CleanAtlantic

Assessment between trawl gears baka and GOV for the study of seabed litter

Action 5.2: Monitoring the presence of ML in the Marine Environment

WP 5: Monitoring data and management

Interreg
Atlantic Area
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AUTHORS	IEO : ANA GARCÍA-ALEGRE, GONZALO GONZÁLEZ-NUEVO, FRANCISCO VELASCO, PABLO OTERO, JESÚS GAGO
PARTICIPANTS	

DISCLAIMER

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Introduction

1. AIM OF THE STUDY

One of the objectives of CleanAtlantic is to improve capabilities to monitor marine litter in different compartments: seafloor, beach and sea surface. For that purpose, current methods and technologies are being reviewed and tested and new technologies explored. Regarding the seafloor, the bottom trawl surveys are one of the most common sampling methods used to monitor seabed litter. The focus of these surveys is the assessment of demersal fish stocks, however, they also provide valuable information for the assessment of seabed litter.

This report aims to assess if there are differences on catchability of seabed litter between the two gears used on the ground fish surveys in the French and Spanish shelves. Baka is the gear used as a sampler in the demersal trawl surveys conducted by the Instituto Español de Oceanografía and the GOV (Grand Overture Vertical) is the standard gear used as a sampler in the ICES area in the demersal trawls surveys carried out by IFREMER and other research institutes in the North of Europe.

The first part of the report summarizes the results of a previous study that compares the catchability of the two gears based on fisheries assessment. This study allows for a better understanding of the different behaviour of these gears on the bottom and how it can affect the catchability of seabed litter.

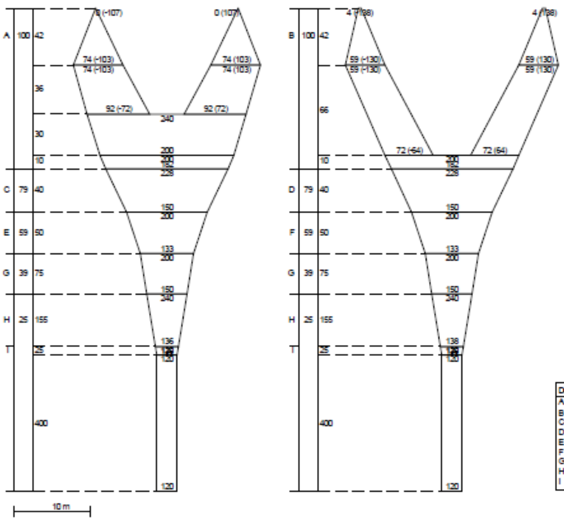
The second part of the report "Assessment of trawl gear baka and GOV performance for the study of seabed litter" analyzed latest data based on 14 paired hauls from 2013 to 2015. As these data come from surveys primarily designed to capture marine biota, an analysis of the fish species captured by the two gears was made firstly in the assumption that fish catchability may provide an indication of the seabed litter catchability. Surprisingly, the further analysis of litter data from the hauls showed that the gear leading to higher yields of benthic or demersal fish species retrieved lower amounts of seabed litter. As marine litter has a highly heterogeneous and non-continuous distribution pattern and the quantities of litter retrieved are scarce, the results cannot be considered conclusive but as a first and preliminary approach to the seabed litter catchability of the compared gears.

2. Previous comparative studies between trawl gear baka and GOV for fisheries assessment

A calibration study between trawl gear baka 44/50 and GOV 36/47, used respectively by the R/V *Cornide de Saavedra* and the R/V *Thalassa*, evaluated the differences on these gears catchability of the main species captured (Sánchez et al., 1994). Based on the aforementioned study, we summarize here the main issues that could be useful to evaluate the differences between these two gears on seabed litter collection.

2.1 GOV *36/47*

The gear GOV 36/47 (Fig. 1) is the standard gear in the ICES area, used as a sampler in the time series of demersal trawl surveys carried out by Ifremer in the Bay of Biscay (French waters). It has a 47.2 m footrope, a 36.0 m headline and a 20 mm mesh size at the cod end. The GOV has three winds of 14 mm steel cable in its mouth. As a difference with the baka, the footrope has 20 cm rotating rubber discs (three sets of 5m) and 10cm (six sets of 5m) which allows working on harder bottoms and a faster trawling speed reaching up to 4 knots.



Description	Material	Runnage (m/kg)	Mesh side (mm)	Diameter (mm)
A	PA	280	100	2.87
B	PA	140	100	4.5
C	PA	280	80	2.87
D	PA	180	80	3.8
E	PA	280	60	2.87
F	PA	180	60	3.8
G	PA	280	40	2.87
H	PA	280	25	2.87
I	PA	180	25	3.8

Figure 1. Scheme of the GOV 36/47 trawl gear used on the French surveys (image from ICES, 2017).

