Overview of the international fishing activities on the Central Oyster Grounds and Frisian Front

Update with Dutch, British, Danish, German, Belgian, Swedish and French data for 2010-2015

Erik F. C. Buisman, Niels T. Hintzen, Katell G. Hamon

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Summary

In response to a request to Wageningen University & Research from the Dutch Ministry of Economic Affairs, an update of the data and analysis on the value of the fishing activities of the Dutch, British, Danish, German, Belgian, Swedish and French fishing fleets on the proposed closed areas on the Central Oyster Grounds and Frisian Front was prepared. This report uses the method presented in Chapter 5 of *Effects of seabed protection on the Frisian Front and Central Oyster Grounds* (Van Oostenbrugge et al. 2015) to update the reports already published by Wageningen Economic Research on fishing activity on the proposed closed areas on the Central Oyster Grounds and Frisian Front (Oostenbrugge, Bartelings et al. 2013, Oostenbrugge and Hamon 2014, van Oostenbrugge and Hamon 2014, Oostenbrugge, Turenhout et al. 2016, Oostenbrugge, Turenhout et al. 2016). The effort, value and landings by the Dutch, British, Danish, German, Belgian, Swedish and French fishing fleets are presented for a five-year period (2010-2015) and show variations over the last years without a clear trend. Value of landings and gross value added of the Dutch, British and Belgian fleets have been fluctuating over the past years but there was a clear upward trend for Danish and German fleets. Sweden and France have not been active in the area over the 2010-2015 period. Main target species of the Central Oyster Grounds and Frisian Front are plaice and sole mostly targeted by the beam trawl fleet, and sprat (largest in volume) targeted by the Danish fleet. The other demersal fleets also catch some nephrops and herring.

1 Introduction

In response to a request to Wageningen University & Research from the Dutch Ministry of Economic Affairs, an update on data and analysis on the value of the fishing activities of the Dutch, British, Danish, German, Belgian, Swedish and French fishing fleets on the proposed closed areas on the Central Oyster Grounds and Frisian Front for bottom-contact gears for the years 2010 to 2015 has been made. This report is a follow-up on the previous analysis of fishing activity performed by Wageningen Economic Research (Hamon et al. 2013, Oostenbrugge et al. 2013, Oostenbrugge and Hamon 2014, Oostenbrugge and Hamon 2014, van Oostenbrugge and Hamon 2014, Oostenbrugge et al. 2016, Oostenbrugge, Turenhout et al. 2016). The first step in order to assess the effects of the closures on the fishing sector is the quantification of the historic fishing activities in the areas. This is important for the estimation of the costs of closures as historic data provide the basis for any analysis of effects of closures and the effect of closures depend on the extent of fishing activities, the type of fisheries in the area and the dependency of these fisheries on the area. In this report the same data sources and methods have been used as in Chapter 5 of the cost-benefit analysis of the Frisian Front and Central Oyster Grounds (Oostenbrugge et al. 2015) and in recent reports (Hamon et al. 2017, Hamon et al. 2017, Hintzen et al. 2017). Research institutes of Great Britain (CEFAS), Denmark (DTU-AQUA), Germany (TI), Belgium (ILVO), Sweden (SLU) and France (IFREMER) were asked to provide aggregated data on the fishing activities of their countries in the proposed closed areas on the Central Oyster Grounds and the Frisian Front, to obtain an overview of the international activities on these fishing grounds.

This exercise was undertaken for the period 2010-2015 for all bottom-trawling fleets for the Central Oyster Grounds and Frisian Front. Fishing activities in the areas were quantified in terms of effort, landings volume, landings value and contribution to the Gross Value Added (GVA). The GVA is especially important as this metric indicates the value of the fishing activities to society: the returns on the invested capital (fishing vessel) and labour by the crew. The analyses are restricted to the fishing activities inside the closed areas and not beyond.

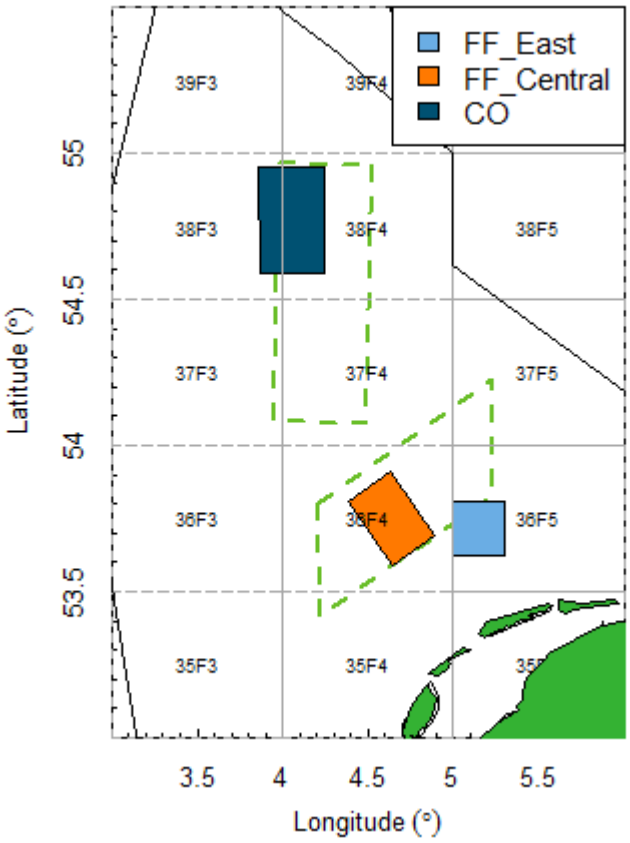

Figure 1.1 *Maps of the proposed closed areas on the Central Oysterground (CO) and the Frisian Front (FF) with the adjacent ICES rectangles*

2 Methodology

2.1 Data

Several data sources were used in this study: Vessel Monitoring System (VMS) data, catch data from logbooks (Fish Registration and Information System), Fleet data from the Netherlands Register of Fishing Vessels (NRV), and Data on landings value and economic performance of all fleets that were obtained from the database[1] of the Annual Economic Report of the EU fishing fleets (STECF, 2016).

