on the seafloor other than outliers. It was therefore decided that the high recordings were included for further analyses instead of being removed as outliers. Afterwards, the ratio of the mean and median values (**Table 3.1**) does not indicate that these high recording values strongly influence the overall mean litter items per km^2.

2.2 BTS

The same quality check was done for the BTS data of 2020-2022. Since the BTS dataset only consist of Dutch data there is no difference in counting litter items between countries. Still, there are some high recordings within the BTS data. All these hauls were doublechecked for potential errors whereby for most hauls pictures were available to verify the recordings. There were no inconsistencies and the recordings were all correct. Therefore, it was decided that the high recordings were included for further analysis instead of being removed as outliers. Afterwards, the ratio of the mean and median values (**Table 3.2)** does not indicate that these high recording values influence the overall mean litter items per km^2 strongly.

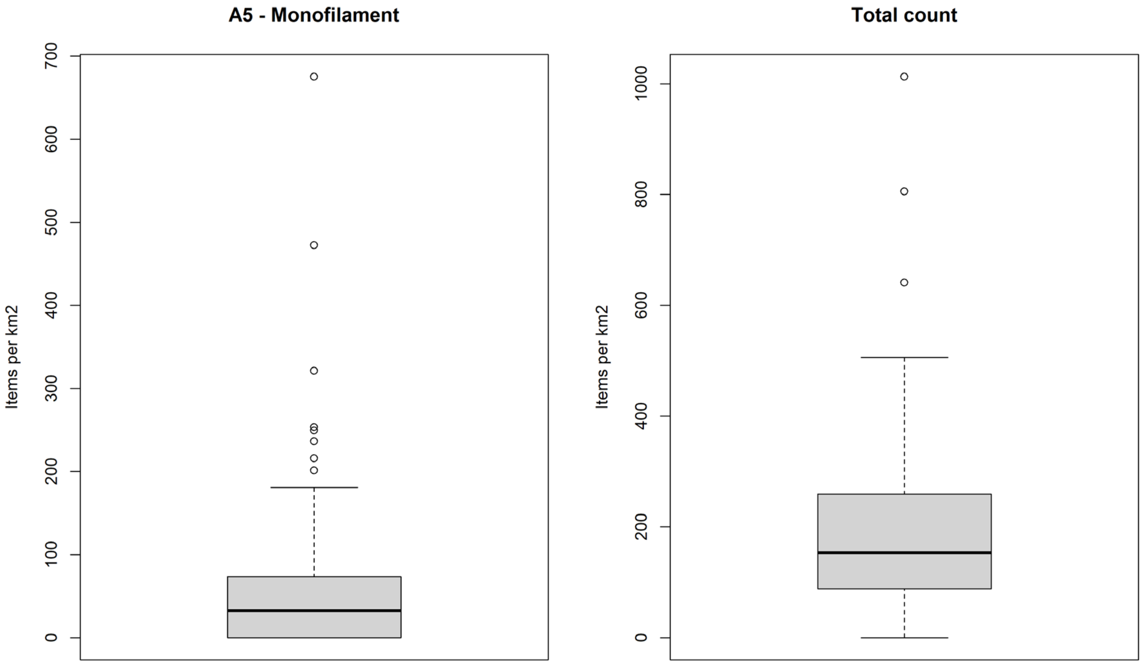


Figure B 2. Boxplots of the mean amount off A5 – Monofilament and total litter items per km^2 of the BTS on the DCS in 2020-2022.

Annex 3 Photos entangled filaments

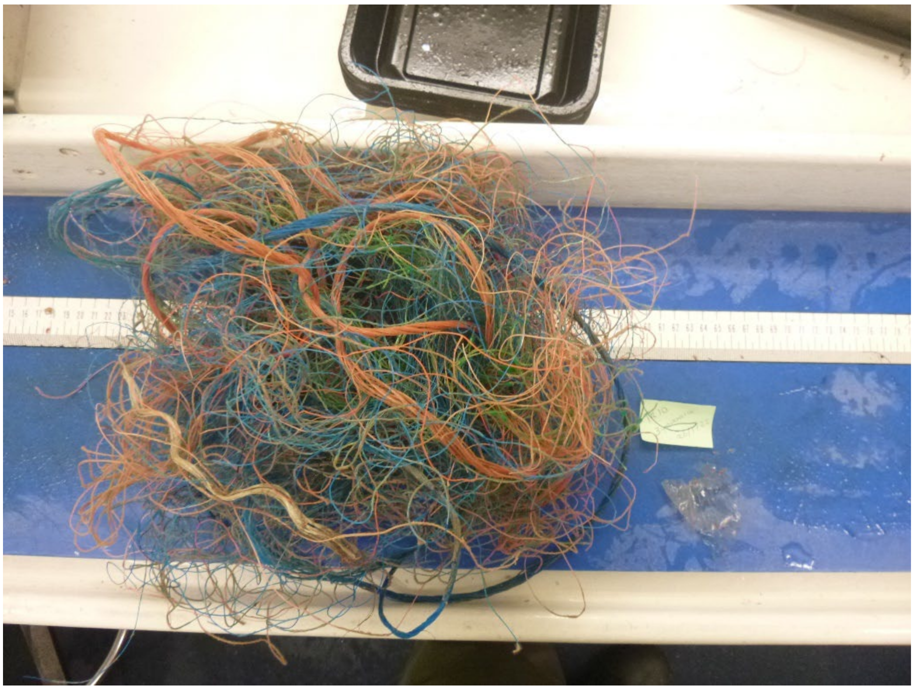


Photo 1. Example of an "A6 – Entangled filament" whereby single items are not recognisable. The Dutch surveyors counted this item as one single "A6 – Entangles filaments".