2.2 Baka 44/50

The baka 44/50 (Fig. 2) is the gear used as a sampler in the time series of demersal trawl surveys conducted by the Instituto Español de Oceanografía in the Bay of Biscay (Spanish waters). It has a 43.6 m footrope, a 60.1 headline and a 20 mm mesh size at the cod end. It has not bridles, it used heavy towing sweeps semi-wired in the trawls, and steel cables of 38mm nylon lined, with a length of 200 m. The traditional trawl wooden doors used were rectangular and weighted 650 kg (used on *Sanchez et al. 1994)*. Afterwards, the doors used were made of metal, Thyborøn type, and lighter (350 kg). For the special characteristics of its towing sweeps (steel cables nylon lined) which act practically buried in the substrate, it trawls at a speed close to 3 knots.

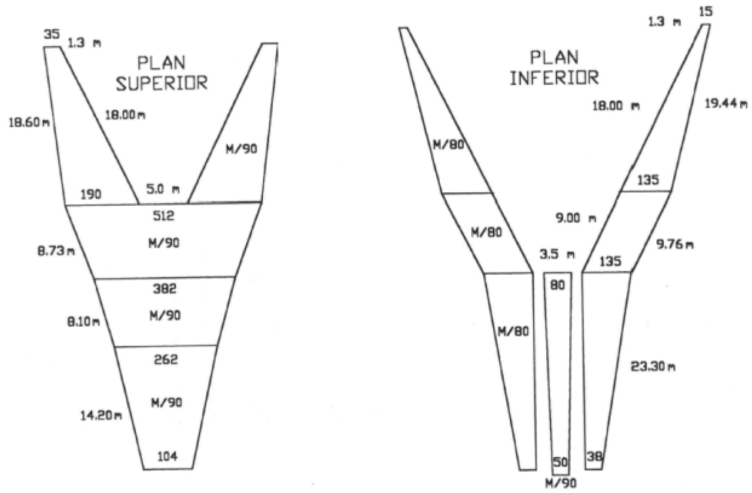


Figure 2. Scheme of the Baca 44/60 trawl gear used during the Spanish surveys on the Iberian Atlantic shelf (image from Sánchez et al. 1994).

2.3 Data

The study was based on 19 parallel hauls of 30 minutes duration using the R/V *Cornide de Saavedra* (baka) and the R/V *Thalassa* (GOV) in the waters of the Bay of Biscay. The mean of catches of the main species per haul and their dispersion statistics were obtained to evaluate the yields of each gear and the selective influence that each of them could have on the demographic structure of the populations.

2.4 Results

The results of this study demonstrate that there are differences on the behaviour of the gears in the bottom and that these have influence on the species that each gear catches. This can be explained by the different fraction of the water column on which the two gears operate. The GOV, with its larger vertical opening, works on the 4 m of water from the bottom, which makes it more effective in capturing semi-pelagic species such as the Atlantic horse mackerel (*Trachurus trachurus*) and Axillary seabream (*Pagellus acarne*) or pelagic species such as Atlantic mackerel (*Scomber scombrus*), European pilchard (*Sardina pilchardus*) or European anchovy (*Engraulis encrasicolus*). The baka works only in the 1.9 m of water from the bottom, but due to its heavy doors and sweeps, which hit the substrate, and its half-buried footrope, it is much more effective to sample species linked to the bottom as Norway lobster (*Nephrops norvegicus*) or megrims (*Lepidorhombus* spp.).

Higher differences in the yields can be expected between the two gears when looking at the catches of benthic invertebrates, as these species have low mobility and are hardly accessible to the GOV. The same may be expected to occur in the case of seabed litter, which is also located on the bottom and with null movement

The case of *Munida sp*., which is a benthic invertebrate with low mobility, is a good example of the great differences in catches between the two gears. The conversion factors indicate a capture power ten times higher in the baka compared to the GOV (Sánchez *et al.* 1994).

2.5 Conclusions

This study shows that both gears exhibit different behaviour in terms of capturing marine biota, being the baka the one that obtains higher yields in species linked to the bottom such as benthic invertebrates. Considering these results, seabed litter catches by these two trawl gears might not be comparable, and in principle, higher yields are expected for baka.

2.6 References

- ICES.2017. Manual of the IBTS North Eastern Atlantic Surveys. Series of ICES Survey Protocols SISP 15. 92 pp. http://doi.org/10.17895/ices.pub.3519

- Sánchez, F., Poulard, J.C., de la Gándara, F. 1994. Experiencia de calibración entre los artes de arrastre BAKA 44/66 y GOV 36/47 utilizado por los B/O Cornide de Saavedra y Thalassa. Inf. Téc. Inst. Esp. Oceanogr. 156.

