Monitoring catches in the pulse fishery

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Content

Samenvatting

Dit rapport geeft informatie over de vangstsamenstelling van de Nederlandse pulsvisserij op platvis. Traditioneel wordt er in de Nederlandse platvisvisserij voornamelijk met de conventionele boomkor gevist. De afgelopen jaren heeft er een geleidelijke en gedeeltelijke overgang plaatsgevonden naar de pulsvisserij, waarbij de wekkerkettingen zijn vervangen door elektrodes. De Nederlandse demersale vissers zijn positief over het pulstuig, voornamelijk door lagere oliekosten en goede tong vangsten. In de zuidelijke Noordzee is sinds 2007 per lidstaat een ontheffing voor 5 procent van de boomkorvloot. Dat wil zeggen dat 5% van de boomkorvloot met het pulstuig mag vissen. In 2011 is bij de toekenning van de vergunningen door de EU de voorwaarde gesteld dat er meer informatie zou worden verzameld over de effecten van de pulsvisserij. Dit rapport beschrijft de onderzoeksactiviteiten die zijn uitgevoerd om aan deze voorwaarde van de EU te voldoen.

Om informatie te verkrijgen over de vangstsamenstelling in de pulsvisserij zijn twee monitorings-programma's opgezet: (1) Een zelfbemonsteringsprogramma, waarbij vissers op basis van een standaard protocol per reis één trek bemonsterden. Hierbij werd de totale vangst geschat, de aanlandingen van de trek genoteerd en een monster met ongesorteerde vangst uitgezocht. De gegevens van deze trek werden genoteerd op een standaard formulier en verstuurd naar IMARES; (2) Een waarnemers-programma waarbij visreizen met het pulstuig werden bemonsterd door onafhankelijke waarnemers. Deze bemonstering vond plaats op basis van het standaard discard bemonsteringsprotocol van IMARES.

Het zelfbemonsteringsprogramma startte in december 2011 en eindigde op 1 maart 2013. In totaal hebben 25 pulsschepen deelgenomen aan het zelfbemonsteringsprogramma en zijn er 627 data formulieren ontvangen. Een deel van de formulieren was niet compleet waardoor uiteindelijk 578 formulieren zijn meegenomen in de analyse. De gemiddelde vangstsamenstelling in 2012 bestond uit 31% aanlandingen, 17% vis discards, 18% benthos discards en 34% debris. Uit de resultaten blijkt dat er veel variatie zit in de vangstsamenstelling per kwartaal en tussen de vijf visgebieden. Er zijn echter geen ruimtelijke patronen en seizoenspatronen gevonden in de resultaten.

In 2012 zijn 10 waarnemersreizen uitgevoerd aan boord van pulsschepen. Gemiddeld bestond de vangstsamenstelling van deze reizen uit 29% aanlandingen, 29% vis discards en 42% benthos discards en debris. De vangstsamenstelling varieerde tussen de waarnemersreizen.

De resultaten van de twee programma's (gegevens uit 2012 en van schepen >300pk) zijn vergeleken om de consistentie van de zelfbemonsteringsmethode te controleren. De vangstvergelijkingen toonden drie significante verschillen tussen de zelfbemonstering en het waarnemersprogramma: de vangsten van benthos & debris, tong discards en maatse kabeljauw zijn significant hoger in het zelfbemonsterings-programma. De verschillen in resultaten zijn mogelijk te verklaren doordat er op andere tijden in andere gebieden is gevist.

De hoeveelheid benthos (aantal per soort) in de vangst van het puls waarnemersprogramma (2012, >300pk) zijn vergeleken met de hoeveelheid benthos in de vangst van de boomkorvisserij (2012, >300pk, gegevens uit de *EU Data Collection Framework program*). Er zijn geen benthos gegevens op soortniveau beschikbaar uit het puls zelfbemonsteringsprogramma. De vergelijking gaf aan dat de vangsten van de waarnemersreizen op de pulsschepen minder zeesterren (16% van de hoeveelheid gevangen op de boomkorschepen) en minder krabben (42% van de hoeveelheid gevangen op de boomkorschepen) bevatten. De gevangen aantallen zeesterren en krabben geven een goede indicatie van de totale hoeveelheid benthos in de vangsten van beide tuigen; de resultaten geven daarmee aan dat er minder benthos wordt gevangen in de pulsvisserij.

De schol- en tongvangsten van het puls zelfbemonstering- en waarnemersprogramma (2012, >300pk) zijn vergeleken met de schol- en tongvangsten van de boomkorvisserij (2012, >300p, gegevens uit de *EU Data Collection Framework program*). Het gemiddelde discardpercentage van schol uit het puls waarnemersprogramma (52%) is vergelijkbaar met het schol discardpercentage van de boomkorvisserij (49%). Het gemiddelde schol discardpercentage van het zelfbemonsteringsprogramma is lager (42%). De hoeveelheden gevangen schol discards in de puls zelfbemonstering (27 kg/uur) en in de puls waarnemersreizen (66 kg/uur) zijn lager dan in de boomkorvisserij (87 kg/uur).

Het gemiddelde discardpercentage van tong uit het puls waarnemersprogramma (10%) is lager dan het discardpercentage van de zelfbemonstering (15%) en de boomkorvisserij (17%). De hoeveelheden gevangen tong discards in de puls zelfbemonstering (6 kg/uur) en puls waarnemersprogramma (4 kg/uur) liggen in hetzelfde bereik als de tongdiscards in de boomkorvisserij (6 kg/uur).

De kabeljauwvangsten zijn erg laag in zowel de zelfbemonstering als het waarnemersprogramma. In het zelfbemonsteringsprogramma lag de gemiddelde vangst van maatse kabeljauw op 3 kg/uur en het gemiddelde discardpercentage op 7%. In het waarnemersprogramma lag de gemiddelde vangst van maatse kabeljauw op 1 kg/uur en het gemiddelde discardpercentage op 12%. Deze hoeveelheden zijn te laag om een betrouwbare vergelijking met de boomkorvisserij te maken.

Summary

This report provides information on the catch composition of the Dutch pulse fishery targeting flatfish. Since 2007 in the southern North Sea, each Member State has a permit for 5 percent of the beam trawl fleet: that part of the fleet is allowed to fish with a pulse gear. In 2011, the permits were given by the EU under the condition that more information on the effects of pulse fishing would be collected. For this reason, the fishing industry started a catch monitoring program with the scientific support of research institute IMARES in December 2011. The catch monitoring program consisted of 25 vessels participating in a self-sampling program and ten observer trips on different vessels and fishing grounds throughout the year.

The self-sampling program showed an average catch composition in 2012 of 31% landings, 17% fish discards, 18% benthos, and 34% debris. In addition, the results show that there is variation in discards between quarters and between the five fishing areas that were defined in the analysis. However, no clear seasonal or spatial patterns have been distinguished. The average catch composition of the observer program consisted of 29% landings, 29% fish discards and 42% benthic species and debris.

The results from 2012 of the two programs and from vessels larger than 300hp are compared to check the consistency of the self-sampling method. The catch comparisons showed three significant differences between the self-sampling and observer program: the catch of benthos & debris, sole discards and cod landings are significantly higher in the self-sampling program. The differences in results may be due to the fact that fishing took place in other times and in other areas.

The benthos catches of the pulse observer program (2012, >300hp) are compared with the benthos catches of the beam trawl fishery (2012, >300hp) from the Data Collection Framework program. No self-sampling data on species level is available. The numbers of starfish and crab caught in the pulse trawl trips were lower than in the conventional beam trawl trips. The pulse vessels caught 16% of the number of starfish caught with the conventional beam trawl and 42% of crabs. The numbers of caught starfish and crabs are good indicators of the caught benthos quantities in the pulse and beam trawl fishery; these results indicate that the pulse fishery therefore catches less benthos compared to the beam trawl fishery.

The plaice and sole catches of the pulse self-sampling and observer program (2012, >300hp) are compared with the plaice and sole catches of the beam trawl fishery (2012, >300hp) from the Data Collection Framework program. The average discard percentage of plaice from the pulse trawl observer program (52%) is similar to the plaice discard percentage of the beam trawl trips (49%). The average discard percentage of the pulse self-sampling program is lower (42%). The actual amount of plaice discards caught in the pulse self-sampling (27 kg/hour) and observer program (66 kg/hour) are lower than in the beam trawl fishery (87 kg/hour).