Photo 2. Example of "A7 – Synthetic rope" which is degrading into multiple "A5 – Monofilament" items, colour and length of the blue monofilaments clearly indicate they are originating from the blue piece of "A7 – Synthetic rope". Such a piece of synthetic rope can easily fall apart once in the cod-end together with the rest of the (fish and benthos) catch. The Dutch surveyors counted this catch of marine litter as one orange "A5 – Monofilament" and one blue "A7 – Synthetic rope".

Annex 4 Data tables with seafloor litter monitoring data

The complete IBTS and BTS DCS datasets are available as Excel files or csv files. The following tables contain only the new added data compared to the previous report in 2022 (Volwater & van Hal, 2022).

Annex 4.a. Complete trawl list of the IBTS Q1 on the DCS for the years 2021-2023, in which the total number of items per trawl (total Count [items/km²] and the number of items per category (A, B, C, D & E [Items/km²]) are reported.

RefNo	Ices.rect	Latitude	Longitude	Country	Institute	Wing_spread (m)	Bottom_track (m)	Duration (min)	year	A	B	C	D	E	F	Total_Count
DK202134	37F3	54.1733	3.0744	DK	DTU-AQUA	22.0	3760	30	2021	24.2	0.0	0.0	0.0	0.0	0.0	24.2
DK202135	38F3	54.8847	3.6916	DK	DTU-AQUA	22.6	3810	30	2021	11.6	11.6	0.0	0.0	0.0	0.0	23.2
DK202136	39F3	55.2372	3.815	DK	DTU-AQUA	22.2	3810	30	2021	47.3	0.0	0.0	0.0	0.0	23.6	70.9
DK202139	40F3	55.5901	3.7144	DK	DTU-AQUA	20.6	3758	30	2021	38.8	0.0	0.0	0.0	0.0	0.0	38.8
DK202141	39F4	55.2919	4.2555	DK	DTU-AQUA	20.7	3706	30	2021	91.3	0.0	0.0	0.0	26.1	0.0	117.3
FR202110	37F4	54.07	4.1371	FR	IFREMER	17.3	3685	30	2021	156.9	0.0	0.0	0.0	15.7	0.0	172.5
FR202111	36F5	53.7475	5.2962	FR	IFREMER	15.7	3771	30	2021	101.3	16.9	0.0	0.0	0.0	0.0	118.2
FR202120	37F5	54.3214	5.3014	FR	IFREMER	17.8	3565	30	2021	220.6	0.0	0.0	0.0	0.0	0.0	220.6
FR202124	38F4	54.9185	4.1159	FR	IFREMER	16.9	3577	30	2021	148.9	0.0	0.0	0.0	0.0	0.0	148.9
FR202127	36F3	53.9072	3.9319	FR	IFREMER	17.1	3658	30	2021	63.9	0.0	0.0	0.0	0.0	0.0	63.9
FR202128	36F4	53.6223	4.5215	FR	IFREMER	16.6	3729	30	2021	32.3	0.0	0.0	0.0	32.3	0.0	64.6
FR202129	35F3	53.2862	3.8243	FR	IFREMER	15.9	3510	30	2021	107.5	0.0	0.0	0.0	17.9	0.0	125.4
FR202130	32F3	51.626	3.1677	FR	IFREMER	17.8	3618	29	2021	93.2	0.0	0.0	0.0	0.0	0.0	93.2
FR20214	32F3	51.8275	3.4376	FR	IFREMER	18.7	2487	20	2021	43.0	21.5	0.0	0.0	43.0	0.0	107.5
FR20215	33F3	52.2512	3.9192	FR	IFREMER	14.6	3708	30	2021	73.9	0.0	0.0	0.0	0.0	0.0	73.9
FR20216	33F4	52.2782	4.1456	FR	IFREMER	15.0	3559	30	2021	37.5	0.0	0.0	0.0	0.0	0.0	37.5
FR20217	35F4	53.1611	4.1522	FR	IFREMER	15.0	3442	30	2021	213.1	0.0	0.0	0.0	0.0	0.0	213.1
FR20218	34F4	52.848	4.1165	FR	IFREMER	15.0	3309	30	2021	80.6	0.0	0.0	0.0	0.0	0.0	80.6
FR20219	34F3	52.673	3.4227	FR	IFREMER	15.4	3526	31	2021	18.4	0.0	0.0	0.0	0.0	0.0	18.4
NL202110	35F4	53.4798	4.483	NL	WMR	16.6	3037	30	2021	139.2	0.0	0.0	0.0	0.0	0.0	139.2