Assessment between trawl gear baka and GOV performance for the study of seabed litter

1. Data availability

The study was based on 14 paired hauls of 30 minutes duration using the R/V Miguel Oliver (baka) and the R/V Thalassa (GOV) and carried out in the waters of the Bay of Biscay (2013-2015) during the Spanish North Coast and French EVHOE surveys, respectively. Data come from the DATRAS database (the Database of Trawl Surveys) and in specific hauls from IEO personal communication.

We analysed species and seabed litter data per each haul for both gears already described in the previous section.

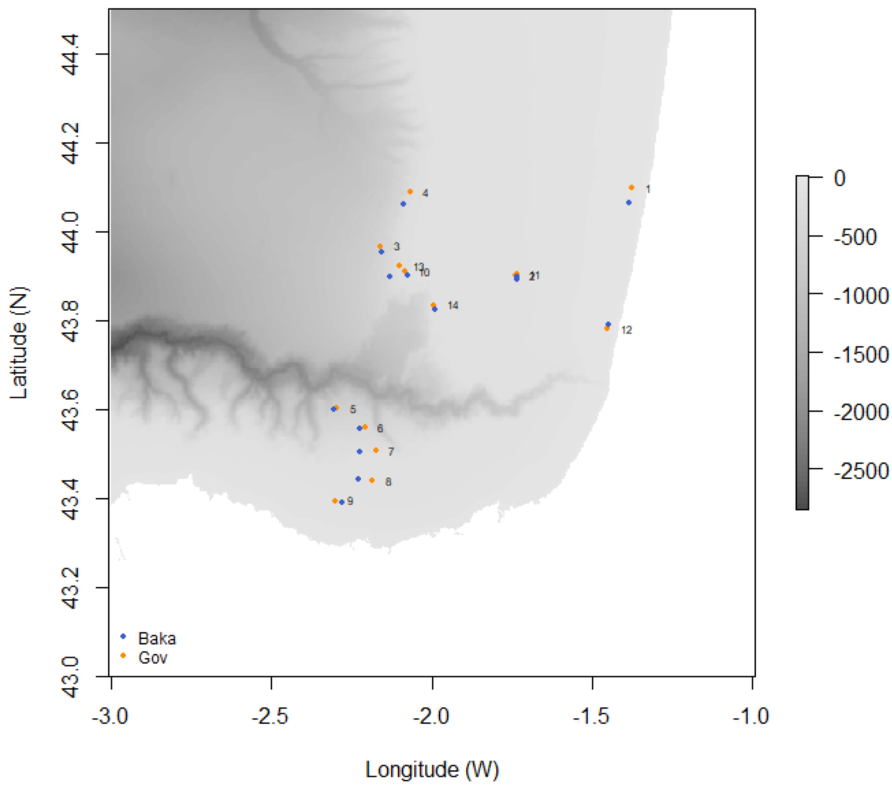


Figure 3. Map of the paired hauls locations (Baka hauls in blue and GOV hauls in orange), showing in grey scale the bathymetry in meters.

2. Data processing

For comparison purposes, species and seabed litter data per haul were referred to the swept area in km^2. For each haul, the density values (number of items x km^{-2} and kg x km^{-2}) were calculated by dividing marine litter number of items or weight by the swept area. The area was calculated on the base of the distance trawled by the net and the estimated horizontal opening. An index was proposed to compare data between both gears for those paired hauls previously shown in Fig. 3:

Index= (Value BAKA - Value GOV)/ Maximum value (Value BAKA or Value GOV).

The Index was calculated for abundance and weight for species and seabed litter data. Positive values indicate a larger capture for the baka gear while negative values indicate major captures for the GOV gear.

2.1 Species data

We analysed all species caught and used the Index to assess differences between species catchability by the two gears. Then, we selected those species that were caught at least in 4 of the 14 paired hauls and classified them by pelagic, demersal or benthic species to evaluate differences in the yields of species linked in a higher or lower degree to the bottom. A table was prepared to summarize the data and the Fisher's test was applied to see if there were significant differences in the species composition of the catches.

2.2 Seabed litter data

The index was calculated in items x km^{-2} and kg x km^{-2} for each paired haul, then the mean and the median for both gears. Significant differences were examined with a sample sign test (median equal to cero).

Also, for each gear, the mean, median, density histograms and percentage of each litter category were calculated to describe the seabed litter captured by each gear. The classification of the seabed litter was done applying the CT-S (CEFAS Trawl litter survey parameters -IBTS) for the baka data and the CT-S-REV (Revised CEFAS Trawl Litter Survey parameters, 2013) for the GOV data.

3. Results

3.1 Species assessment

The results of this analysis corroborates a different behaviour of the gears on the bottom as demonstrated by the differences in the species catches. The Index shows positive values ≥0.25 for 115 species while only

27 species achieve negatives values ≤ 0.25. The baka gear has a higher capture capacity for the majority of species in the area of study and therefore seems to provide a more representative sample of the studied area.