2.2 Fishing activity for bottom-contact gears

2.2.1 Base data

The abovementioned data sources were analysed in a standardised manner, where a script is developed that describes the processing and analysis of the data sets and can be applied by any nation that has similar VMS and logbook data in a standardised format. The same standardised script was applied to Dutch, German, Danish, British and Belgian data. Sweden already had data available that had been processed in a way that was very similar to the process outlined by Wageningen University & Research. France used own software to process the data but followed similar steps as outlined by Wageningen University & Research. The script calculates effort, total landings and landings of the main fish species in the area of interest. Based on pre-VMS and logbook data for the years 2010 to 2015, which were processed to remove erroneous fields, the script calculates effort, total landings and landings of the main fish species in the area of interest.

The same method (and script) was used for all countries involved in this study because all of them use the same type of data, except for France and Sweden (see Hintzen et al. 2012 for a description of the data format).

The pre-processing of the dataset for the Dutch data follows the approach developed in Hintzen et al. (2013). VMS records are removed when they are:

- Duplicates or pseudo-duplicates
- Not positioned on the globe
- Located in a harbour
- Located on land
- Associated with vessel speeds >20 knots.

Logbook records are removed when they:

- Are duplicates
- Have arrival times before departure times
- Start before the 1 January of the year considered (despite the fact that the end of the trip falls within the considered year)
- Overlap with other trips.

[1] https://stecf.jrc.ec.europa.eu/documents/43805/1481615/2016_STECF+16-11+-+EU+Fleet+Economic+and+Transversal+data+tables.zip and https://stecf.jrc.ec.europa.eu/documents/43805/1034590/2015_STECF+15-07+-+EU+Fleet+Economic+data+tables.zip downloaded on 21 September 2016

2.2.2 Link VMS and logbook data

To further analyse the data, the spatial resolution in the VMS data must be linked to the catch and effort data in the logbooks. Therefore, the VMS and logbook data in the ICES rectangles of interest were selected. All ICES rectangles overlapping with the Central Oyster Grounds and Frisian front area were selected (see Figure 1.1). Because the Central Oyster Grounds and Frisian Front are particularly sensitive to bottom-contact gears, we selected only those gear types (see full list of the gears considered in Table 2.1).

VMS and logbook datasets are linked using the vessel identifier and date-time stamp. In other words, records (also called pings) in the VMS dataset that fall within the departure-arrival timeframe of a trip described in the logbook are assigned the unique trip number from the logbook record and allow for an analysis of the two datasets simultaneously.

2.2.3 Define fishing activity

For each gear type, the activity of the vessel (floating, fishing or steaming) is defined based on the instantaneous speed in VMS records (see Table 2.1). For each ping, the state of the vessel is identified based on gear and speed.

Table 2.1 *Determination of fishing activity based on the vessel speed. The speeds used in the Dutch fleet are presented.*

Gear	Gear code	Floating	Fishing	Steaming
Beam trawls	TBB	<2 knots	2-8 knots	>8 knots
Danish and Scottish Seines	SDN and SSC	<0.5 knots	0.5-6 knots	>6 knots
Dredges	DRB	<1 knots	1-5 knots	>5 knots
Otter board or twin trawls	OTB and OTT	<1 knots	1-5 knots	>5 knots
Pair trawls	PTB	<1 knots	1-5 knots	>5 knots

For other countries, the speeds can be modified based on the specifics of the fleet.

2.2.4 Assign effort and landings to pings

Each VMS ping represents a certain amount of time, usually equal to the interval rate at which VMS pings are emitted, ranging from 30 minutes to 2 hours. The fishing effort is defined as the sum of these time steps for those pings where the previous analysis indicated a ‘fishing’ state.

The landings are recorded by trip, per ICES rectangle and day in the logbook. For this analysis, we retained the landings of the top 10 species (in volume) and the total landings per year and per country for the ICES rectangles and gears of interest.

For each trip that could be linked to VMS data, the landings and the days at sea are as registered in the logbooks are allocated to the VMS pings in a step wise process: If a match in trip, ICES rectangle, and fishing day is found, the registered landings are assigned to the VMS pings, weighted by the average time each VMS ping represents (ranging from 30 minutes to 2 hours). If a match cannot be found, fishing day and/or ICES rectangle is left out of the equation. Any remaining logbook record that could not be matched to any VMS ping is assigned to following the same step wise process, but dropping the requirement that vessel ID in both datasets must be the same. This results in a full allocation of all landings of the logbook data to the VMS data.

For the trips that could not be linked to VMS points (e.g. small vessels that do not carry VMS transducers on-board), the total days at sea and landings in the adjacent ICES rectangle are aggregated.

2.2.5 Define pings in the areas of interest

The coordinates of each VMS ping are compared to the location of the proposed closed areas on the Central Oyster Grounds and Frisian Front (see Figure 1.1). When a VMS ping is located inside any of the areas, it is selected and assigned to the area of interest (see Appendix 1 for information on each of the areas).

The data for each country is hereafter aggregated by year, subarea, gear type and vessel length category. Vessel length is used to link the data to economics (see Section2.3). The logbook records without VMS data are also aggregated by year, ICES rectangle, gear type and vessel length category.

2.2.6 Uncertainty in the analyses

In the analyses a number of assumptions have to be made related to fishing activity and linking catches to VMS pings. Although these assumptions have been tested thoroughly, consultations with fishermen to verify our assumptions and international consultations on these methods have taken place, the final results are uncertain and changes in assumptions will likely affect the numeric values presented in the results. It is anticipated however that these differences do not alter the conclusions. No exercise has been undertaken to quantify the uncertainty however.