NL202111	33F4	52.3113	4.3781	NL	WMR	16.0	4605	30	2021	67.7	0.0	0.0	0.0	0.0	0.0	67.7
NL202112	38F3	54.6495	3.5551	NL	WMR	17.4	3713	30	2021	31.0	0.0	0.0	0.0	0.0	0.0	31.0
NL202113	38F4	54.9263	4.153	NL	WMR	19.7	3478	30	2021	29.2	0.0	0.0	0.0	0.0	0.0	29.2
NL202114	39F4	55.2358	4.3026	NL	WMR	18.5	3594	30	2021	90.1	0.0	0.0	0.0	0.0	0.0	90.1
NL202115	39F3	55.23	3.507	NL	WMR	16.5	3437	30	2021	17.6	0.0	0.0	0.0	0.0	0.0	17.6
NL202116	34F4	52.9558	4.2236	NL	WMR	16.8	3765	30	2021	47.4	0.0	0.0	0.0	0.0	0.0	47.4
NL202117	34F3	52.8895	3.7256	NL	WMR	16.8	3278	30	2021	54.5	0.0	0.0	0.0	0.0	0.0	54.5
NL202118	35F3	53.1113	3.3288	NL	WMR	16.2	3758	30	2021	49.2	0.0	0.0	0.0	0.0	0.0	49.2
NL202120	37F3	54.1078	3.0901	NL	WMR	18.3	3903	30	2021	69.9	0.0	14.0	0.0	0.0	0.0	83.9
NL202121	36F3	53.8955	3.1108	NL	WMR	20.2	3504	31	2021	112.8	0.0	0.0	0.0	0.0	0.0	112.8
NL202152	33F3	52.1528	3.868	NL	WMR	16.4	3693	30	2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NL20217	37F4	54.2023	4.4765	NL	WMR	19.1	3918	30	2021	93.6	0.0	0.0	0.0	0.0	0.0	93.6
NL20218	36F4	53.9651	4.8515	NL	WMR	17.8	3545	30	2021	79.4	0.0	0.0	0.0	0.0	0.0	79.4
NL20219	36F5	53.791	5.1621	NL	WMR	17.4	3258	30	2021	159.0	0.0	17.7	0.0	0.0	0.0	176.7
DK202218	40F3	55.5588	3.2857	DK	DTU-AQUA	21.5	3693	30	2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DK202219	39F3	55.3609	3.7163	DK	DTU-AQUA	-9.0	3741	30	2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DK202220	39F4	55.1384	4.0812	DK	DTU-AQUA	22.6	3750	30	2022	0.0	0.0	0.0	11.8	0.0	0.0	11.8
DK202221	38F4	54.9119	4.1247	DK	DTU-AQUA	22.3	3726	30	2022	72.2	0.0	0.0	0.0	0.0	0.0	72.2
FR202211	32F3	51.8105	3.6068	FR	IFREMER	14.8	3295	30	2022	143.5	0.0	0.0	0.0	0.0	20.5	164.0
FR202212	33F4	52.1615	4.2395	FR	IFREMER	13.3	3446	30	2022	21.8	21.8	0.0	0.0	0.0	0.0	43.6
FR202213	36F4	53.85	4.5765	FR	IFREMER	16.6	3484	31	2022	190.2	0.0	0.0	0.0	17.3	0.0	207.5
FR202214	37F4	54.3578	4.7272	FR	IFREMER	17.5	3453	30	2022	132.4	0.0	0.0	0.0	0.0	0.0	132.4
FR202220	37F5	54.1771	5.5439	FR	IFREMER	17.0	3498	31	2022	235.4	0.0	0.0	0.0	0.0	0.0	235.4
FR202221	36F5	53.9417	5.2586	FR	IFREMER	18.1	3499	30	2022	126.3	0.0	0.0	0.0	0.0	0.0	126.3
FR202222	36F3	53.8203	3.4699	FR	IFREMER	16.5	3412	30	2022	355.3	35.5	0.0	0.0	0.0	0.0	390.8
FR202223	35F3	53.404	3.7326	FR	IFREMER	17.3	3476	30	2022	83.1	0.0	0.0	0.0	0.0	0.0	83.1
FR202224	35F4	53.1534	4.1469	FR	IFREMER	16.0	3527	30	2022	177.2	17.7	0.0	0.0	0.0	0.0	194.9
FR202225	34F3	52.6793	3.4191	FR	IFREMER	17.0	3501	31	2022	33.6	0.0	0.0	0.0	0.0	0.0	33.6
FR202226	34F4	52.7074	4.0311	FR	IFREMER	15.7	3293	31	2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FR202227	33F3	52.2015	3.6738	FR	IFREMER	16.2	2962	30	2022	125.0	0.0	0.0	0.0	0.0	0.0	125.0
3400001	33F4	52.3557	4.39383	NL	WMR	15.5	2285	21.4	2022	0.0	0.0	0.0	0.0	112.9	0.0	112.9
3400002	34F4	52.6692	4.37033	NL	WMR	17.4	3126	30.1	2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3400007	38F4	54.781	4.93	NL	WMR	18.1	3561	30.1	2022	15.5	0.0	0.0	0.0	0.0	0.0	15.5