Then, focusing on the type of species, Annex 1 shows the list of the species caught at least in four hauls with the index of abundance and weight and the type of species (benthic, demersal or pelagic). The index reaches values close to 1 for the majority of species (mainly demersal or benthic species linked to the bottom) while only negatives values were obtained for a few pelagic species. Thus, the baka is more effective in capturing species linked to the bottom while the GOV is more effective in species not linked to the bottom.

Table 1 summarizes the number of each type of species caught by each gear. Fisher test (*p* value <0.001) confirmed significant difference in the type of species captured by baka and GOV.

Table 1. Number of species caught (benthic, demersal or pelagic) by each gear.

	Benthic	**Demersal**	**Pelagic**	**Total**
Baka	18	22	3	43
GOV	0	1	7	8

3.2 Seabed litter assessment

3.2.1 Paired hauls data

The index calculated with the paired hauls was -0.42 when considering the number of items and 0.08 for weight. This indicates that higher numbers of seabed litter items were collected with the GOV gear, while in terms of weight the yields for both gears were similar although a bit higher with the baka gear. However, one sample sign test did not confirm significant differences (p value >0.05 for items and weight indices).

Table 2 shows an overview of the index for the seabed litter collected (abundance and weight) per paired haul. Figure 4 displays the data (e.g. number of items x km^{-2} and kg x km^{-2}) per gear and paired haul (Annex 4 shows the tables with the data used). Large differences on weight in hauls 6 and 10 are due to heavy items found in these GOV hauls: a big item of 17.1 kg in the haul 6 (classified as Other Miscellaneous) and five items between 1 and 2 kg such a pallet, a tyre, a fishing net and others. Thus, this also explained why there was a significant difference between the mean and the median in the index of weight (Table 2).

Table 2. Overview of the capture of seabed litter using the Index of abundance and weight.

Paired hauls	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Mean	Median
No. items	0.72	-0.33	-0.79	0.50	-0.48	-0.91	-0.81	-0.50	-0.55	-0.68	-0.78	0.11	-1	NA	**-0.42**	**-0.55**
kg	0.53	0.47	0.90	0.66	0.83	-0.98	0.96	0.83	-0.94	-0.93	-0.92	0.58	-1	NA	**0.08**	**0.53**

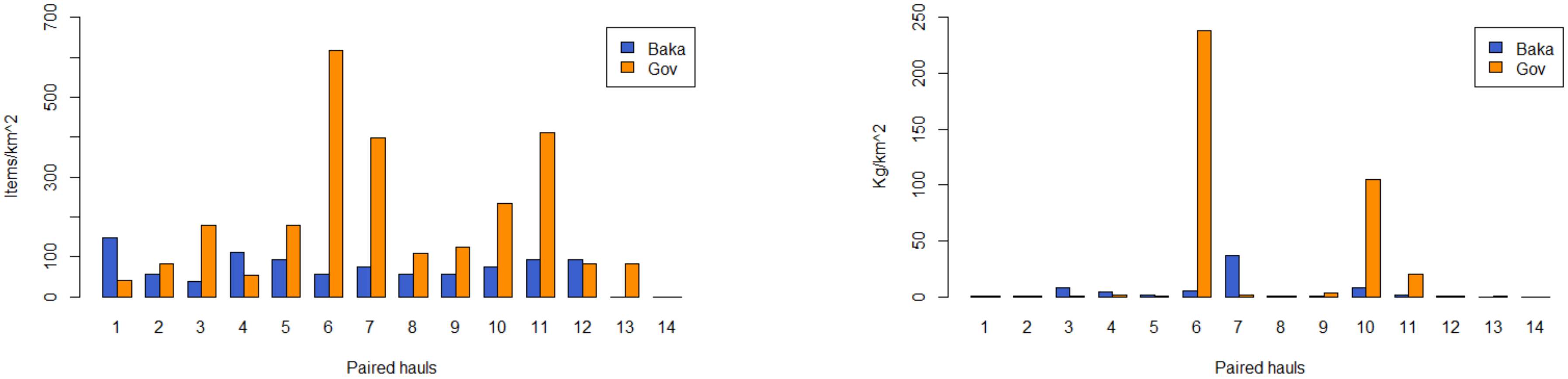


Figure 4. Histograms of number of items x km^{-2} (left) and kg x km^{-2} (right) per type of gear (baka and GOV) in each paired haul.

3.2.2 Baka data

Mean densities of 67.3 ± 10.7 items x km^{-2} and 4.9 ± 2.6 kg × km^{-2} and median densities of 64.6 items x km^{-2} and 1.3 kg x km^{-2} were found for the baka gear.

Figures 5 and 6 illustrate the percentage of the type of seabed litter found by number of items x km^{-2} and kg x km^{-2}, respectively. Annex 2 shows the classification of items following the CT-S Litter reference list. In both cases plastic bags were the most abundant items. In terms of abundance bags were followed by synthetic rope and plastic sheet, but when considering weight, they were followed by plastic bottles and other plastic. In both cases plastic is the major category, with 90.2 % in terms of abundance and 97.6 % in terms of weight.