2.3 Economics

The resulting effort (sea days) and landings per gear type, vessel length class, country and year are used to calculate the value of landings and gross value added (GVA). The landings data were combined with economic information from the database of the Annual Economic Report of 2016 (STECF 2016). In this database, catch information (landings volume and value) is available at the level of gear type, vessel length category and ICES subarea (e.g. Central North Sea). Because of this, the landings value in the areas of interest (AoIvalue) was estimated by combining the landing volume in the proposed closed areas (AoIlandings) with the average fish price (CNSvalue/CNSlandings) for each gear type *g*, vessel length class *l*, country *c* and year *y* in the Central North Sea, CNS (see Appendix 2):

$$AoIvalue_{g,l,c,y} = AoIlandings_{g,l,c,y} \cdot \frac{CNSvalue_{g,l,c,y}}{CNSlandings_{g,l,c,y}}$$

The GVA generated in the areas of interest by each gear *g*, vessel length category *l*, country *c* and year *y* ($AoIGVA_{g,l,c,y}$) was estimated using the value of landings in the areas of interest for the gear, vessel length category, country and year and the GVA per euro landed for each fleet of the same vessel length category using the gear, weighted by the value of landings in the Central North Sea, caught by the fleet in question with the gear (see Appendix 2):

$$AoIGVA_{g,l,c,y} = AoIvalue_{g,l,c,y} \cdot \frac{\sum_f \left(\frac{GVA_{f,c,y}}{value_{f,c,y}} CNSvalue_{f,g,l,c,y} \right)}{\sum_f CNSvalue_{f,g,l,c,y}}$$

Because STECF 2016 data only covers economic data until 2014, 2015 GVA values are calculated based on the GVA and fleet values of 2014. The GVA calculation is done as follows:

$$GVA_{f,c,y} = \frac{value_{f,c,y} + rightincome_{f,c,y} + otherincome_{f,c,y}}{EnergyCost_{f,c,y} + rightCost_{f,c,y} + VariableCost_{f,c,y} + RepairCost_{f,c,y} + FixedCost_{f,c,y}}$$

Where *rightincome* and *rightCost* represent the income and costs to lease quota out or in, *otherincome* are all the other income sources apart from value of landings and right income. In addition to right costs, energy costs, repair costs, other variable costs and fixed costs are also considered in the calculation of the GVA.

3 Results

3.1 Fishing activity

Over the 2010-2015 period the amount of fishing activities with bottom-contacting gear has varied significantly from year to year in the proposed closed areas on the Central Oyster Grounds and Frisian Front (Figure 3.1 and Table 3.1) most of the logbook records in the Central Oyster Grounds and Frisian Front areas could be matched with VMS data (see Table A3.1 in Appendix 3); for all countries the coverage rate of VMS data was above 94% on average for the period studied. This result allows us to focus more on the dataset where VMS and Logbooks are linked and provide greater spatial and temporal resolution.

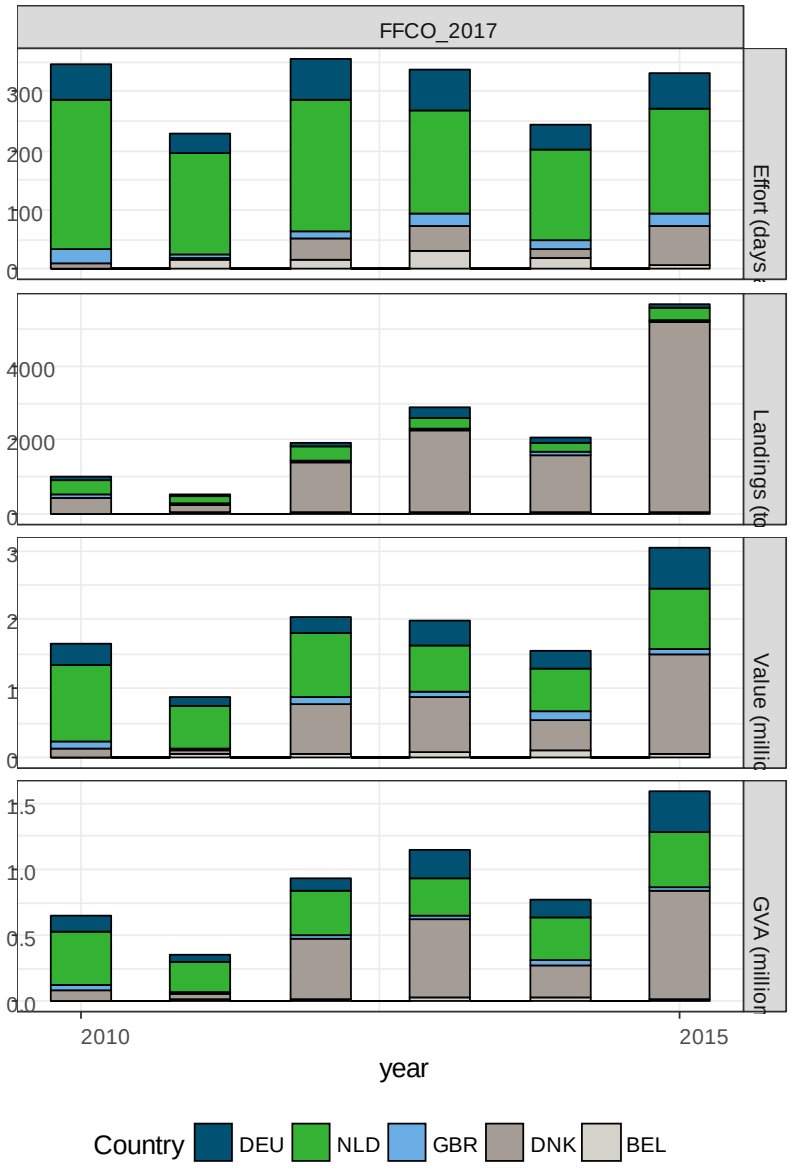

Figure 3.1 *Historical trend of the fishing activities by the different fleets in the proposed closed areas of the Central Oyster Grounds and Frisian Front. Effort, landings, value of landings and GVA are given by country*
Source: Logbook data and VMS data and data from the Annual Economic report (STECF 2016), processed by WUR, CEFAS, TI,DTU, ILVO, SLU and IFREMER.

When using only the combined VMS-logbook information, we see that the effort in the area has varied from year to year with different patterns for the different countries. For the Belgian fleet, fishing activities effort seems to be declining while Dutch, British and German activity is more variable without a clear trend. Danish activity is increasing on the Central Oyster Grounds and Frisian Front while France and Sweden have not fished in the areas during the 2010-2015 period. Over the period, the Dutch effort was on average 192 days, while British, German, Danish and Belgian activities amounted to 17, 55, 28 and 15 days at sea respectively, about 10 to 4 times less. While the effort showed a downward trend, the landings remained relatively stable over the period at an average of 318 tonnes for the Netherlands, 55 tonnes for Great Britain, 21 tonnes for Belgium, 134 tonnes for Germany, and 1,825 tonnes for Denmark, representing a value of 805 k€ (Netherlands), 89 k€ (Great Britain), 53 k€ (Belgium), 316 k€ (Germany) and 593 k€ (Denmark), and a GVA of 334 k€ (Netherlands), 27 k€ (Great Britain), 19 k€ (Belgium), 152 k€ (Germany) and 373 k€ (Denmark). The values for the various subareas can be found in Appendix 1.