3400009	37F5	54.3593	5.563	NL	WMR	18.7	3512	30.1	2022	15.2	0.0	0.0	0.0	0.0	0.0	15.2
3400010	36F6	53.8715	6.10267	NL	WMR	17.9	3304	30.1	2022	33.8	0.0	0.0	0.0	0.0	0.0	33.8
3400011	37F4	54.2022	4.52067	NL	WMR	20.2	3461	30.2	2022	71.5	0.0	0.0	0.0	0.0	0.0	71.5
3400012	36F5	53.95	5.20467	NL	WMR	19.6	3448	30	2022	59.1	0.0	0.0	0.0	0.0	0.0	59.1
3400013	36F4	53.9133	4.89833	NL	WMR	18.7	3200	30.2	2022	33.4	0.0	0.0	0.0	0.0	0.0	33.4
3400020	33F3	52.1937	3.67883	NL	WMR	17.9	3532	30.1	2022	15.8	0.0	0.0	0.0	0.0	0.0	15.8
3400021	34F3	52.6545	3.32533	NL	WMR	18.7	3443	30	2022	31.1	0.0	0.0	0.0	0.0	0.0	31.1
3400022	37F3	54.2268	3.2855	NL	WMR	18.7	3395	30	2022	47.2	0.0	0.0	0.0	0.0	0.0	47.2
3400023	37F2	54.2738	2.84867	NL	WMR	18.9	3505	30.2	2022	60.4	0.0	0.0	0.0	0.0	0.0	60.4
3400025	38F3	54.7008	3.5965	NL	WMR	17.9	3546	30	2022	47.1	0.0	0.0	0.0	0.0	0.0	47.1
3400027	39F3	55.4423	3.7645	NL	WMR	18.1	3513	30	2022	31.4	0.0	0.0	0.0	0.0	0.0	31.4
3400028	40F3	55.611	3.46417	NL	WMR	19.3	3579	30	2022	29.0	0.0	0.0	0.0	0.0	0.0	29.0
3400031	36F3	53.6893	3.2835	NL	WMR	20.6	3439	30	2022	42.3	0.0	0.0	0.0	0.0	0.0	42.3
3400032	35F3	53.4172	3.25967	NL	WMR	17.6	3472	30.1	2022	0.0	0.0	16.4	0.0	0.0	0.0	16.4
3400034	32F3	51.8313	3.66167	NL	WMR	18.1	1638	16	2022	33.7	0.0	0.0	0.0	0.0	0.0	33.7
3400035	32F3	51.8082	3.5675	NL	WMR	16.8	3628	30	2022	49.2	0.0	0.0	0.0	0.0	16.4	65.6
3400001	32F3	51.8203	3.6248	NL	WMR	16.8	3390	30	2023	35.1	0.0	0.0	0.0	0.0	0.0	35.1
3400002	36F5	53.8008	5.7316	NL	WMR	14.5	3639	30	2023	94.7	56.8	0.0	0.0	0.0	0.0	151.5
3400003	36F6	53.6166	6.1193	NL	WMR	15.7	4323	30	2023	88.7	0.0	0.0	0.0	0.0	0.0	88.7
3400010	37F5	54.3076	5.2471	NL	WMR	18.9	3566	30	2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3400011	37F4	54.206	4.59	NL	WMR	17.9	3373	30	2023	0.0	0.0	16.5	0.0	0.0	16.5	33.0
3400012	36F4	53.9096	4.3393	NL	WMR	17.4	3588	30	2023	144.4	0.0	0.0	0.0	0.0	0.0	144.4
3400036	33F4	52.221	4.2828	NL	WMR	14.7	3646	30	2023	18.7	0.0	0.0	0.0	0.0	0.0	18.7
3400037	33F3	52.4493	3.9185	NL	WMR	16.0	3470	30	2023	53.9	0.0	0.0	0.0	0.0	0.0	53.9
3400038	34F4	52.7033	4.3873	NL	WMR	16.2	3445	30	2023	35.8	0.0	0.0	0.0	0.0	0.0	35.8
3400039	35F4	53.025	4.304	NL	WMR	16.6	3463	30	2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3400044	38F4	54.8085	4.4051	NL	WMR	18.7	3440	30	2023	31.1	0.0	0.0	0.0	0.0	0.0	31.1
3400045	38F4	54.9003	4.7428	NL	WMR	16.6	3502	30	2023	34.4	0.0	0.0	0.0	0.0	0.0	34.4
3400046	39F4	55.107	4.3703	NL	WMR	17.4	3541	30	2023	16.3	0.0	0.0	0.0	0.0	0.0	16.3
3400047	39F3	55.1508	3.68	NL	WMR	16.4	3561	30	2023	17.1	0.0	0.0	0.0	0.0	0.0	17.1
3400051	38F3	54.7403	3.3413	NL	WMR	16.6	3523	30	2023	85.4	0.0	0.0	0.0	0.0	0.0	85.4
3400053	37F3	54.1193	3.3385	NL	WMR	16.4	3588	30	2023	33.9	0.0	0.0	0.0	0.0	0.0	33.9
3400054	36F3	53.8183	3.518	NL	WMR	16.2	3517	30	2023	35.0	0.0	0.0	0.0	0.0	0.0	35.0