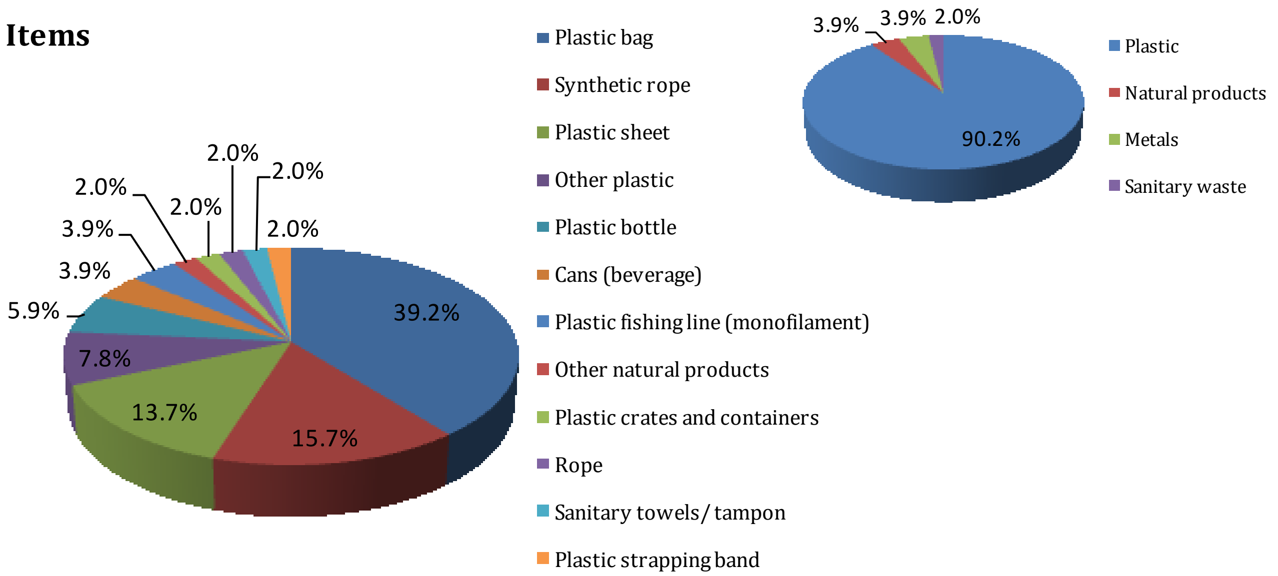


Figure 5. Pie chart showing the percentage of items x km^{-2} for the different types of seabed litter (on the left) and the percentage into broader categories (on the right).

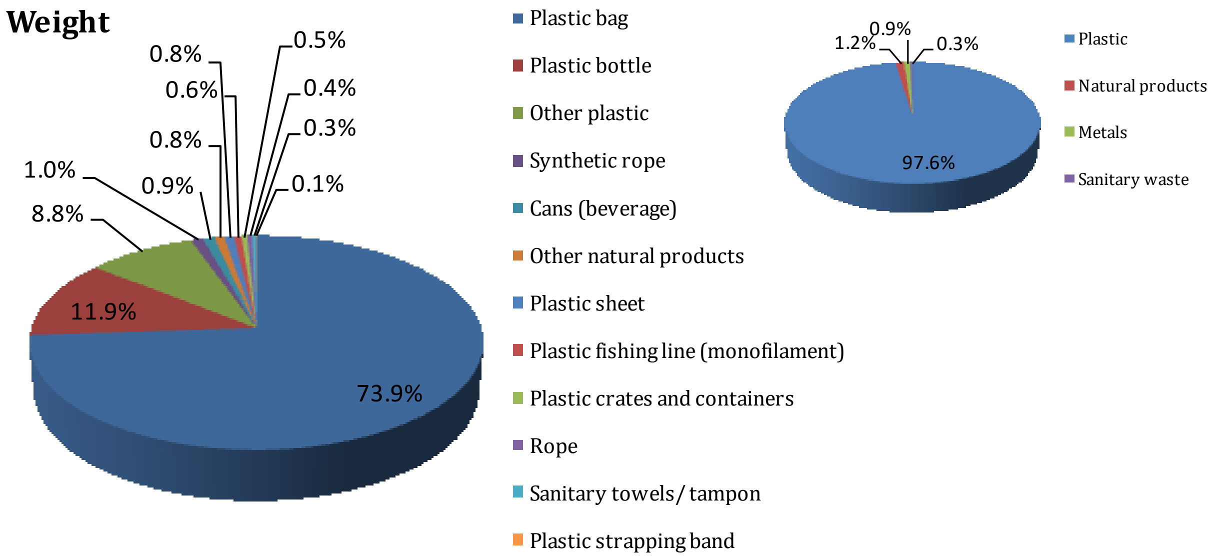


Figure 6. Pie chart showing the percentage of kg×km^{-2} for the different types of seabed litter (on the left) and the percentage into broader categories (on the right).