The average sole discard percentage of the pulse observer program (10%) is lower than the average sole discard percentage of the pulse trawl self-sampling trips (15%) and the beam trawl trips (17%). The amounts of sole discards caught in the pulse self-sampling (6 kg/hour) and observer program (4 kg/hour) lie in the same range as the sole discard catches in the beam trawl fishery (6 kg/hour).

Cod catches are very low in both the pulse self-sampling and observer program. The self-sampling program showed an average landing rate of 3 kg/hour and an average discard percentage of 7%. The observer program showed an average landing rate of 1 kg/hour and an average discard percentage of 12%. Cod catches are too low to make a reliable comparison with the beam trawl fishery.

1. Introduction

A large part of the Dutch fishing fleet targets Dover (common) sole (*Solea solea*) and plaice (*Pleuronectes platessa*). These species are flatfish that bury themselves in the seabed. Traditionally, to catch these species, a beam trawl with tickler chains was used to stimulate the fish to come up from the seabed and swim into the net. In the early 2000s, the pulse technique was re-introduced. This technique is based on the beam trawl technique, but the tickler chains are replaced with electrodes. Pulses between the electrodes generate muscle contraction in the buried fish so that they come up and get caught in the net. The new pulse technique is appreciated by many Dutch fishermen because of reduced fuel costs and good sole catches.

Fishing with pulse gear is only allowed with a permit, due to an existing regulation which prohibits fishing with electrical currents (EU control regulation 850/98). Since 2007 in the southern North Sea, each Member State has a permit for 5 percent of the beam trawl fleet: that part of the fleet is allowed to fish with a pulse gear. From 2007-2010, the EU granted the first pulse-permits. In 2011, the permits were doubled under the condition that information on the effects of the pulse trawl fishery on the ecosystem would be collected. To meet these conditions, the Cooperative Fisheries Organisation (C.F.O.) decided to set up a monitoring program that consisted of a combination of self-sampling and observer trips.

Self-sampling is seen as an affordable method to obtain a high sampling coverage in time and space (Kraan et al., 2013). Scientists however do raise concerns about the potential bias of self-sampling data because fishers have a direct stake in the outcome of the research (Kraan et al., 2013). A cross check of self-sampling data with data from another independent source can help to assess whether or not bias is an issue. Therefore, the pulse monitoring consisted of both a self-sampling scheme and an observer scheme and the results were compared to check the consistency of the self-sampling data.

The specific objective of this monitoring program was to gain insight in the catch composition of the Dutch pulse fishery targeting flatfish, with special attention for plaice, sole and benthic organisms. The self-sampling program ran from December 2011 until Februari 2013. The observer trips took place throughout 2012. The catch monitoring program was funded by the fishing industry and scientific support was provided by research institute IMARES.

The results of the pulse monitoring program contribute to the general knowledge on pulse fishing which is discussed in Quirijns et al (in prep).

2. Assignment

The fishing industry requested IMARES to set up a catch monitoring program for the pulse fishery, consisting of a self-sampling program and independent observer trips. The present report will answer the following research questions:

1. What is the spatial variation of discards in the pulse fishery?
2. What is the seasonal variation of discards in the pulse fishery?
3. What percentage of the catch consists of discarded benthos?
4. What is the proportion of discards versus landings for plaice and sole catches?
5. How do the results from self-sampling compare to the results of the observer trips?
6. How do discards in the pulse trawl fishery compare to discards in the conventional beam trawl fishery?

3. Methods

This chapter describes the methods used for self-sampling (1) and observer trips (2) and the methods for analysis of the self-sampling data and the independent observer data. The results from both programs are described in the next chapter.

Self-sampling method

<u>Vessel selection</u>

The intention at the beginning of the project was to perform the self-sampling program with 20 pulse trawling vessels. IMARES and the C.F.O. developed criteria for the selection of pulse vessels for the self-sampling program. Ideally, selection should take place based on fishing effort. However, the fishing effort of the pulse fleet in 2010 and 2011 was not likely to be representative for the fishing effort in 2012, because of the increasing number of vessels using the pulse trawl.

IMARES and the Cooperative Fisheries Organisation (C.F.O.) decided on the following criteria for the selection of vessels:

- Representative number of vessels ≤300hp and >300hp
- Representative distribution between harbours
- Representative distribution between fishing areas
- Willingness to cooperate in the program

Based on these criteria, the C.F.O. selected and asked 20 vessels to participate in the program.

No statistical analysis has been done to test whether or not the chosen selection of vessels is representative for the entire pulse fleet and whether or not the sampled hauls in the self-sampling program are representative for the total pulse trawl fishing effort in the North Sea. A statistical analysis was not part of the study. Nevertheless, based on IMARES expert judgement, the 2012 results for all fish and benthos species can be treated as representative for the whole pulse fleet for the following reasons:

- almost 50% of the pulse vessels participated in the program
- a large set of correctly sampled data forms were used (n= 578)
- the program ran for more than one whole year
- the locations of the sampled hauls showed a wide spread over the fishing areas in the North Sea

<u>Responsibilities and Communication</u>

In the self-sampling program, IMARES was responsible for the self-sampling protocol, data forms, data collection and data processing. The fisheries representatives were responsible for communication with the participants and for keeping track of the submitted data forms. During all meetings with participants, fishermen's representatives were present to explain the importance of the research.

<u>Catch sampling</u>

Every week the participants sampled the catch of one haul, at a fixed day and time. The total volume of that haul was estimated, landings were registered and a sample of the catch was taken and sorted.

The volume of the total catch could be estimated in two different ways:

1) Estimate the total catch by sight: fishermen estimated how many baskets of catch were present in the so-called box where total catch is collected

2) Count the amount of discards (in baskets) at the end of the sorting process: to be able to do so, valves ('kleppen') had to be installed in the waste chute of the vessel. With these valves the number of baskets of discarded catch could be counted. The total volume of the catch could then be estimated by adding landings to the number of discards.

The catch sample consisted of one basket (50L) of unsorted catch. The basket was filled by taking five subsamples at different time points throughout the processing of the haul. The subsamples were taken with a 10-liter bucket. The catch sample was sorted into categories: plaice, sole, cod and other fish species (both commercial and non-commercial), benthic species and debris (e.g. stones, peat and shells). All fish categories were separated into landings and discards.

The results were registered on the standard form that was developed for this self-sampling program (see annex A). On this form, three tables needed to be completed: 1) general information like gear specifications and the position of the haul; 2) data on the volume of the total catch and the weight of landings of this haul and 3) the weight of the different categories in the sample.

Quality assurance

To assess and improve the quality of the self-sampling data, the following activities were undertaken:

- At the beginning of the project, in December 2011, a training was given to all participants performing the self-sampling procedure as described in the protocol
- In April 2012, all data forms that were submitted to IMARES were checked. As a result of this check, the protocol and form were changed so that only the weight of the sample categories had to be registered, compared to both weight and volume. Furthermore, fishermen that filled in forms incorrectly received extra attention; IMARES and a representative from the fisheries sector visited these vessels to explain the sampling protocol and form again.
- In June 2012, a check was done to evaluate the representativeness of the sampled fleet compared to the whole pulse fleet. A map of all sampled positions was shown to a group of pulse fishermen to check whether or not the sampled hauls were representative for the total fishing area of the Dutch pulse fleet. In addition it was checked whether or not the distribution of vessels between ≤300hp and >300hp was representative for the whole fleet. Based on the outcome, extra vessels from the south of the Netherlands and extra vessels ≤300hp were asked to participate in the program. As a result, extra vessels started sampling in September 2012. In total 25 vessels participated in the program from September 2012 onwards.
- In June 2012, extra instructions on how to distinguish benthos and debris/waste was provided to the participants as benthos and waste were sometimes incorrectly registered.
- In August/September 2012, an instruction video of the sampling procedure was kindly made by a participating vessel. This video was provided to all (old and new participants).
- In August/September 2012, IMARES and a fisheries representative visited two harbours where they presented the status of the research and preliminary results to the participants. Any possible improvements were discussed during these meetings.