3400057	35F3	53.1213	3.333	NL	WMR	15.8	3560	30	2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3400058	34F3	52.7833	3.4923	NL	WMR	16.6	3447	30	2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DK202324	37F3	54.2907	3.1192	DK	DTU-AQUA	21.4	3630	30	2023	25.7	0.0	0.0	0.0	0.0	12.9	38.6
DK202335	39F4	55.2902	4.2529	DK	DTU-AQUA	20.6	3741	30	2023	77.9	0.0	0.0	0.0	0.0	0.0	77.9
DK202336	39F3	55.0827	3.7355	DK	DTU-AQUA	21.9	3621	30	2023	75.7	0.0	12.6	0.0	0.0	0.0	88.3
DK202337	38F3	54.856	3.6691	DK	DTU-AQUA	21.6	3680	30	2023	12.6	0.0	0.0	0.0	0.0	0.0	12.6
FR202311	32F3	51.8293	3.6582	FR	IFREMER	14.6	3402	30	2023	80.5	0.0	0.0	0.0	0.0	0.0	80.5
FR202312	33F3	52.3761	3.4344	FR	IFREMER	16.8	3147	30	2023	18.9	0.0	0.0	0.0	0.0	0.0	18.9
FR202313	34F3	52.6103	3.2771	FR	IFREMER	18.1	3678	34	2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FR202325	34F4	52.914	4.226	FR	IFREMER	15.3	3352	30	2023	117.0	0.0	0.0	0.0	0.0	0.0	117.0
FR202326	33F4	52.3346	4.4236	FR	IFREMER	14.4	3354	31	2023	62.1	0.0	0.0	0.0	0.0	0.0	62.1
FR202327	35F4	53.2214	4.2206	FR	IFREMER	14.6	3392	30	2023	40.4	0.0	0.0	0.0	0.0	0.0	40.4
FR202328	36F4	53.5679	4.3353	FR	IFREMER	15.4	3346	30	2023	19.4	0.0	0.0	0.0	19.4	0.0	38.8
FR202329	36F5	53.7409	5.2298	FR	IFREMER	15.0	3468	31	2023	57.7	19.2	0.0	0.0	38.4	0.0	115.3
FR202334	37F5	54.1716	5.5292	FR	IFREMER	18.4	3393	30	2023	64.1	0.0	0.0	0.0	32.0	0.0	96.1
FR202336	37F4	54.0973	4.1824	FR	IFREMER	18.5	3332	30	2023	48.7	0.0	0.0	0.0	0.0	0.0	48.7
FR202337	36F3	53.603	3.8196	FR	IFREMER	17.3	3240	30	2023	142.7	0.0	0.0	17.8	0.0	0.0	160.6
FR202338	35F3	53.3906	3.2055	FR	IFREMER	16.1	3219	30	2023	347.3	0.0	0.0	0.0	19.3	0.0	366.6