Table 3.1 *Overview of effort, landings and values and gross value added of the fishing sector in the proposed closed areas of the Central Oyster Grounds and Frisian Front of the different fleets (VMS and logbook merged data only)*

Country	2010	2011	2012	2013	2014	2015 a)	Average
Effort (days at sea)							
Netherlands	250	173	221	175	154	177	192
Great Britain	26	6	13	20	15	22	17
Denmark	8	2	36	45	13	66	28
Germany	60	33	69	68	42	58	55
Belgium	1	17	15	30	20	8	15
Sweden	0	0	0	0	0	0	0
France	0	0	0	0	0	0	0
Total	345	230	354	337	244	331	307
Landings (tonnes)							
Netherlands	409	216	370	305	281	325	318
Great Britain	68	25	51	53	83	53	55
Denmark	431	218	1,372	2,216	1,523	5,186	1,825
Germany	113	64	108	272	112	135	134
Belgium	1	13	18	34	47	13	21
Sweden	0	0	0	0	0	0	0
France	0	0	0	0	0	0	0
Total	**1,023**	**536**	**1,919**	**2,880**	**2,047**	**5,713**	**2,353**
Value (1,000 euros)							
Netherlands	1115	608	939	668	632	869	805
Great Britain	102	38	96	73	134	90	89
Denmark	123	60	724	788	422	1,442	593
Germany	311	135	231	377	242	602	316
Belgium	3	40	50	80	105	42	53
Sweden	0	0	0	0	0	0	0
France	0	0	0	0	0	0	0
Total	**1,654**	**881**	**2,040**	**1,986**	**1,536**	**3,044**	**1,857**
Gross Value Added (1,000 euros)							
Netherlands	413	230	344	283	317	417	334
Great Britain	34	9	27	24	43	28	27
Denmark	85	42	454	586	243	828	373
Germany	119	52	88	217	130	307	152
Belgium	2	16	18	33	32	14	19
Sweden	0	0	0	0	0	0	0
France	0	0	0	0	0	0	0
Total	**652**	**350**	**931**	**1,143**	**765**	**1,593**	**906**

a) 2015 GVA data are based on the 2014 GVA factors, 2015 value of landings for Denmark is based on 2014 factor. Source: Logbook data and VMS data and data from the Annual Economic report (STECF 2015), processed by WUR, CEFAS, TI,DTU, ILVO, SLU and IFREMER.

The majority of the fishing activities on the Central Oyster Grounds and Frisian Front is carried out by Dutch vessels followed by Danish, German, British and Belgian fleets. The fishing occurs mainly with beam trawls and otter-board trawls (Figure 3.2). The category beam trawls (TBB) includes besides the traditional beam trawl also new techniques like pulse trawl and sum wing that are currently more commonly used than the traditional beam trawl in the Dutch fleet. The Dutch fleet also operates seines in the area.

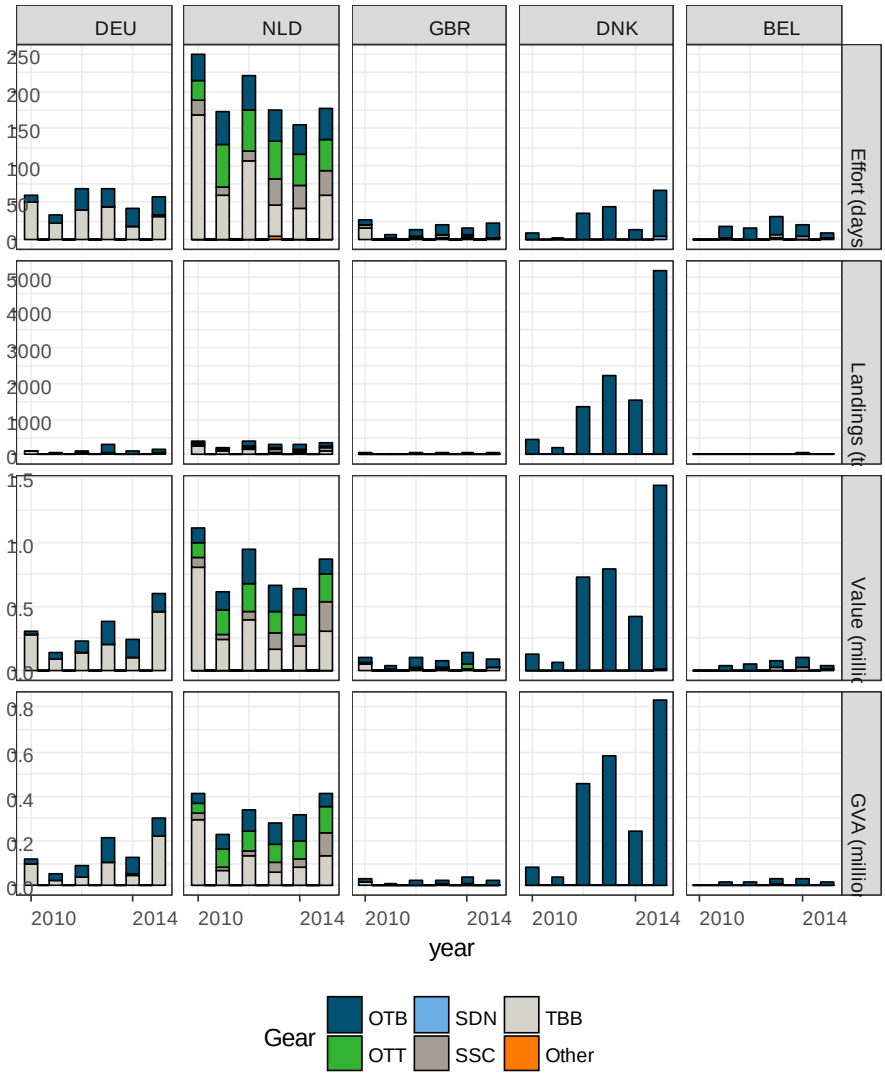

Figure 3.2 *Historical trend of the fishing activities with different gears (OTB: Otterboard trawl; OTT: twinrig; SDN: Danish seine; SSC: Scottish seine; TBB: beam trawl)in the proposed closure of the Central Oyster Grounds and Frisian Front for the different countries. Effort, landings, value of landings and GVA are given by country*
Source: Logbook data and VMS data and data from the Annual Economic report (STECF 2016), processed by WUR, CEFAS, TI, DTU, ILVO, SLU and IFREMER.