A total of 627 data forms were submitted, representing 627 hauls in the same amount of trips. IMARES received around 10 forms per week, compared to the twenty that was initially accounted for. The lower sampling frequency was caused by occasional bad weather, technical problems or maintenance. Incomplete forms could not be used in the data analyses. 49 forms (8%) were disqualified because of different reasons:

- Species that were present in the catch sample were not present in the total reported landings.
- The amount of a species (kg) in the landing sample was larger than the amount of that species (kg) in the total landings.
- Sample information was reported in volume (instead of weight).
- Benthos was only qualitatively described - weight was not registered
- Haul position, needed for defining fishing area, was missing.

The other 578 forms were used in the analyses. Each registered haul was attributed to a fishing area as shown in figure 3.1.

Raising procedure catch sample to haul level

The self-sampling data were raised to haul level for the analysis of the results. To convert the weights of landings and discards in the catch sample to total weights in the haul, a landing ratio was used. This factor was based on the proportion of marketable sole in the total catch of the specific haul and the proportion of marketable sole in the catch sample. We used sole for the raising procedure because it is the main target species of the pulse fleet and it is therefore present in almost all catches.

The landing ratio was used to convert all data in the catch sample (plaice, sole, cod, fish, benthos and debris) to haul level. This raising method assumes that (i) the amount of sole landings in a sample is representative for the total sole landings in a haul; (ii) the total amount of sole landings in a haul has been recorded accurately; (iii) that the sole raising factor can be applied to other species and (iv) that this landing factor can also be used to convert the amount of discards in the sample to haul level. For a detailed description of the raising procedure, see annex B1.

Percentages

The raised amount (kg) of landings and discards at haul level were used to calculate the composition of the entire catch of the haul in percentages.

The raised amount (kg) of landings and discards per haul (around 120 minutes) were converted to landings and discards in kg/hour. The amount of landings and discards in kg/hour were used to calculate the discard percentage for plaice, sole and cod. The percentages were calculated by dividing total landings or discards by total catches of that particular group (area or year) (Table 3.1).

Table 3.1: *Example of the calculations of the percentages*

	Catch (kg/h)	**Landings (kg/h)**	**% Landings**	**Discards (kg/h)**	**% Discards**
Trip A	200	100	50%	100	50%
Trip B	20	10	50%	10	50%
Trip C	1100	1000	91%	100	9%
Average	440	370	84% (370/440*100)	70	16% (70/440*100)

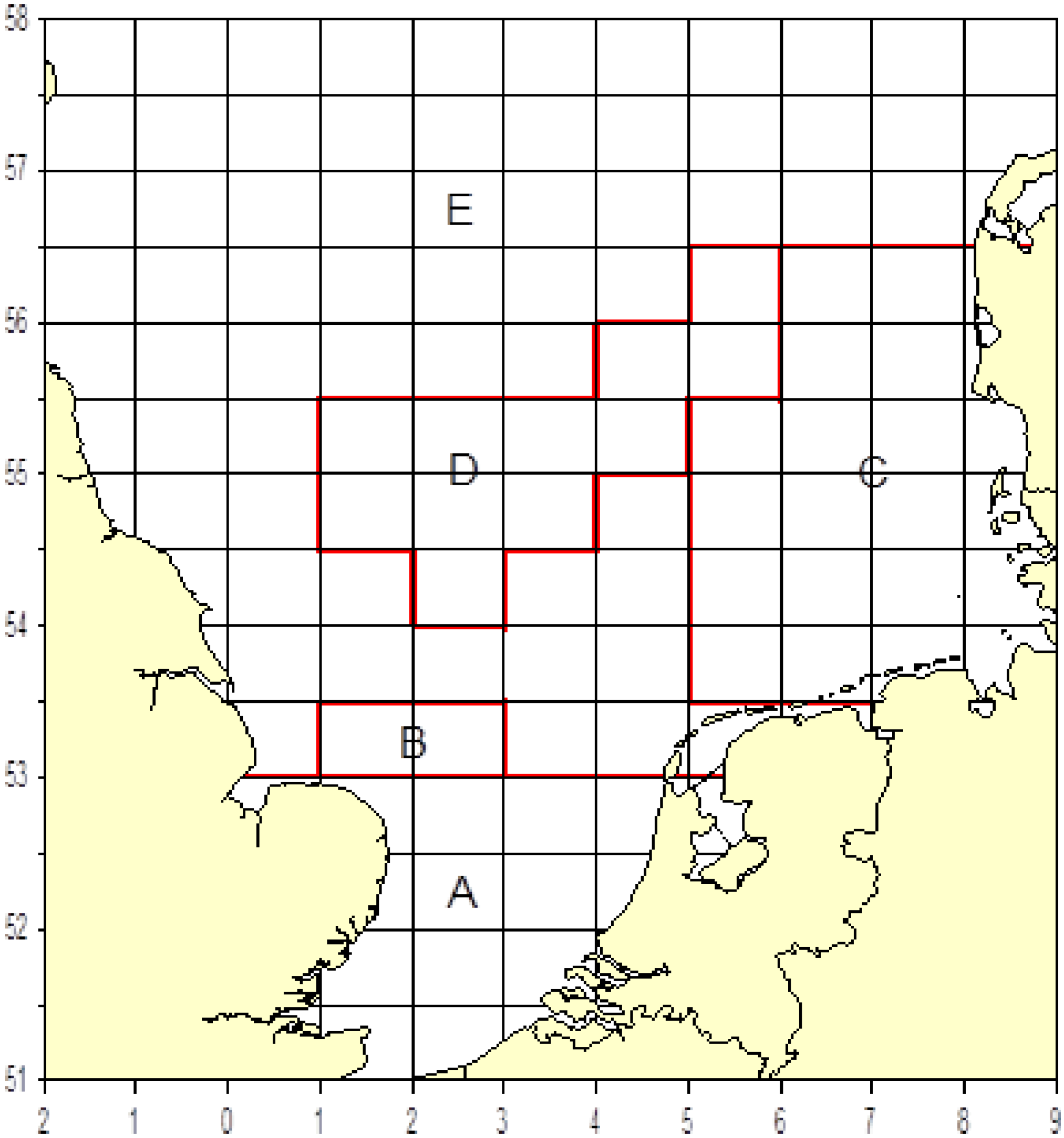

Figure 3.1: *The North Sea has been subdivided into 5 fishing areas: Southern North Sea (A), "English Banks" (B), German Bight (C), The Dogger bank (D), Central North Sea (E)*

Observer method

In addition to the self-sampling program, independent observers joined ten trips with pulse trawl vessels in all quarters of 2012. The observer trips were done by IMARES and ILVO (The Institute for Agricultural and Fisheries Research in Belgium). The results from these observer trips are compared with the results of the self-sampling trips to check the consistency between both programs.

Vessel selection

Vessels participating in the observer trips were selected from the group of self-sampling vessels. Vessels were selected by the fishery sector based on engine power (≤300hp or >300hp) and fishing area.

Sampling procedure

Observer trips were carried out by observers from IMARES and ILVO following the discard protocol from the Data Collection Framework (DCF) (Uhlmann et al., in prep). This method was chosen because it is the standard protocol for discard research done by IMARES. As a result, the results from the pulse observer program could be compared with other results from the DCF as the same analysis method was used. The protocol was discussed with all observers before the start of the program, to ensure that observers from IMARES and ILVO executed the protocol in the same way.

The observers registered the following information for all hauls during the observer trip:

1) General information: start and end times, duration, position of the haul and weather conditions during the haul.
2) The volumes of catches and landings. The catch volume was estimated by sight. The total landed volume was based on official auction lists from the harbour. Auction lists were used to check if logbook data corresponded to what was actually landed in the auction.

The observer aimed to sample at least 66% of the total hauls during the observer trip. For each sampled haul, the total volume of the catch (in boxes) was estimated by both the observer and the skipper/crew and an average from these estimates was used. The crew sorted the catch by retaining the marketable portion, while the observer collected a representative subsample (max. 1 box, ca. 40 kg) of the discards. The discard sample consisted of five subsamples taken at different time points throughout the processing of the haul. These subsamples were taken by randomly filling a 10-liters bucket with discards. The sample was sorted by species; the numbers at length of all fish were recorded and numbers of non-fish species were recorded. From each sampled haul, also numbers at length were determined for a sample (10 litre bucket) of sole and/or plaice in the landings.