Annex 4.b. Complete trawl list of the BTS Q3 on the DCS for the years 2020-2022, in which the total number of items per trawl (total Count [items/km²] and the number of items per category (A, B, C, D & E [Items/km²]) are reported.

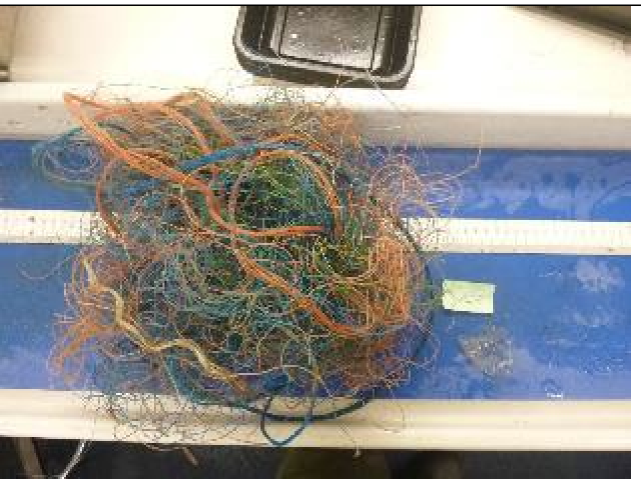
Ices.rect	Latitude	Longitude	Survey_date	Country	Institute	Wing_spread (m)	Bottom_track (m)	Duration (min)	year	A	B	C	D	E	F	Total_Count
35F3	53.2945	3.8455	17-8-2020	NL	WMR	8	3913	30	2020	255.6	0	0	0	0	0	255.6
39F3	55.4095	3.5675	19-8-2020	NL	WMR	8	3836	30.2	2020	32.6	0	32.6	0	0	0	65.2
36F3	53.651	3.36217	20-8-2020	NL	WMR	8	4079	30	2020	122.5	0	0	0	30.6	0	153.1
37F3	54.24467	3.86033	20-8-2020	NL	WMR	8	4531	30.2	2020	55.2	27.6	0	0	0	0	82.8
38F4	54.58967	4.29	20-8-2020	NL	WMR	8	3958	30.1	2020	94.8	0	0	0	0	0	94.8
38F3	54.84417	3.16867	1-9-2020	NL	WMR	8	3689	30	2020	271.1	0	0	0	0	0	271.1
33F4	52.34867	4.04283	27-7-2020	NL	WMR	8	3889	30	2020	64.2	0	0	32.1	0	0	96.3
34F4	52.573	4.27983	27-7-2020	NL	WMR	8	3704	30	2020	0	0	0	0	0	0	0
34F3	52.58483	3.76717	27-7-2020	NL	WMR	8	4259	30	2020	0	0	0	0	0	0	0
35F3	53.08933	3.24683	28-7-2020	NL	WMR	8	3704	30	2020	135	0	33.7	0	33.7	0	202.4
35F3	53.28583	3.1345	28-7-2020	NL	WMR	8	3889	30	2020	321.4	0	0	0	0	0	321.4
35F3	53.42917	3.38	28-7-2020	NL	WMR	8	3704	30	2020	202.2	0	0	0	33.7	0	235.9
36F3	53.65217	3.3595	28-7-2020	NL	WMR	8	4630	30	2020	108	0	0	0	0	0	108
36F3	53.8665	3.26883	28-7-2020	NL	WMR	8	4630	30	2020	243	0	27	0	0	0	270
36F3	53.90767	3.64867	28-7-2020	NL	WMR	8	3889	30	2020	224.9	32.1	32.1	0	0	0	289.1
38F3	54.7775	3.33683	29-7-2020	NL	WMR	8	4259	30	2020	58.6	0	0	0	0	0	58.6
38F3	54.60767	3.51333	29-7-2020	NL	WMR	8	4074	30	2020	306.8	0	0	0	0	0	306.8
37F3	54.42667	3.61667	29-7-2020	NL	WMR	8	4074	30	2020	184.1	0	0	0	0	0	184.1
37F3	54.28167	3.87033	29-7-2020	NL	WMR	8	4074	30	2020	122.8	0	0	0	61.4	0	184.2
37F4	54.30183	4.18833	29-7-2020	NL	WMR	8	4630	30	2020	135	0	0	0	0	0	135
37F4	54.09333	4.19867	29-7-2020	NL	WMR	8	4630	30	2020	0	0	0	0	0	0	0
34F3	52.80817	3.29233	30-7-2020	NL	WMR	8	4074	30	2020	122.8	0	0	0	30.7	0	153.5
34F3	52.57	3.30367	30-7-2020	NL	WMR	8	4074	30	2020	245.5	0	0	0	30.7	0	276.2
33F3	52.36733	3.265	30-7-2020	NL	WMR	8	3889	30	2020	160.6	0	0	32.1	161	32	385.5
33F3	52.12767	3.36883	30-7-2020	NL	WMR	8	4074	30	2020	61.4	30.7	0	0	0	0	92.1