3.2 Species targeted

The main species targeted by the beam-trawl fleet on the Central Oyster Grounds and Frisian Front is plaice with low catches of sole. The other demersal gears catch a combination of species such as sprat, plaice and herring. Some sole and nephrops are caught as well. All other species have much lower landings with the notable anomaly of the Danish fleet in 2014 that caught sprat (Figure 3.3).

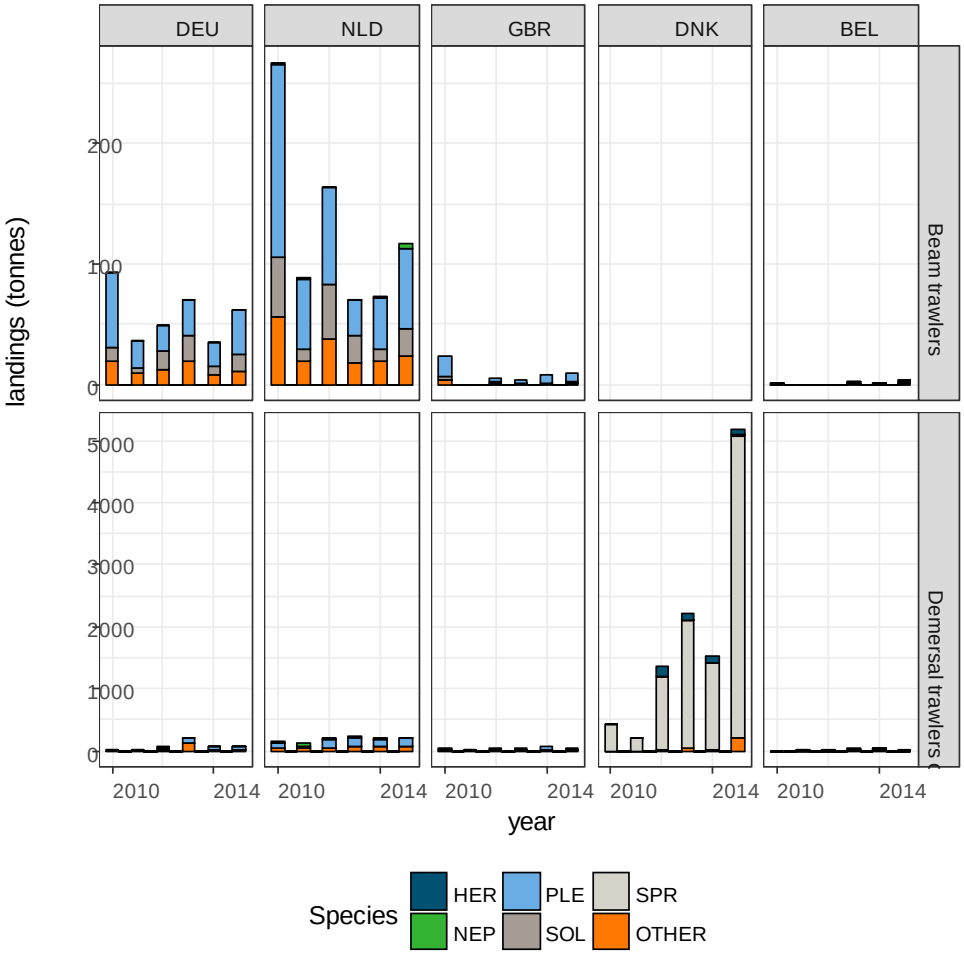

Figure 3.3 *Landings in tonnes for the top 5 species per country on the proposed closed areas of the Central Oyster Grounds and Frisian Front for bottom-contact gears*
Source: Logbook data processed by WUR, CEFAS, TI,DTU, ILVO, SLU and IFREMER; HER=herring, NEP=nephrops, PLE=plaice, SOL=sole, SPR=sprat

4 Discussion and conclusion

The fishing intensity in the proposed closed areas on the Central Oyster Grounds and Frisian Front (see Figure 1.1) has fluctuated over the 2010-2015 period. The Netherlands has the highest fishing activity in the area, followed by Germany, Denmark, Great Britain and Belgium. France and Sweden have reported not to have fished in the areas studied. This is probably due to the interest in target species in the area, which is especially plaice, one of the main target species for the Dutch beam trawl fleet. Other demersal fisheries (especially Denmark) catch mixtures of small pelagics such as sprat and herring.

There are no clear trends in the fishing activity over the 2010-2015 period with fluctuating effort. Only Denmark shows an increase in landings due to their targeting small pelagics. GVA of the Danish and German fleets have strongly increased over the past few years while the Dutch, British and Belgian fleet have been fluctuating without a clear trend in nearly all of the indicators. The total value of landings has remained relatively stable on the Central Oyster Grounds and Frisian Front ranging from about €0.9m in 2011 up to €3m in 2015.

The reported values of the areas of interest do not necessarily reflect the value of these areas for the fishing sector in the (near) future. The value of an area results from the combination of available fish and the effort applied in an area. If one of these factors changes, the value of such an area changes as well. When fishers move their effort to different locations, the future value of these areas will decline and closure of these specific areas may result in smaller economic losses. We assume that fishers move their effort to other locations in case of area closures. The effects of moving effort to another location (displacement) on catch and revenue are less well understood. Although attempts have been made (Oostenbrugge et al. 2015) research in the field of displacement remains necessary. If effects are small at the scale of the fleet, this does not imply that individual fishers will not be affected substantially by a closure of a specific area at sea. The effects of closing a specific area are generally thought to have less effect fleet wide than on specific individuals or fishing companies.