Each sampled trip took place in one or more fishing areas (see figure 3.1). The collected data has been raised to trip level.

Raising procedure catch sample to trip level

The data collected in the observer trips were raised to trip level. For the landing data, the information from the auction lists were used and this information in only available on trip level. For the discard data, the data collected by the observers were used for the analysis. Because different sources of information were used for these catch components, different raising procedures were used for discards and landings. For more information on the raising procedure, see annex B2.

Percentages
The raised amount (kg) of landings and discards in the catch were used to calculate the composition of the entire catch in percentages.

The raised amount (kg) of landings and discards per haul (30 minutes) were raised to landings and discards in kg/hour. The amount of landings and discards in kg/hour were used to calculate the discard percentage for plaice and sole. The percentages were calculated by dividing total landings or discards by total catches of that particular group (area or year) (Table 3.1).

Comparison self-sampling and observer data

The self-sampling data and observer data were statistically compared to check the consistency of the self-sampling data. Only the data from 2012 of ships >300hp were used for the comparison. The observer trips only took place in 2012 and for the ships ≤300hp, not enough data were available for a comparison. The average amounts of the self-sampling and observer data on haul level were statistically analysed using an unpaired t-test[1] with $p<0.05$. For the comparison, the catch, plaice and sole data of the observer trips was converted to haul level. This was done because the self-sampling data are only available on haul level:

$$Observer\ data\ per\ haul = \frac{Observer\ data\ per\ trip}{Number\ of\ sampled\ hauls\ per\ trip} \quad (10)$$

The observer sampling method does not weigh the separate benthos species and debris fractions. The amounts caught per specie or fraction are too low to be accurately weighted on board of a commercial vessel. Consequently, a comparison of benthos and debris separately could not be done.

Comparison pulse monitoring data and beam trawl data

The 2012 results of the self-sampling trips and the observer trips were generally compared with the results of the 2012 beam trawl fishery that was sampled as part of the EU Data Collection Framework program (DCF) (Uhlmann et al., in prep). No statistical comparison was done.

The beam trawl data were collected through self-sampling. "In the self-sampling program, fishers themselves retain discarded fractions of their catches on board their vessels during a number of fishing trips throughout the year. For each sampled haul, information on the composition and volume of the catch, environmental (e.g. wind direction and speed, latitude and longitude position, and water depth) and operational characteristics (e.g. start and end time of setting the net, gear type, and mesh size) was recorded. Discard samples from the self-sampling program were returned to the laboratory to determine species composition, size and age structure of a subsample (Uhlmann et al., in prep)".

In the DCF self-sampling program, trips were pre-determined from a reference fleet of 23 participating vessels. Sampling was carried out on board vessels from nine different metiers under which the beam trawlers with 70-99 mm meshes and >300hp and ≤300hp. In 2012, 61 trips with beam trawl vessels with 70-99 mm meshes >300hp were sampled and 20 trips with beam trawl vessels with 70-99 mm meshes and ≤300hp were sampled.

Only data from vessels larger than 300hp were used for the comparison because not enough data from the pulse monitoring program from the ships ≤300hp were available for a comparison with the beam trawl data.

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[1] A significance test for the mean value of a normal distribution.

4. Results

This chapter describes the results of the pulse monitoring program. First, general information on the self-sampling and observer program is described in this chapter. Second, answers are given to the specific research questions.

General information on the self-sampling program

In total, 25 vessels participated in the self-sampling program which ran from December 2011 until February 2013. Specifications of these vessels can be found in annex C1. The total sampling fleet submitted 578 forms that could be used for the analyses. The majority of the hauls took place in the Southern North Sea (427 hauls, i.e. 74%) and the Central North Sea (87 hauls, i.e. 15%). The remaining hauls took place on the "English Banks" (31 hauls, i.e. 5%), in the German Bight (26 hauls i.e. 5%) and on the Doggerbank (7 trips, i.e. 1%) (Figure 4.1: table 4.2).

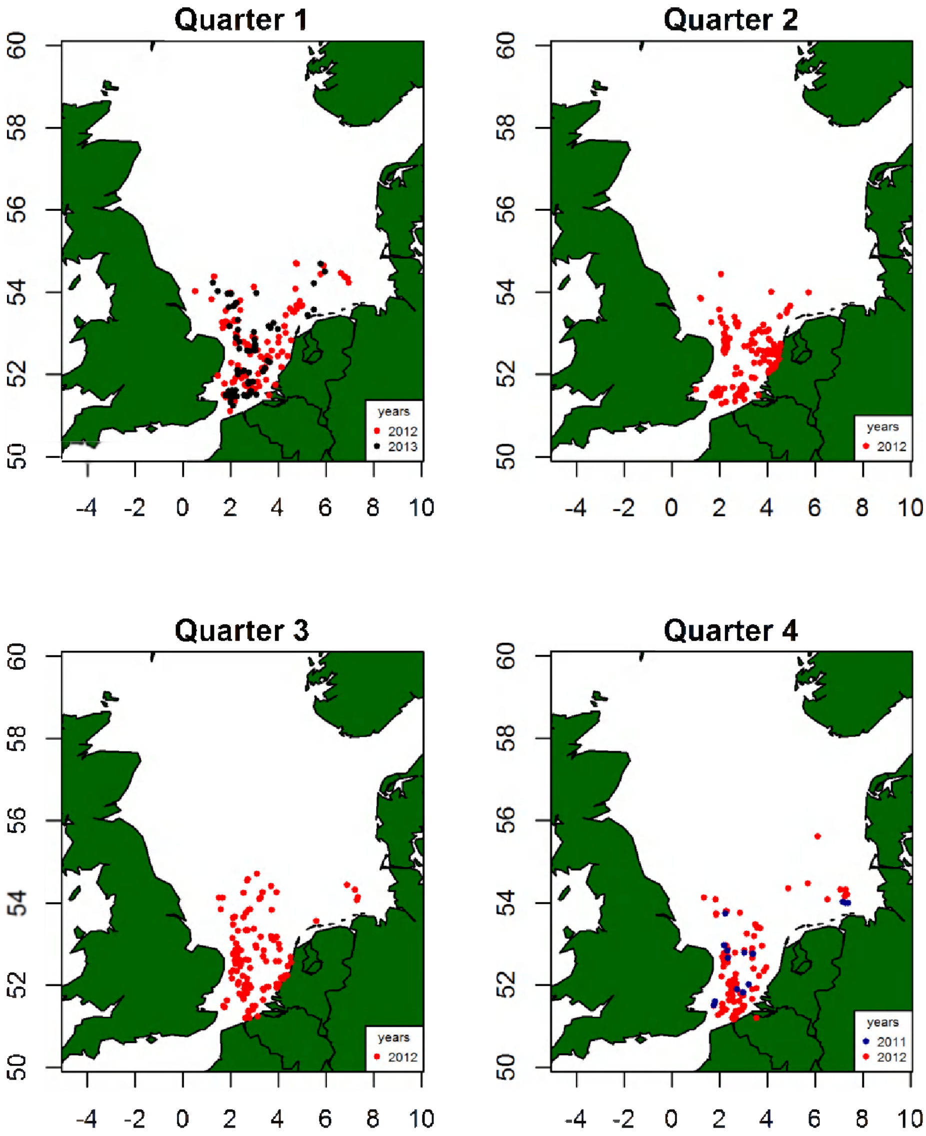

Figure 4.1: *Haul positions of the self-sampling trips 2011-2013 per quarter. The colours of the dots represent the year: blue = December 2011, red = 2012 and black = January and February 2013*

General information on the observer trips

In 2012, ten observer trips were carried out on different pulse trawl vessels (vessel specifications in annex C2). In total 446 hauls were sampled. An overview of the positions of the sampled hauls of all observer trips can be found in figure 4.2. Table 4.1 gives an overview of the fishing areas of each observer trip and the number of sampled hauls per trip. Annex D gives an overview of the haul positions per quarter and per observer trip.