32F3	51.63267	3.24967	30-7-2020	NL	WMR	8	4259	30	2020	58.6	0	29.3	0	0	0	87.9
32F3	51.74583	3.369	30-7-2020	NL	WMR	8	3704	30	2020	168.7	0	0	0	0	0	168.7
33F4	52.205	4.047	3-8-2020	NL	WMR	8	3013	22.8	2020	0	0	0	0	0	0	0
33F4	52.404	4.11367	3-8-2020	NL	WMR	8	3869	30.3	2020	96.9	0	0	0	0	0	96.9
34F4	52.70717	4.5475	3-8-2020	NL	WMR	8	4186	26	2020	29.9	0	0	0	0	0	29.9
38F4	54.61767	4.41583	4-8-2020	NL	WMR	8	4144	30	2020	120.7	0	0	0	0	0	120.7
38F4	54.848	4.39267	4-8-2020	NL	WMR	8	3973	30	2020	31.5	31.5	0	0	0	0	63
39F4	55.0785	4.448	4-8-2020	NL	WMR	8	3821	30.3	2020	65.4	0	0	0	0	0	65.4
37F5	54.18183	5.199	5-8-2020	NL	WMR	8	4630	30	2020	189	0	0	0	0	0	189
37F5	54.26683	5.455	5-8-2020	NL	WMR	8	4630	30	2020	108	27	0	0	0	0	135
36F6	53.92967	6.06733	11-8-2020	NL	WMR	8	3704	30	2020	236.2	0	0	0	0	0	236.2
36F5	53.80733	5.874	11-8-2020	NL	WMR	8	3889	30	2020	192.8	0	0	0	64.2	0	257
36F5	53.967	5.81917	11-8-2020	NL	WMR	8	4074	30	2020	153.4	0	0	0	0	0	153.4
36F5	53.922	5.2765	11-8-2020	NL	WMR	8	4444	30	2020	309.4	28.1	28.1	0	28.1	0	393.7
36F5	53.751	5.2535	11-8-2020	NL	WMR	8	3704	30	2020	168.5	0	0	0	0	0	168.5
36F4	53.6645	4.82617	11-8-2020	NL	WMR	8	3889	30	2020	225	32.1	0	0	0	0	257.1
36F4	53.78517	4.4905	12-8-2020	NL	WMR	8	4259	30	2020	88	0	0	0	29.3	0	117.3
36F4	53.5885	4.33117	12-8-2020	NL	WMR	8	2592	23	2020	1012.8	0	0	0	0	0	1012.8
35F4	53.4015	4.40383	12-8-2020	NL	WMR	8	3704	30	2020	438.6	33.7	0	0	33.7	0	506
35F4	53.2195	4.10733	12-8-2020	NL	WMR	8	3889	30	2020	224.9	32.1	0	0	32.1	0	289.1
35F4	53.05883	4.33117	12-8-2020	NL	WMR	8	3889	30	2020	225	0	0	0	0	32	257.1
34F4	52.87567	4.41133	12-8-2020	NL	WMR	8	3704	30	2020	641.1	0	0	0	0	0	641.1
39F3	55.32317	3.33217	1-9-2021	NL	WMR	8	3741	30.2	2021	133.6	0	0	0	0	0	133.6
38F3	54.8115	3.5835	1-9-2021	NL	WMR	8	3791	30.2	2021	329.8	0	0	0	33	0	362.8
38F4	54.82533	4.1605	1-9-2021	NL	WMR	8	3821	30.2	2021	98.1	0	0	0	0	0	98.1
35F3	53.0505	3.32517	6-9-2021	NL	WMR	8	2723	23.2	2021	183.6	0	0	0	0	0	183.6
40F3	55.70783	3.47467	7-9-2021	NL	WMR	8	3680	30	2021	101.9	0	0	0	0	0	101.9
37F3	54.15833	3.3555	13-9-2021	NL	WMR	8	3705	30	2021	134.9	0	0	0	33.7	0	168.6
36F3	53.73833	3.42567	13-9-2021	NL	WMR	8	3740	30	2021	133.6	0	0	0	0	0	133.6
33F4	52.424	4.04283	2-8-2021	NL	WMR	8	3661	29.6	2021	136.5	0	0	0	0	0	136.5
37F3	54.29167	3.34867	3-8-2021	NL	WMR	8	3858	30.2	2021	226.8	0	32.4	0	32.4	0	291.6
37F3	54.1055	3.49567	3-8-2021	NL	WMR	8	3873	30.3	2021	96.8	0	0	0	0	0	96.8
36F3	53.91283	3.2765	3-8-2021	NL	WMR	8	4398	30	2021	113.6	0	0	0	28.4	0	142
36F3	53.78183	3.51867	3-8-2021	NL	WMR	8	4198	30.1	2021	0	0	0	0	0	0	0
36F3	53.8625	3.83267	3-8-2021	NL	WMR	8	3850	30.1	2021	259.9	0	0	0	0	0	259.9
36F4	53.878	4.2405	3-8-2021	NL	WMR	8	4563	30	2021	137	0	0	0	0	0	137
36F4	53.7965	4.675	3-8-2021	NL	WMR	8	4761	30	2021	52.6	0	0	0	0	0	52.6
36F4	53.635	4.32217	4-8-2021	NL	WMR	8	2350	15	2021	0	53.2	0	0	0	0	53.2
35F4	53.41367	4.39317	4-8-2021	NL	WMR	8	3182	27.3	2021	275.1	0	0	0	0	0	275.1
35F3	53.32917	3.66717	4-8-2021	NL	WMR	8	3686	30.2	2021	305.2	0	0	33.9	0	0	339.1
35F3	53.3905	3.3965	4-8-2021	NL	WMR	8	3778	30.2	2021	132.4	0	0	0	0	0	132.4
34F3	52.791	3.3275	5-8-2021	NL	WMR	8	3602	30	2021	138.8	0	0	0	0	0	138.8
33F3	52.37933	3.18483	5-8-2021	NL	WMR	8	3725	30.2	2021	771.8	33.6	0	0	0	0	805.4
33F3	52.15733	3.31317	5-8-2021	NL	WMR	8	4150	30	2021	271	30.1	30.1	0	0	30	361.3
32F3	51.7435	3.35533	5-8-2021	NL	WMR	8	2255	15.5	2021	277.1	0	0	55.4	0	0	332.5
32F3	51.6365	3.26583	5-8-2021	NL	WMR	8	3909	26.1	2021	479.7	0	0	0	0	0	479.7
34F4	52.64083	4.30517	9-8-2021	NL	WMR	8	3945	30	2021	31.7	0	0	0	0	0	31.7
34F4	52.82617	4.441	9-8-2021	NL	WMR	8	4278	29.8	2021	58.4	0	0	0	0	0	58.4
34F4	52.9495	4.26283	9-8-2021	NL	WMR	8	2756	17.4	2021	45.4	0	0	0	0	0	45.4
38F3	54.62683	3.49933	10-8-2021	NL	WMR	8	4397	30	2021	170.6	0	0	0	0	0	170.6