3.2.3 GOV data

Mean densities of 185.2 ± 46.8 items×km^{-2} and 26.5 ± 17.9 kg×km^{-2} and median densities of 116.6 items×km^{-2} and 0.6 kg×km^{-2} were found for the GOV gear.

Figures 7 and 8 illustrate the percentage of the type of seabed litter found by Items×km^{-2} and kg×km^{-2} respectively. Annex 3 show the classification of items using the CT-S-REV Litter reference list. In terms of abundance synthetic rope and other plastic represent the most abundant items. In general terms plastic made up the 79.9% of the items found. Considering weight, the most abundant category was Miscellaneous with 65.4 % and the items most represented were classified as other (Miscellaneous), followed by tyre (Rubber). This difference between number of items and weight was due to heavier items caught, which belong to Miscellaneous and Rubber categories. For example, an item of 17.1 kg and classified as Other Miscellaneous and a tyre and other rubber item that biased the comparison due to these *abnormal events*.

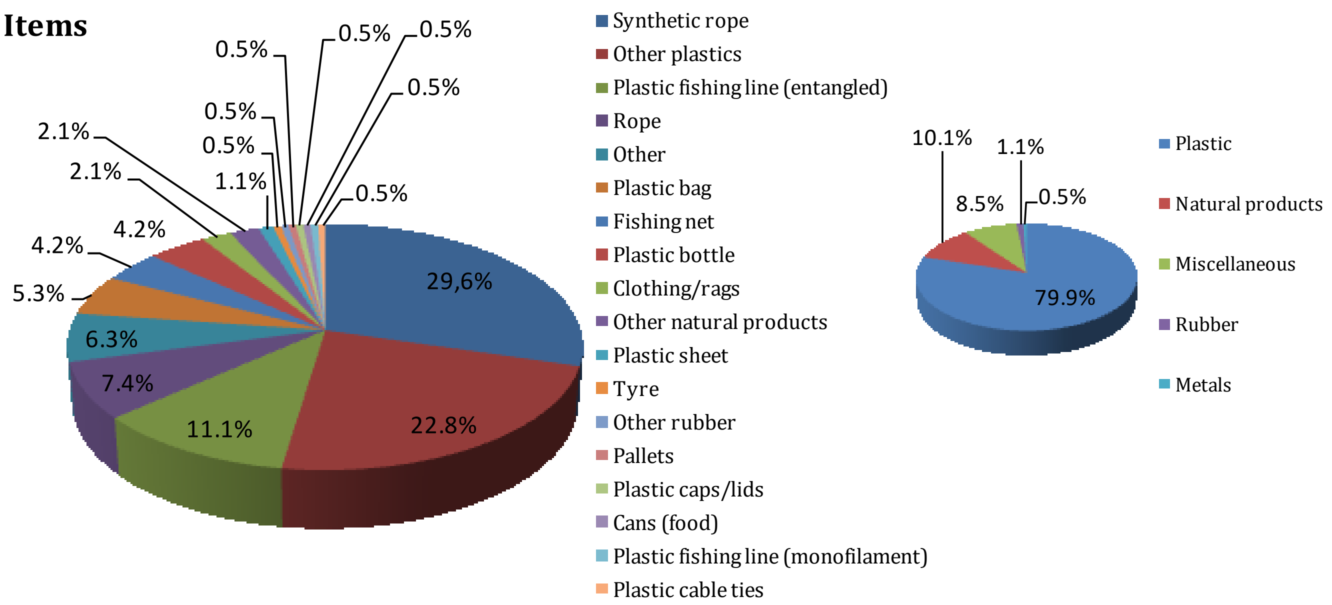


Figure 7. Pie chart showing the percentage of Items×km^{-2} for the different types of seabed litter (on the left) and the percentage into broader categories (on the right).