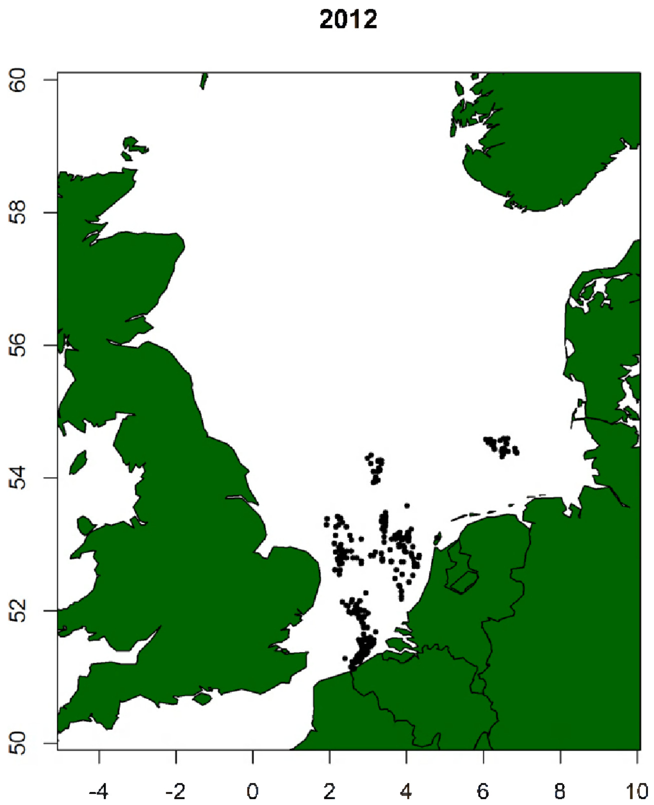

***Figure 4.2**: Haul positions for the ten observer trips*

***Table 4.1:** Overview of the 10 observer trips. Specifications of vessels can be found in Annex C2.*

Tripnr	Year	Q	Fishing area(s)	nr hauls	nr hauls sampled
Obs_1	2012	1	Southern North Sea	38	28
Obs_2	2012	1	Southern North Sea	35	24
Obs_2	2012	1	Central North Sea	2	2
Obs_3	2012	2	Southern North Sea	19	8
Obs_3	2012	2	"English Banks"	18	7
Obs_4	2012	2	Southern North Sea	13	11
Obs_4	2012	2	Central North Sea	28	24
Obs_5	2012	3	Southern North Sea	118	33
Obs_5	2012	3	Central North Sea	2	0
Obs_6	2012	3	Central North Sea	32	25
Obs_6	2012	3	Doggerbank	1	1
Obs_7	2012	3	Southern North Sea	35	25
Obs_7	2012	3	"English Banks"	1	1
Obs_8	2012	4	German Bight	33	24
Obs_9	2012	4	Southern North Sea	12	9
Obs_9	2012	4	Central North Sea	28	20
Obs_10	2012	4	Southern North Sea	31	24

1. What is the spatial variation of discards in the pulse fishery?

In this study, no **clear spatial pattern** in discards in the pulse fishery could be distinguished.

Spatial variation in discard rates could be addressed using the self-sampling data on pulse fisheries because spatial coverage in the self-sampling trips covered all five fishing areas. The observer data did not cover all areas. In addition, the observer data are only sampled in small areas in short time periods (see figure 4.2) and would not give a reliable variation.

The self-sampling data provided no indication for a clear spatial pattern in discards in the pulse fishery (see table 4.2; figure 4.3). The percentage of fish discards in the total catch was relatively stable between the five fishing areas (6-33%) (see table 4.2). The percentages of benthic discards were further apart: 66% in the German Bight and 7% in the Southern North Sea.

Table 4.2: *Overview of the average catch composition for the self-sampling trips per fishing area for 2011-2013: landings (L%), fish discards ($DC\%_{fish}$), benthic discards ($DC\%_{bent}$) and debris ($DC\%_{deb}$). Samples in 2011 were only taken in December; samples in 2013 were only taken in January and February.*

Fishing area	Year	Nr. trips	% trips	L%	$DC\%_{fish}$	$DC\%_{bent}$	$DC\%_{deb}$
Central North Sea	2011	1*	0.2%	30%	33%	37%	0%
	2012	73	12.6%	19%	14%	45%	21%
	2013	13	2.2%	14%	3%	20%	64%
Doggerbank	2011						
	2012	7	1.2%	40%	13%	33%	14%
	2013						
German Bight	2011	3*	0.5%	16%	12%	66%	6%
	2012	20	3.0%	31%	15%	52%	1%
	2013	3*	0.5%	79%	7%	13%	0%
"English Banks"	2011						
	2012	27	4.7%	30%	20%	11%	40%
	2013	4*	0.7%	20%	6%	30%	44%
Southern North Sea	2011	11	1.9%	30%	18%	11%	41%
	2012	370	64.0%	31%	17%	12%	39%
	2013	46	8.0%	26%	14%	7%	53%
Total		**578**	**100 %**	**28%**	**15%**	**21%**	**36%**
Min				16%	6%	7%	0%
Max				79%	33%	66%	64%

** denotes that only very few samples were taken in that quarter and data are not representative for drawing conclusions*

2. What is the seasonal variation of discards in the pulse fishery?

In this study, **no clear seasonal pattern** in the amount of discards could be distinguished in any of the fishing areas.

Seasonal variation in discard rates could be addressed using the self-sampling data on pulse fisheries because samples are available from each week from December 2011 until Februari 2013. The observer data do cover all months, but only 1 week per month and would therefore not give a reliable variation (see figure 4.2).

The results from figure 4.3 show the variation in catch composition between areas and quarters. For some quarter/area combinations, only a few samples were available (Table 4.2), making the estimated catch composition less reliable (e.g. Central North Sea in Q4-2011; German Bight in Q4-2011 and Q1-2013; English Banks in Q1-2013). There is no indication of a seasonal pattern in the discards in any of the fishing areas.