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Appendix 1 Characteristics of the activities in the sub-areas of the Central Oyster Grounds of all countries

Table A1.1 *Overview of effort and landings of the different fleets in the different sub-areas (logbook and VMS merged)*

Country	Year	Gear	Sub-area	Effort (days at sea)	Landings (kg)	Type of data
BEL	2010	TBB	CO	0	777	FFCO_2017.Rdata-tacsatEflalo
BEL	2010	OTB	FF_Central	0	261	FFCO_2017.Rdata-tacsatEflalo
BEL	2010	TBB	FF_Central	0	353	FFCO_2017.Rdata-tacsatEflalo
BEL	2011	OTB	CO	1	1499	FFCO_2017.Rdata-tacsatEflalo
BEL	2011	TBB	CO	0	49	FFCO_2017.Rdata-tacsatEflalo
BEL	2011	OTB	FF_Central	14	10760	FFCO_2017.Rdata-tacsatEflalo
BEL	2011	SSC	FF_East	2	828	FFCO_2017.Rdata-tacsatEflalo
BEL	2012	OTB	CO	7	11817	FFCO_2017.Rdata-tacsatEflalo
BEL	2012	OTB	FF_Central	8	5939	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	OTB	CO	0	238	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	OTB	FF_Central	23	20598	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	SSC	FF_Central	2	4101	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	TBB	FF_Central	0	629	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	SSC	FF_East	4	7686	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	TBB	FF_East	1	1149	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	OTB	CO	6	25922	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	OTB	FF_Central	9	6765	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	SSC	FF_Central	1	6469	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	TBB	FF_Central	1	664	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	SSC	FF_East	3	6935	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	OTB	CO	1	2558	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	OTB	FF_Central	5	7358	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	TBB	FF_Central	2	3000	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	OTB	FF_East	0	188	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	TBB	FF_East	0	181	FFCO_2017.Rdata-tacsatEflalo
DEU	2010	OTB	CO	7	16354	FFCO_2017.Rdata-tacsatEflalo
DEU	2010	OTB	FF_Central	3	3265	FFCO_2017.Rdata-tacsatEflalo
DEU	2010	TBB	FF_Central	50	93078	FFCO_2017.Rdata-tacsatEflalo
DEU	2010	TBB	FF_East	1	340	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	OTB	CO	8	23400	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	TBB	CO	0	149	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	OTB	FF_Central	4	4156	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	TBB	FF_Central	19	35088	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	OTB	FF_East	0	55	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	TBB	FF_East	2	1184	FFCO_2017.Rdata-tacsatEflalo
DEU	2012	OTB	CO	19	47835	FFCO_2017.Rdata-tacsatEflalo
DEU	2012	OTB	FF_Central	9	10472	FFCO_2017.Rdata-tacsatEflalo
DEU	2012	TBB	FF_Central	29	40594	FFCO_2017.Rdata-tacsatEflalo
DEU	2012	TBB	FF_East	12	8636	FFCO_2017.Rdata-tacsatEflalo
DEU	2013	OTB	CO	14	56928	FFCO_2017.Rdata-tacsatEflalo
DEU	2013	OTB	FF_Central	10	144979	FFCO_2017.Rdata-tacsatEflalo
DEU	2013	TBB	FF_Central	43	69258	FFCO_2017.Rdata-tacsatEflalo
DEU	2013	TBB	FF_East	1	848	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	OTB	CO	17	68161	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	OTB	FF_Central	6	8267	FFCO_2017.Rdata-tacsatEflalo

Country	Year	Gear	Sub-area	Effort (days at sea)	Landings (kg)	Type of data
DEU	2014	OTT	FF_Central	2	849	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	TBB	FF_Central	16	34738	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	TBB	FF_East	0	467	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	OTB	CO	23	68533	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	OTT	CO	0	604	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	OTB	FF_Central	3	4559	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	TBB	FF_Central	32	61629	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	OTB	FF_East	0	41	FFCO_2017.Rdata-tacsatEflalo
DNK	2010	OTB	CO	8	431165	FFCO_2017.Rdata-tacsatEflalo
DNK	2010	OTB	FF_Central	0	126	FFCO_2017.Rdata-tacsatEflalo
DNK	2011	OTB	CO	2	218318	FFCO_2017.Rdata-tacsatEflalo
DNK	2012	OTB	CO	31	1180499	FFCO_2017.Rdata-tacsatEflalo
DNK	2012	OTB	FF_Central	1	8172	FFCO_2017.Rdata-tacsatEflalo
DNK	2012	OTB	FF_East	4	183816	FFCO_2017.Rdata-tacsatEflalo
DNK	2013	OTB	CO	7	757481	FFCO_2017.Rdata-tacsatEflalo
DNK	2013	OTB	FF_Central	14	426588	FFCO_2017.Rdata-tacsatEflalo
DNK	2013	OTB	FF_East	23	1032017	FFCO_2017.Rdata-tacsatEflalo
DNK	2014	OTB	CO	9	1517436	FFCO_2017.Rdata-tacsatEflalo
DNK	2014	OTB	FF_Central	4	5677	FFCO_2017.Rdata-tacsatEflalo
DNK	2015	OTB	CO	50	3853290	FFCO_2017.Rdata-tacsatEflalo
DNK	2015	SDN	CO	5	12054	FFCO_2017.Rdata-tacsatEflalo
DNK	2015	OTB	FF_Central	4	526964	FFCO_2017.Rdata-tacsatEflalo
DNK	2015	OTB	FF_East	7	794162	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	OTB	CO	7	34249	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	SSC	CO	1	2002	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	TBB	CO	0	40	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	TBB	FF_Central	15	23685	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	SSC	FF_East	3	7671	FFCO_2017.Rdata-tacsatEflalo
GBR	2011	OTB	CO	4	17471	FFCO_2017.Rdata-tacsatEflalo
GBR	2011	OTT	CO	1	7316	FFCO_2017.Rdata-tacsatEflalo
GBR	2011	TBB	FF_Central	0	93	FFCO_2017.Rdata-tacsatEflalo
GBR	2012	OTB	CO	9	39491	FFCO_2017.Rdata-tacsatEflalo
GBR	2012	OTT	CO	3	5650	FFCO_2017.Rdata-tacsatEflalo
GBR	2012	TBB	FF_Central	1	3730	FFCO_2017.Rdata-tacsatEflalo
GBR	2012	TBB	FF_East	1	1672	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	OTB	CO	13	33470	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	SSC	CO	3	13940	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	TBB	CO	1	1703	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	TBB	FF_Central	1	1100	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	SSC	FF_East	2	2363	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	TBB	FF_East	1	542	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	OTB	CO	8	55188	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	OTT	CO	3	19354	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	TBB	CO	1	5642	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	TBB	FF_Central	1	1697	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	SSC	FF_East	2	1084	FFCO_2017.Rdata-tacsatEflalo
GBR	2015	OTB	CO	18	42743	FFCO_2017.Rdata-tacsatEflalo
GBR	2015	SDN	CO	0	4	FFCO_2017.Rdata-tacsatEflalo
GBR	2015	OTB	FF_Central	2	364	FFCO_2017.Rdata-tacsatEflalo
GBR	2015	TBB	FF_Central	2	9817	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	OTB	CO	13	35992	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	OTT	CO	13	31013	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	TBB	CO	1	6164	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	OTB	FF_Central	23	20870	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	OTT	FF_Central	14	13835	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	TBB	FF_Central	151	243085	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	SSC	FF_East	18	40238	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	TBB	FF_East	17	18047	FFCO_2017.Rdata-tacsatEflalo