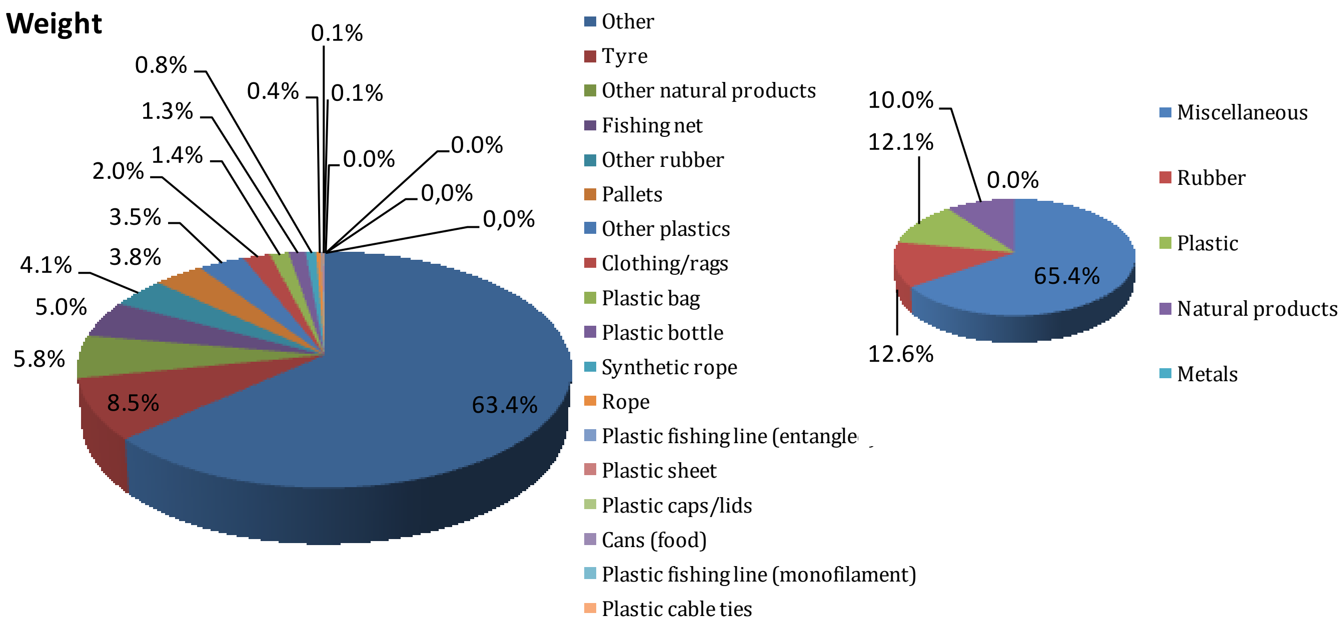


Figure 8. Pie chart showing the percentage of kg×km^{-2} for the different types of seabed litter (on the left) and the percentage into broader categories (on the right).

4. Conclusions

- New data from 2013-2015 corroborates the study of Sánchez et *al*. (1994). Both gears obtain different yields in species linked to the bottom and pelagic species, where the baka obtained higher values on benthic and demersal species and GOV on pelagic species. This makes sense due to the different design and behaviour of the gears explained in the aforementioned study.
- This fact made us think that the baka gear would obtain higher yields of seabed litter. However, data from the 14 paired hauls did not confirm this pattern. Higher yields collecting seabed litter for abundance were found on the GOV gear while only a slightly higher value was found on weight by the baka. Plastic was the major type of litter captured by both gears, except in terms of weight by the GOV gear.
- In conclusion, considering the different behaviour of the two gears on the bottom, the different catchability of the species linked to the bottom and this preliminary study on seabed litter with no conclusive results, we "advise" that seabed litter caught with these two trawl gears are not comparable. Future studies focused on seabed litter are required to assess if there is a correlation on seabed marine litter catches between both gears.

5. References

- ICES Database of Trawl Surveys (DATRAS), 2020. ICES, Copenhagen.
- ICES, 2017. SISP 15 - Manual of the IBTS North Eastern Atlantic Surveys (Survey protocol No. 15), ICES Survey Protocols (SISP). ICES publishing, Copenhagen, Denmark. https://doi.org/10.17895/ices.pub.3519
- IEO personal communication. Assessment between trawl gear Baka and Gov for the study of seabed litter_DATA.xlsx
- Litter reference list (CT-S and CT-S Revised): CEFAS Trawl litter survey parameters (IBTS) and Revised CEFAS Trawl litter survey parameters (2013). Available at: https://vocab.ices.dk/?ref=1381

6. Annex 1

Annex 1. Overview of the species caught at least 4 times with the Index of abundance and weight and the type of species (benthic, demersal or pelagic). N is the number of paired hauls used (at least one gear capture this species).