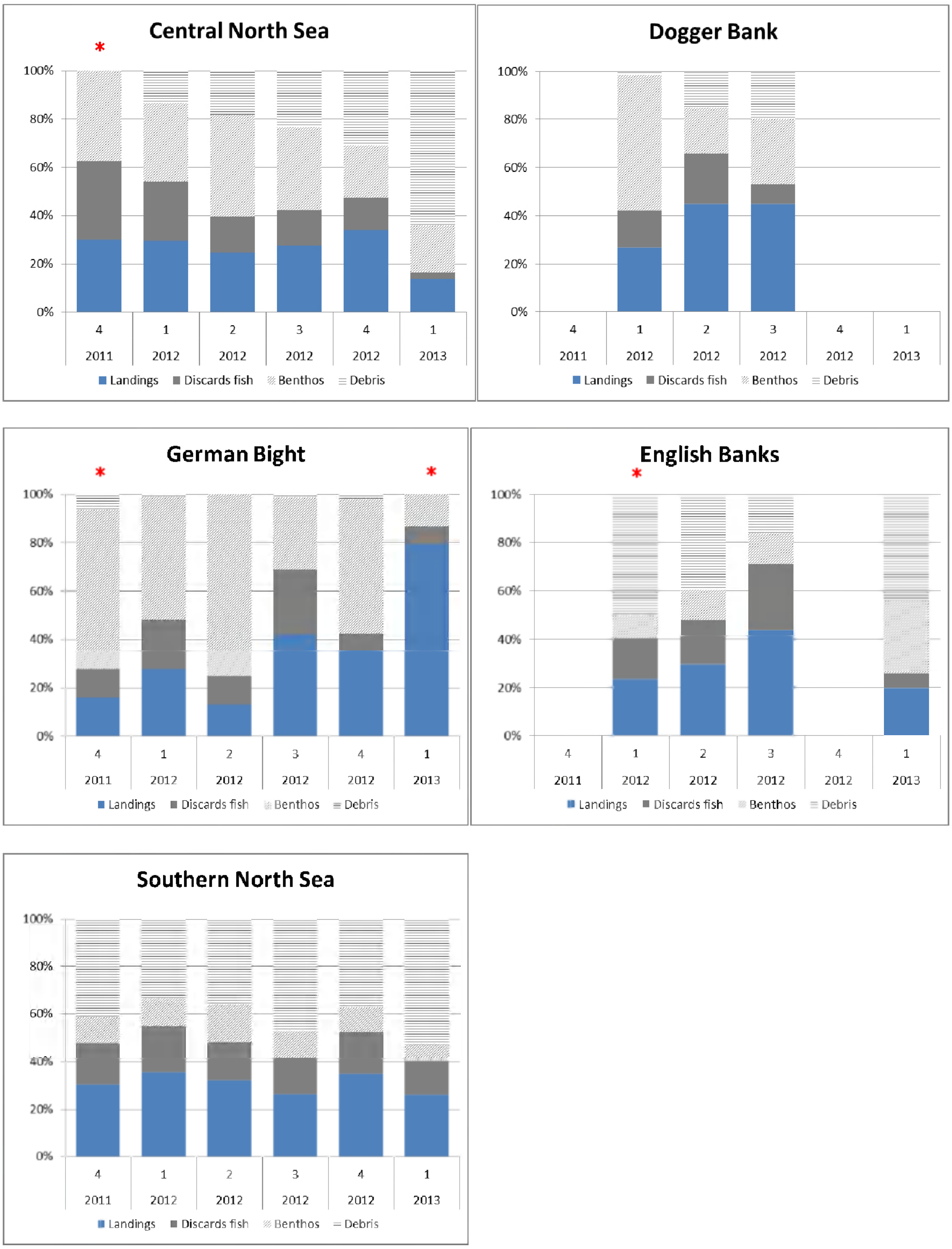

***Figure 4.3**: Average catch composition by year, quarter and fishing area for the self-sampling trips. Q4 of 2011 only consists of data from December 2011. Q1 of 2013 only consists of data of January and February 2013. Therefore, Q4 from 2011 and 2012 and Q1 from 2012 and 2013 are not comparable.*

** denotes that only very few samples were taken in that quarter and data are not representative for drawing conclusions*

3. Which percentage of the catch in the pulse fishery consists of discarded benthos?

In the self-sampling monitoring, the average catch composition over all areas in 2012 was: 31% landings, 17% fish discards, **18% benthic discards** and 34% debris.

In the observer trips, no distinction could be made between the amounts of benthos and debris in the catch, but the combination of **benthos and debris in the observer trips was on average 42%** which is somewhat lower than the results for the self-sampling program (52% benthic discards and debris).

Catch composition self-sampling trips

The catch composition of the self-sampling program from 2011-2013 over all areas was 28% landings, 15% fish discards, 21% benthos discards and 36% debris (table 4.2). In 2011 and 2013 samples were however only taken in quarter 4 and quarter 1 respectively. This means that the estimated catch compositions from 2011-2013 are not representative for a whole year. For 2012, however, data are available for each quarter and area.

The average overall catch composition in the self-sampling data over all areas in 2012 was: 31% landings (all commercially landed fish species), 17% fish discards (all discarded fish species), **18% benthos discards**, 34% debris (Figure 4.4). Annex E1 and E2 gives an overview of the catch composition in the pulse fleet >300hp and ≤300hp.

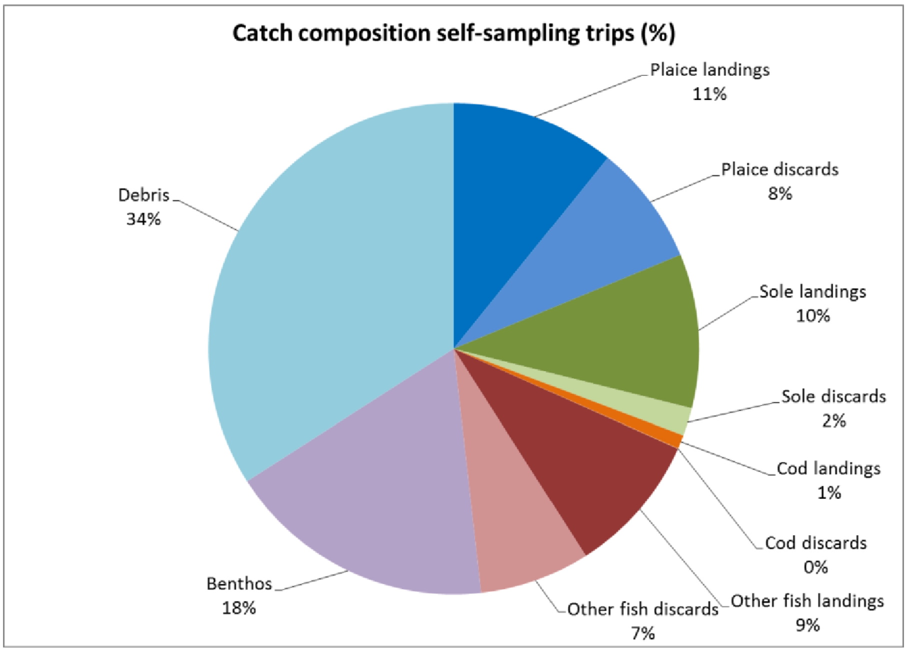

Figure 4.4: *Average catch composition over all self-sampling trips in 2012*

Catch composition observer trips

On average the catch consisted of 29% landings (all commercially landed fish species), 29% fish discards (all discarded fish species) and **42% benthos & debris**[2] (Figure 4.5). Annex E3 gives an overview of the catch composition in the pulse observer trips >300hp and ≤300hp. It should be noted that the presented percentages for ≤300hp are based on only 2 observer trips. The catch composition for each observer trip is shown in figure 4.6.

2 Debris consists of dead material, such as stones, shells and turf.

It was not possible to treat benthos and debris as separate categories in the data-analysis from the observer trips. During these trips, the weight of benthos and debris was not measured separately, but instead was calculated by subtracting the weight of landings and fish discards from the total catch.