Country	Year	Gear	Sub-area	Effort (days at sea)	Landings (kg)	Type of data
NLD	2011	OTB	CO	6	13114	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	TBB	CO	2	6124	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	OTB	FF_Central	38	42835	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	OTT	FF_Central	53	41525	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	TBB	FF_Central	56	80784	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	OTB	FF_East	1	166	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	OTT	FF_East	4	6941	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	SSC	FF_East	12	22404	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	TBB	FF_East	2	1672	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	OTB	CO	34	104523	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	OTT	CO	3	4707	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	TBB	CO	1	2306	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	OTB	FF_Central	11	12325	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	OTT	FF_Central	53	48491	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	TBB	FF_Central	93	147466	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	SSC	FF_East	14	36464	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	TBB	FF_East	12	13984	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	DRB	CO	1	312	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	OTB	CO	32	93747	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	OTT	CO	4	7362	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	TBB	CO	0	160	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	OTB	FF_Central	10	11814	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	OTT	FF_Central	47	44457	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	SSC	FF_Central	1	2651	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	TBB	FF_Central	41	65462	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	DRB	FF_East	3	95	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	SSC	FF_East	33	73748	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	TBB	FF_East	3	5065	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTB	CO	20	74270	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTT	CO	2	5037	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTB	FF_Central	18	27694	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTT	FF_Central	40	45842	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	SSC	FF_Central	2	7591	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	TBB	FF_Central	40	70845	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTT	FF_East	1	2	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	SSC	FF_East	29	48228	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	TBB	FF_East	2	1682	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTB	CO	10	23262	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTT	CO	10	24748	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	TBB	CO	0	186	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTB	FF_Central	31	32633	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTT	FF_Central	32	45094	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	SSC	FF_Central	9	40493	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	TBB	FF_Central	60	116414	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTB	FF_East	1	775	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTT	FF_East	0	225	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	SSC	FF_East	23	40680	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	TBB	FF_East	1	426	FFCO_2017.Rdata-tacsatEflalo

Source: Logbook data and VMS data and data from the Annual Economic report (STECF 2016), processed by WUR, CEFAS, TI,DTU, ILVO, SLU and IFREMER.

Appendix 2 Economic factors

The economic factors are calculated from the data of the Annual Economic report 2016 (STECF, 2016). The value factor (expressed in €/kg) represents the $CNSvalue_{g,l,c,y}/CNSlandings_{g,l,c,y}$ factor in 2.3 and the GVA factor (no unit) represents the proportion of the value of landings available for capital and labour payments:

$$\frac{\sum_f \left(\frac{GVA_{f,c,y}}{value_{f,c,y}} CNSvalue_{f,g,l,c,y}\right)}{\sum_f CNSvalue_{f,g,l,c,y}}$$

Table A2.1 *Value and GVA factors per year, country, gear and length class*

Country	Year	Gear	Vessel length class	value factor	GVA factor
DEU	2010	OTB	18-24	2.11	0.62
DEU	2010	OTB	>24	0.35	0.56
DEU	2010	TBB	18-24	2.26	0.57
DEU	2010	TBB	>24	3.04	0.35
DEU	2011	OTB	18-24	2.51	0.53
DEU	2011	OTB	>24	0.39	0.51
DEU	2011	TBB	>24	2.4	0.31
DEU	2012	OTB	18-24	1.93	0.56
DEU	2012	OTB	>24	1.02	0.38
DEU	2013	OTB	18-24	1.8	0.7
DEU	2013	OTB	>24	0.37	0.52
DEU	2013	TBB	18-24	3.82	0.63
DEU	2013	TBB	>24	2.84	0.5
DEU	2014	OTB	18-24	1.87	0.58
DEU	2014	OTB	>24	0.67	0.51
DEU	2015	OTB	18-24	2.14	0.58
DEU	2015	OTB	>24	0.5	0.51
DEU	2015	TBB	>24	7.94	0.48
NLD	2010	OTB	18-24	2.26	0.37
NLD	2010	OTB	>24	1.91	0.38
NLD	2010	OTT	18-24	2.52	0.35
NLD	2010	OTT	>24	2.89	0.4
NLD	2010	PTB	>24	2.18	0.35
NLD	2010	SDN	>24	1.8	0.4
NLD	2010	SSC	>24	1.62	0.4
NLD	2010	TBB	>24	3.04	0.37
NLD	2011	OTB	18-24	2.57	0.46
NLD	2011	OTB	>24	2.23	0.35
NLD	2011	OTT	18-24	4.05	0.46
NLD	2011	OTT	>24	3.87	0.4
NLD	2011	SDN	>24	1.8	0.4
NLD	2011	SSC	>24	1.77	0.4
NLD	2011	TBB	18-24	1.69	0.4
NLD	2011	TBB	>24	2.67	0.29
NLD	2012	OTB	18-24	2.3	0.37
NLD	2012	OTB	>24	1.73	0.37
NLD	2012	OTT	18-24	4.24	0.4
NLD	2012	OTT	>24	4.2	0.38
NLD	2012	SDN	>24	1.28	0.38
NLD	2012	SSC	>24	1.78	0.38