38F3	54.77017	3.79517	10-8-2021	NL	WMR	8	3784	30	2021	66	0	0	0	0	0	66
38F4	54.828	4.17883	10-8-2021	NL	WMR	8	4088	30	2021	0	0	0	0	0	0	0
38F4	54.88017	4.77433	10-8-2021	NL	WMR	8	3875	30	2021	225.9	0	0	0	0	32	258.2
37F4	54.30217	4.189	11-8-2021	NL	WMR	8	4693	30	2021	79.9	0	0	0	26.6	0	106.5
37F4	54.2575	4.55933	11-8-2021	NL	WMR	8	4711	30	2021	212.2	53	53.1	0	0	80	397.9
37F5	54.288	5.14783	11-8-2021	NL	WMR	8	5082	30	2021	123	0	0	0	98.4	0	221.4
36F5	53.91033	5.30217	16-8-2021	NL	WMR	8	4352	30	2021	172.3	0	0	0	0	0	172.3
36F5	53.90783	5.64983	16-8-2021	NL	WMR	8	4162	29.8	2021	90.1	0	0	0	0	0	90.1
36F5	53.759	5.62383	16-8-2021	NL	WMR	8	4431	30	2021	141	0	0	0	0	0	141
36F5	53.74283	5.08283	17-8-2021	NL	WMR	8	4340	30	2021	288	0	28.8	0	57.6	0	374.4
39F3	55.2971	3.3718	1-9-2022	NL	WMR	8	3637	30	2022	103.1	0	0	0	0	0	103.1
39F4	55.2818	4.0683	1-9-2022	NL	WMR	8	3794	30	2022	98.8	0	0	0	65.9	0	164.7
38F4	54.8351	4.2425	1-9-2022	NL	WMR	8	3897	30	2022	32.1	0	0	0	0	0	32.1
38F3	54.815	3.6075	1-9-2022	NL	WMR	8	3761	30	2022	99.7	0	0	0	0	0	99.7
37F3	54.4403	3.597	1-9-2022	NL	WMR	8	3794	30	2022	197.5	0	0	0	0	0	197.5
35F3	53.402	3.2023	5-9-2022	NL	WMR	8	3803	30	2022	164.4	0	0	0	0	0	164.4
36F3	53.6676	3.1925	13-9-2022	NL	WMR	8	3802	30	2022	0	0	0	0	0	0	0
33F4	52.1855	4.0655	1-8-2022	NL	WMR	8	2838	22	2022	44	0	0	0	44	0	88
32F3	51.9085	3.7948	1-8-2022	NL	WMR	8	1900	15	2022	65.8	0	0	0	0	0	65.8
32F3	51.7675	3.4058	1-8-2022	NL	WMR	8	3457	30	2022	72.4	0	0	0	0	0	72.4
33F3	52.1326	3.3398	2-8-2022	NL	WMR	8	3881	29	2022	64.4	0	0	0	0	0	64.4
33F3	52.392	3.2143	2-8-2022	NL	WMR	8	3652	30	2022	273.8	0	0	0	0	0	273.8
36F3	53.6315	3.3323	2-8-2022	NL	WMR	8	4093	30	2022	61	0	0	0	0	0	61
36F3	53.8125	3.5281	2-8-2022	NL	WMR	8	3804	30	2022	262.9	0	0	0	0	0	262.9
36F3	53.8578	3.2571	3-8-2022	NL	WMR	8	4358	30	2022	172.1	0	0	0	0	0	172.1
37F3	54.1158	3.3431	3-8-2022	NL	WMR	8	4009	30	2022	467.7	0	0	0	0	0	467.7
37F3	54.3183	3.303	3-8-2022	NL	WMR	8	3858	30	2022	194.4	0	32.4	0	0	0	226.8
38F3	54.6753	3.473	3-8-2022	NL	WMR	8	4045	30	2022	154.5	0	0	0	0	0	154.5
38F3	54.8683	3.7823	3-8-2022	NL	WMR	8	3766	30	2022	99.6	0	33.2	0	0	0	132.8
39F4	55.0953	4.1873	3-8-2022	NL	WMR	8	3889	30	2022	160.7	0	0	0	0	0	160.7
38F4	54.6	4.8138	4-8-2022	NL	WMR	8	3368	30	2022	111.3	0	0	0	0	0	111.3
34F4	52.6945	4.2323	8-8-2022	NL	WMR	8	3363	30	2022	37.2	0	0	0	37.2	0	74.4
34F4	52.8968	4.3945	8-8-2022	NL	WMR	8	3658	30	2022	68.3	0	0	0	0	0	68.3
36F5	53.9068	5.2528	9-8-2022	NL	WMR	8	4538	30	2022	165.3	0	0	0	0	0	165.3
36F5	53.9338	5.5873	9-8-2022	NL	WMR	8	4161	30	2022	180.3	0	0	0	0	0	180.3
37F5	54.1628	5.6311	9-8-2022	NL	WMR	8	3891	30	2022	192.7	0	0	0	0	0	192.7
36F6	53.93	6.1368	15-8-2022	NL	WMR	8	4053	30	2022	277.5	61.7	0	0	0	0	339.2
36F5	53.9048	5.8125	15-8-2022	NL	WMR	8	4042	30	2022	185.6	0	0	30.9	0	31	247.4
36F5	53.7898	5.4838	15-8-2022	NL	WMR	8	3971	30	2022	314.8	31.5	0	0	0	0	346.3
38F4	54.873	4.758	16-8-2022	NL	WMR	8	4135	30	2022	121	0	0	0	0	0	121
37F4	54.4278	4.8013	16-8-2022	NL	WMR	8	3997	30	2022	125.1	0	0	0	0	0	125.1
37F4	54.1066	4.5745	16-8-2022	NL	WMR	8	4560	30	2022	27.4	0	0	0	54.8	0	82.2
36F4	53.9111	4.3401	16-8-2022	NL	WMR	8	4205	30	2022	118.8	0	0	0	0	0	118.8
36F4	53.7185	4.5576	16-8-2022	NL	WMR	8	3171	30	2022	78.8	0	0	0	0	0	78.8
36F4	53.5741	4.3126	16-8-2022	NL	WMR	8	3333	30	2022	300	0	0	0	0	0	300
35F3	53.4165	3.1895	17-8-2022	NL	WMR	8	4045	30	2022	30.9	0	0	0	0	0	30.9
35F4	53.3786	4.1323	17-8-2022	NL	WMR	8	2073	15	2022	241.2	0	0	0	0	60	301.5
35F4	53.0658	4.6181	17-8-2022	NL	WMR	8	2730	30	2022	137.4	0	45.8	0	0	92	274.8
33F4	52.4225	4.0368	18-8-2022	NL	WMR	8	2321	15	2022	0	0	0	0	0	0	0

Annex 5 Examples of top-10 litter types

A5 - Monofilament	
A2 - Sheet	
A7 – Synthetic rope	

A3 - Bag	
A6 – Entangled filaments	
A11 - Crates	
A14 - Other	

E1 - Wood	
A1 - Bottle	
B2 - Cans	

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