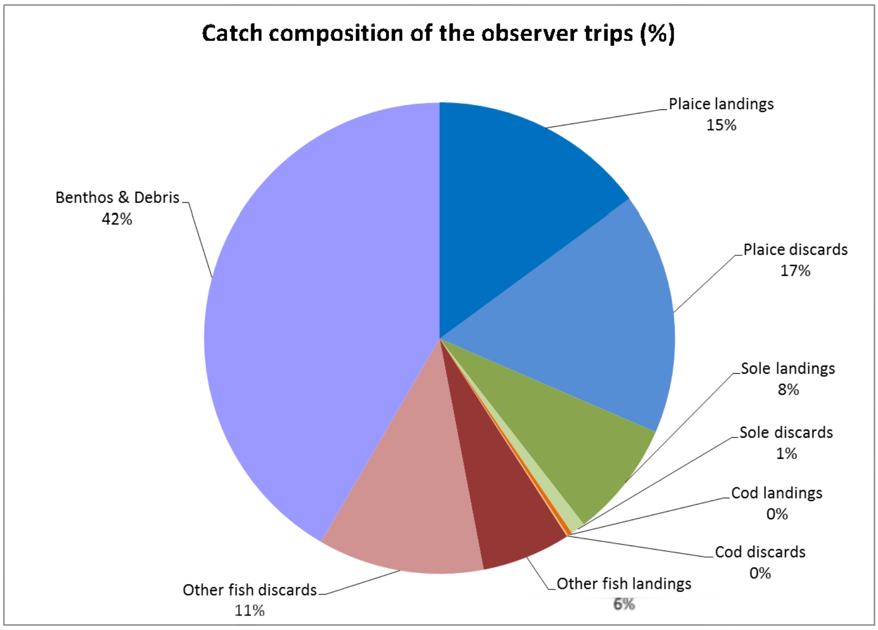

Figure 4.5: *Average catch composition over all observer trips*

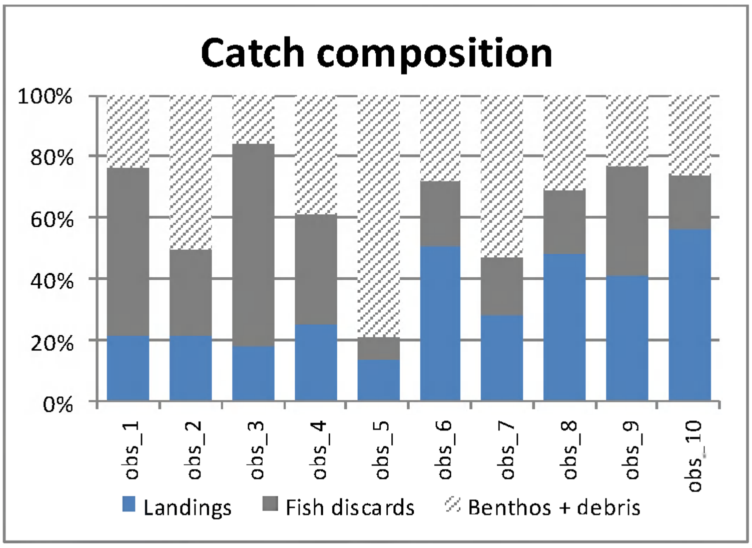

Figure 4.6: *Catch composition by observer trip*

On board, observers measure the length of each fish and the numbers of benthos in the discard sample (Annex G & H). The most frequently discarded benthos species are common starfish (*Asterias rubens*), serpent star (*Ophiura ophiura*), swimming crab (*Liocarcinus holsatus*), sand star (*Astropecten irregularis*), hermit crab (*Pagurus bernhardus*) and sea urchin (*Echinidae*) (Annex G). Most frequently discarded fish species are plaice, dab, sole, whiting and solenette (Annex H).

4. What is proportion of discards versus landings for plaice, sole and cod in the pulse fishery?

The average **plaice** catch over all self-sampling trips consisted of 59% landings and 41% discards. In the observer trips, on average 48% of the plaice catch consisted of landings and 52% of discards.

The average **sole** catch over all self-sampling trips consisted of 85% landings and 15% discards. In the observer trips, on average 90% of the sole catch consisted of landings and 10% of discards.

The average **cod** catch over all self-sampling trips consisted of 93% landings and 7% discards. In the observer trips, on average 88% of the cod catch consisted of landings and 12% of discards.

Plaice, sole and cod catches in the self-sampling program
The average landings and discards described below are in kg/hour with the standard deviation between brackets. On average over all sampled hauls in the self-sampling trips, 38 (±45) kg/hour plaice was landed (59%) and 27 (±45) kg/hour plaice was discarded (41%). The average discard percentage of plaice varied between 8%-59% for the different areas and quarters (Table 4.3).

On average over all sampled hauls in the self-sampling trips, 34 (±19) kg/hour sole was landed (85%) and 6 (±25) kg/hour plaice was discarded (15%). The average discard percentage of sole varied between 3%-25% for the different areas and quarters (Table 4.3).

Cod catches were relatively low in the self-sampling trips. On average over all sampled hauls in the self-sampling trips, 3 (±11) kg/hour cod was landed (93%) and 0.2 (±3) kg/hour plaice was discarded (7%). The average discard percentage of cod varied between 0%-80% for the different areas and quarters (Table 4.3).

Plaice, sole and cod catches in the observer program
Average landings of plaice per trip varied between 21-141 kg/hour with a total average over all trips of 61 (±44) kg/hour (48%). The average discards over all trips varied between 16-242 kg/hour with an average of 66 (±66) kg/hour (52%). The discard percentage by trip varied between 23% and 83% (Table 4.4).

The sole catches per hour were lower than plaice catches. Landings of sole varied between 15-52 kg/hour with a total average over all trips of 32 (±14) kg/hour (90%). The average sole discards over all trips varied between 0-15 kg/hour with an average of 4 (±4) kg/hour (10%). The discard percentage by trip varied between 0% and 25% (Table 4.4).

Cod catches were very low in the observer trips. Landings of cod varied between 0-2 kg/hour with a total average over all trips of 1 (±1) kg/hour (88%). The average cod discards over all trips varied between 0-1 kg/hour with an average of <1 (±<1) kg/hour (12%). The discard percentage by trip varied between 0% and 100% (Table 4.4).

Table 4.4 also shows the average plaice and sole catches for each vessel type. The two trips on a vessel with engine power less than 300hp have a higher average discard percentage of sole of 23%, while the trips with vessels that have an engine power higher than 300hp generated a lower discard percentage of sole (8%).

The standard deviations in both the self-sampling and the observer program are high.

Table 4.3: *Overview average landings (L, kg/hour), discards (DC, kg/hour), and discard percentage (DC%) with respect to the landings for plaice and sole by year, quarter (Q) and fishing area for the self-sampling trips. The table also includes in standard deviation and minimum and maximum value.*

				Plaice			Sole			Cod		
Year	**Q**	**Nr. trips**	**Fishing area**	**L**	**DC**	**DC%**	**L**	**DC**	**DC%**	**L**	**DC**	**DC%**
2011	4	1*	Central North Sea	24	24	50%	29	5	14%	0	0	
		3*	German Bight	2	3	59%	42	4	9%	0	0	
		11	Southern North Sea	63	38	38%	31	5	13%	1	4	80%
2012	1	22	Central North Sea	52	44	45%	23	3	12%	2	0	0%
		2*	Doggerbank	43	19	31%	30	3	10%	4	0	0%
		7	German Bight	65	39	37%	25	6	20%	0	0	
		10	"English Banks"	31	25	45%	31	7	17%	1	0	0%
		80	Southern North Sea	37	31	45%	30	4	12%	9	<1	3%
2012	2	15	Central North Sea	38	27	42%	22	4	16%	0	0	
		1*	Doggerbank	227	107	32%	0	0		0	0	
		1*	German Bight	43	47	52%	25	8	25%	0	0	
		10	"English Banks"	47	29	38%	21	1	5%	0	0	
		115	Southern North Sea	26	20	43%	33	4	10%	2	<1	3%
2012	3	23	Central North Sea	52	37	42%	30	1	4%	1	<1	39%
		4*	Doggerbank	100	19	16%	22	1	3%	0	0	
		4*	German Bight	6	7	56%	34	4	10%	0	0	
		7	"English Banks"	43	36	46%	31	4	11%	0	0	
		99	Southern North Sea	28	23	46%	41	12	23%	3	<1	2%
2012	4	13	Central North Sea	73	14	16%	40	2	6%	<1	0	0%
		8	German Bight	21	4	15%	32	4	12%	0	0	
		76	Southern North Sea	42	34	44%	45	9	17%	3	0	0%
Average 2012		**497**		**37**	**27**	**42%**	**35**	**6**	**15%**	**3.1**	**0.1**	**3%**
St. Dev.				43	45		19	27		11	1	
2013	1	13	Central North Sea	55	10	15%	30	2	7%	1	0	0%
		3*	German Bight	129	11	8%	16	1	8%	0	0	
		4*	"English Banks"	34	12	26%	28	2	7%	0	0	
		46	Southern North Sea	42	29	41%	36	4	11%	4	<1	9%
Average				**38**	**27**	**41%**	**34**	**6**	**15%**	**3.0**	**0.2**	**7%**
St. Dev.				45	45		19	25		11	3	
Min				2	3	8%	0	0	3%	0	0	0%
Max				227	107	59%	45	12	25%	9	5	80%

* *denotes that only very few samples were taken in that quarter and data are not representative for drawing conclusions*

Table 4.4: *Overview discards (kg/hour), landings (kg/hour) and discard percentage (DC%) with respect to the landings for plaice, sole and cod by observer trip and averaged over all observer trips and observer trips ≤300hp and >300hp. The table also includes in standard deviation and minimum and maximum value.*

Tripnr	**Engine Power (hp)**	**Plaice**			**Sole**			**Cod**		
		L	**DC**	**DC%**	**L**	**DC**	**DC%**	**L**	**DC**	**DC%**
Obs_1	≤300	21	44	68%	16	2	11%	2	<1	11%
Obs_2	>300	26	34	57%	16	1	7%	2	<1	10%
Obs_3	>300	51	247	83%	27	3	9%	1	1	36%
Obs_4	>300	34	67	66%	25	2	6%	1	<1	8%
Obs_5	≤300	51	45	47%	45	15	25%	<1	0	0%
Obs_6	>300	135	48	26%	15	0	0%	1	<1	21%
Obs_7	>300	23	16	41%	40	2	6%	2	<1	<1%
Obs_8	>300	52	31	38%	42	1	3%	0	<1	100%
Obs_9	>300	78	81	51%	42	8	15%	1	0	0%
Obs_10	>300	141	42	23%	52	4	7%	2	<1	7%
Average	≤300	36	45	56%	30	9	23%	1	<1	
Average	>300	68	71	51%	32	3	8%	1	<1	
Average	**Total**	**61**	**66**	**52%**	**32**	**4**	**10%**	**1**	**<1**	**12%**
St. Dev.		44	66		14	4		1	<1	
Min		21	16	23%	15	0	0%	0	0	0%
Max		141	247	83%	52	15	25%	2	1	100%

5. How do the results from self-sampling trips compare to the results of the observer trips in the pulse fishery?

Catch comparisons showed **three significant differences** between the self-sampling and observer program: **catches of benthos & debris, discards of sole and landings of cod** are significantly higher in the self-sampling program.