Country	Year	Gear	Vessel length class	value factor	GVA factor
NLD	2012	TBB	18-24	3.32	0.53
NLD	2012	TBB	>24	2.35	0.34
NLD	2013	OTB	18-24	2	0.47
NLD	2013	OTT	18-24	3.26	0.48
NLD	2013	OTT	>24	3.3	0.37
NLD	2013	SDN	>24	1.7	0.37
NLD	2013	SSC	>24	1.57	0.37
NLD	2013	TBB	18-24	3.91	0.51
NLD	2013	TBB	>24	2.29	0.36
NLD	2014	OTB	18-24	2.05	0.57
NLD	2014	OTB	>24	1.62	0.43
NLD	2014	OTT	18-24	2.81	0.57
NLD	2014	OTT	>24	3.57	0.43
NLD	2014	SSC	>24	1.69	0.42
NLD	2014	TBB	>24	2.57	0.44
NLD	2015	OTB	18-24	2.26	0.57
NLD	2015	OTT	18-24	2.89	0.57
NLD	2015	OTT	>24	3.97	0.43
NLD	2015	SSC	>24	2.89	0.42
NLD	2015	TBB	18-24	2.9	0.54
NLD	2015	TBB	>24	2.6	0.44
GBR	2010	OTB	dec-18	2.06	0.39
GBR	2010	OTB	18-24	2.22	0.36
GBR	2010	OTB	>24	1.06	0.36
GBR	2010	PTB	dec-18	1.72	0.39
GBR	2010	PTB	18-24	1.58	0.36
GBR	2010	SSC	>24	1.64	0.36
GBR	2010	TBB	>24	2.09	0.3
GBR	2011	OTB	18-24	2.8	0.41
GBR	2011	OTB	>24	1.27	0.24
GBR	2011	OTT	18-24	2.8	0.41
GBR	2011	TBB	>24	2.04	0.25
GBR	2012	OTB	18-24	2.84	0.41
GBR	2012	OTB	>24	1.86	0.29
GBR	2012	TBB	>24	2.01	0.21
GBR	2013	OTB	18-24	2.36	0.41
GBR	2013	OTT	18-24	2.62	0.41
GBR	2013	TBB	>24	1.63	0.15
GBR	2014	OTT	18-24	3.28	0.4
GBR	2014	OTT	>24	1.56	0.3
GBR	2014	TBB	>24	1.76	0.22
GBR	2015	OTB	dec-18	3.26	0.43
GBR	2015	OTB	18-24	3.38	0.4
GBR	2015	OTT	18-24	3.42	0.4
GBR	2015	TBB	>24	2.22	0.22
DNK	2010	OTB	>24	0.25	0.73
DNK	2011	OTB	18-24	0.6	0.56
DNK	2011	OTB	>24	0.28	0.7
DNK	2012	OTB	>24	0.51	0.64
DNK	2013	OTB	>24	0.35	0.75
DNK	2014	OTB	>24	0.28	0.57
DNK	2015	OTB	>24	0.28	0.57
BEL	2010	OTB	18-24	2.9	0.43
BEL	2010	SSC	>24	1.98	0.51
BEL	2010	TBB	>24	2.28	0.46
BEL	2011	OTB	18-24	3.06	0.4
BEL	2011	SSC	>24	2.31	0.45
BEL	2011	TBB	>24	2.39	0.49

Country	Year	Gear	Vessel length class	value factor	GVA factor
BEL	2012	OTB	18-24	2.83	0.36
BEL	2012	SSC	>24	1.7	0.38
BEL	2012	TBB	>24	2.08	0.4
BEL	2013	OTB	18-24	2.93	0.42
BEL	2013	SSC	>24	1.29	0.42
BEL	2013	TBB	>24	1.87	0.39
BEL	2014	OTB	18-24	2.65	0.3
BEL	2014	SSC	>24	1.31	0.3
BEL	2014	TBB	18-24	4.07	0.3
BEL	2014	TBB	>24	2.13	0.48
BEL	2015	OTB	18-24	3.28	0.3
BEL	2015	TBB	>24	2.82	0.48
SWE	2011	OTB	>24	0.22	0.49
FRA	2010	OTB	dec-18	0.6	0.51
FRA	2010	OTB	18-24	1.01	0
FRA	2010	OTB	>24	2.01	0
FRA	2010	SDN	>24	2.01	0
FRA	2011	OTB	18-24	1.33	0.41
FRA	2011	OTB	>24	0.8	0
FRA	2011	SDN	>24	0.8	0
FRA	2012	OTB	18-24	1.19	0.34
FRA	2013	OTB	18-24	1.32	0.38
FRA	2013	OTB	>24	1.28	0.34
FRA	2014	OTB	18-24	1.28	0.39
FRA	2014	SDN	>24	0.77	0.37
FRA	2015	OTB	18-24	1.28	0.39
FRA	2015	SDN	>24	0.77	0.37

Appendix 3 Coverage of VMS-logbook data

Table A3.1 *Percentage coverage of the VMS-logbook data compared to the logbook data in the ICES rectangle of interest (Figure 1.1)*

Country	data	2010	2011	2012	2013	2014	2015	Average
DEU	Effort	98	96	96	98	99	94	97
NLD	Effort	98	98	97	99	99	97	98
GBR	Effort	98	95	81	89	97	99	94
DNK	Effort	100	100	100	100	100	100	100
BEL	Effort	91	97	94	100	97	94	95
SWE	Effort	100	100		100	100	100	100
FRA	Effort	100	100	100	100	100	100	100
DEU	Landings	97	94	95	97	99	96	96
NLD	Landings	97	97	98	100	99	98	98
GBR	Landings	98	99	74	97	99	100	95
DNK	Landings	100	100	100	100	100	100	100
BEL	Landings	92	97	98	100	99	95	97
SWE	Landings	100	100		100	100	100	100
FRA	Landings	100	100	100	100	100	100	100

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MEMORANDUM
2017-078

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Memorandum 2017-078

The mission of Wageningen University and Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 5,000 employees and 10,000 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.