Species	Index_Abundance	N	Index_Weight	N	Type of species
Callionymus maculatus	1	6	1	6	Benthic
Eledone cirrhosa	1	11	1	11	Benthic
Lesueurigobius friesii	1	6	1	6	Benthic
Polybius henslowii	1	4	1	4	Benthic-Pelagic
Dichelopandalus bonnieri	1	4	1	4	Demersal
Rossia macrosoma	1	4	1	4	Demersal
Sepietta oweniana	1	4	1	4	Demersal
Todaropsis eblanae	1	11	1	11	Demersal
Loligo forbesii	0.97	4	0.98	4	Demersal
Chelidonichthys obscurus	0.97	4	0.97	4	Demersal
Cepola macrophthalma	0.96	4	0.96	4	Demersal
Bathysolea profundicola	0.95	4	0.96	4	Benthic
Microchirus variegatus	0.9	9	0.88	9	Benthic
Lepidorhombus whiffiagonis	0.86	9	0.95	9	Benthic
Solea solea	0.85	5	0.91	5	Benthic
Lophius piscatorius	0.8	8	0.78	8	Benthic
Molva macrophthalma	0.75	6	0.74	6	Demersal
Arnoglossus laterna	0.75	8	0.78	8	Benthic
Trachurus mediterraneus	0.68	9	0.58	9	Pelagic
Lepidorhombus boscii	0.68	11	0.78	11	Benthic
Conger conger	0.64	12	0.52	12	Demersal
Phycis blennoides	0.63	9	0.73	9	Demersal
Lophius budegassa	0.58	7	0.5	7	Benthic
Scyliorhinus canicula	0.57	13	0.74	13	Benthic
Eutrigla gurnardus	0.55	7	0.46	7	Demersal
Boops boops	0.51	5	0.15	5	Pelagic -Demersal
Gadiculus argenteus	0.5	9	0.52	9	Demersal
Callionymus lyra	0.5	9	0.47	9	Benthic
Trachinus draco	0.49	4	0.52	4	Benthic
Argentina sphyraena	0.49	9	0.59	9	Demersal
Mullus surmuletus	0.48	5	0.53	5	Demersal
Arnoglossus imperialis	0.45	4	0.66	4	Benthic
Nephrops norvegicus	0.44	4	0.31	4	Benthic
Galeus melastomus	0.4	7	0.6	7	Benthic
Capros aper	0.39	9	0.41	9	Demersal
Trigla lyra	0.34	5	0.14	5	Demersal

Scomber japonicus	0.33	6	0.33	6	Pelagic
Trisopterus luscus	0.29	8	0.27	8	Demersal
Chelidonichthys cuculus	0.27	8	0.15	8	Demersal
Illex coindetii	0.21	11	0.22	11	Demersal
Helicolenus dactylopterus	0.14	4	0.07	4	Demersal
Merluccius merluccius	0.11	14	0.65	14	Demersal
Sepia elegans	NA	0	0.5	4	Demersal
Micromesistius poutassou	-0.04	12	0.26	12	Demersal
Engraulis encrasicolus	-0.15	8	-0.21	8	Pelagic
Zeus faber	-0.29	4	-0.1	4	Pelagic-Demersal
Maurolicus muelleri	-0.35	4	NA	0	Pelagic-Demersal
Scomber scombrus	-0.38	8	-0.58	8	Pelagic
Sardina pilchardus	-0.41	6	-0.33	6	Pelagic
Trachurus trachurus	-0.43	12	-0.79	12	Pelagic
Scomber colias	-1	5	-1	5	Pelagic

7. Annex 2

Annex 2. List of seabed litter collected with the baka gear using the CT-S Litter reference list

Code CT-S	Description
A	**Plastic**
A1	Plastic bottle
A10	Plastic strapping band
A11	Plastic crates and containers
A12	Other plastic
A2	Plastic sheet
A3	Plastic bag
A5	Plastic fishing line (monofilament)
A7	Synthetic rope
B	**Sanitary waste**
B6	Sanitary towels/ tampon
C	**Metals**
C2	Cans (beverage)
F	**Natural products**
F2	Rope
F5	Other natural products

8. Annex 3

Annex 3. List of seabed litter collected with the GOV gear using the CT-S-REF Litter reference list

Code CT-S-REV	Description
A	**Plastic**
A1	Plastic bottle
A14	Other plastics
A2	Plastic sheet
A3	Plastic bag
A4	Plastic caps/lids
A5	Plastic fishing line (monofilament)
A6	Plastic fishing line (entangled)
A7	Synthetic rope
A8	Fishing net
A9	Plastic cable ties
B	**Metals**
B1	Cans (food)
C	Rubber
C4	Tyre
C6	Other rubber
E	**Natural products**
E2	Rope
E4	Pallets
E5	Other natural products
F	**Miscellaneous**
F1	Clothing/rags
F3	Other

9. Annex 4

Annex 4a. ***Overview of number of items×km^{-2} per baka and GOV for each paired haul.***

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Mean	Median
Baka	147.7	55.4	36.9	110.8	92.3	55.4	73.9	55.4	55.4	73.9	92.3	92.3	0	0	67.3	64.6
GOV	41.2	82.3	178.3	54.9	178.3	617.3	397.8	109.7	123.5	233.2	411.5	82.3	82.3	0	185.2	116.6

Annex 4b. ***Overview of number kg×km^{-2} per baka and GOV for each paired haul.***

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Mean	Median
Baka	0.9	0.6	8.3	3.9	1.8	5.6	36.8	0.7	0.2	7.5	1.7	1.0	0	0	4.9	1.3
GOV	0.4	0.3	0.8	1.3	0.3	238.1	1.6	0.1	3.0	104.7	20.3	0.4	0.3	0	26.5	0.6