The results of the self-sampling and observer trips are compared to check the consistency of the two sampling methods. The consistency check consists of a comparison of the average catch compositions and comparisons of the average plaice, sole and cod landings and discards.

Catch composition

The average catch composition (kg) of the self-sampling hauls is statistically compared with the average catch composition (kg) of the observer trips. For the comparison, only data from 2012 were used and vessels with engines larger than 300hp (Annex E2). In the comparison, the catch composition is divided into different categories: fish landings, fish discards and benthos & debris combined. Figure 4.7 shows the average catch (bar graph) and the confidence interval (line) per category of the self-sampling hauls and observer trips. 95% of the average catch data fall within the confidence interval.

The t-test ($p<0.05$) showed that there is a significant difference in the average catch of benthos & debris between the self-sampling and observer trips. The benthos & debris catches are higher in the self-sampling hauls than in the observer trips.

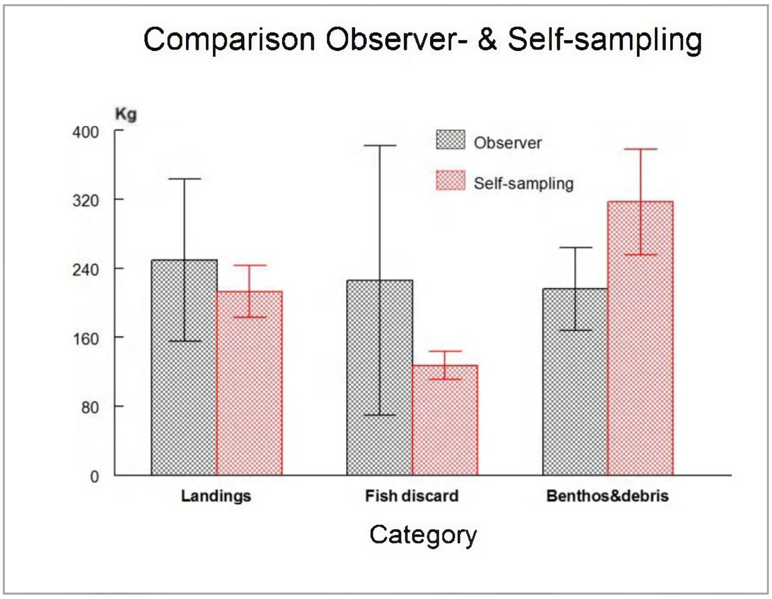

Figure 4.7: *Comparison of the mean catch of fish landings, fish discards and benthos & debris in kg of the self-sampling (red) and observer (black) trips from vessels >300hp and executed in 2012*

<u>Landings and discards of plaice, sole and cod</u>

The average plaice, sole and cod landings and discards (kg/hour) of the self-sampling hauls were statistically compared to the observer trips. The comparison is based on 2012 data for vessels larger than 300hp. Figure 4.8 shows the average landings and discards (bar graph) and the confidence interval (line) per category of the self-sampling hauls and observer trips. In order to show the results of the three species, a logarithmic y-axis was used.

The t-test ($p<0.05$) showed that there is a significant difference in the average sole discards and cod landings between the self-sampling and observer trips, where the self-sampling trips have a higher average catches of sole discards and cod landings compared to the observer trips.

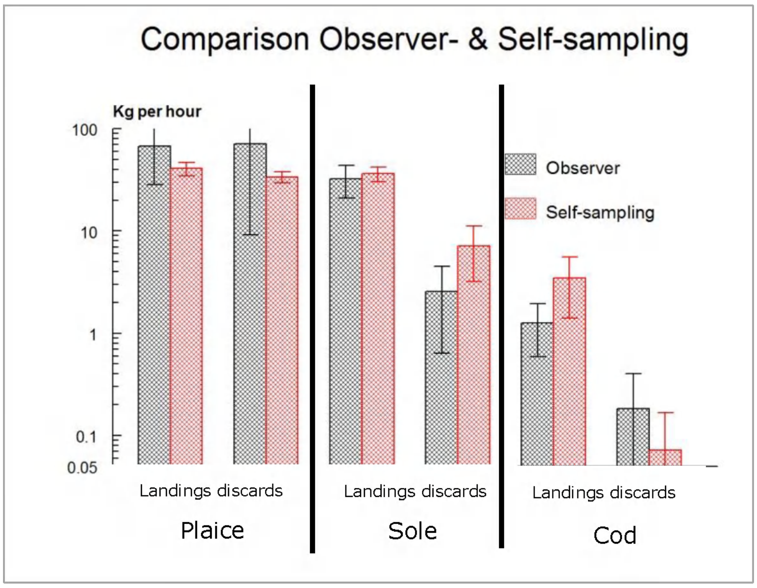

Figure 4.8: *Comparison of the mean catch of plaice, sole and cod landings (kg/hour) and discards (kg/hour) of the self-sampling (red) and observer (black) trips from vessels >300hp and executed in 2012*

6. How do discards in pulse trawl fishing compare to discards in conventional beam trawl fishing?

Only a general comparison of the data from 2012 and vessels >300hp is made, no statistical comparison is done to compare the pulse and beam trawl data.

The **numbers of starfish and crab** caught in the pulse trawl trips were lower than in the conventional beam trawl trips. The pulse vessels caught 16% of starfish compared to catches from the conventional beam trawl and 42% of crabs. The numbers of starfish and crabs give a good indication of the caught quantities of benthos in the pulse and beam trawl fishery which means that less benthos is caught in the pulse fishery.

The average discard percentage of **plaice** from the pulse trawl observer program (52%) is similar to the plaice discard percentage of the beam trawl trips (49%). The average discard percentage of the pulse self-sampling program is lower (42%). The amount of plaice discards caught in the pulse self-sampling (27 kg/hour) and observer program (66 kg/hour) are lower than in the beam trawl fishery (87 kg/hour).

The average discard percentage of **sole** from the pulse trawl observer program (10%) is lower than the sole discard percentage of the self-sampling trips (15%) and beam trawl trips (17%%). The amount of sole discards caught in the pulse self-sampling (6 kg/hour) and observer program (4 kg/hour) lie in the same range as the sole discard catches in the beam trawl fishery (6 kg/hour).

Benthos
Table 4.5 shows the average numbers per hour of starfish and crabs caught in the observer trips in the pulse monitoring program (>300hp, 2012) and observer trips on the conventional beam trawl vessels (>300hp, 70-99mm mesh size, 2012). No self-sampling data on species level is available.

The starfish catch consisted of the following species: Common starfish (*Asterias rubens*), sand star (*Astropecten irregularis*), common brittlestar (*Ophiura fragalis*), brittlestar (*Ophiuar albida*), serpent star (*Ophiura ophiura*), L. ciliaris. The crab catch consisted of the following species: Hyas sp., contracted crab (*Hyas coarctatus*), great spider crab (*Hyas araneus*), long legged spider crab (*Macropodia rostrata*), helmet crab (*Corystes cassivelaunus*), circular crab (*Atelecyclus rotundatus*), edible crab (*Cancer pagurus*), blue leg swimming crab (*Liocarcinus depurator*), swimming crab (*Liocarcinus holsatus*), velvet swimming crab (*Necora puber*), marbled swimming crab (*Liocarcinus marmoreus*), hairy crab (*Pilumnus hirtellus*), risso's crab (*Xantho pilipes*), angular crab (*Goneplax rhomboids*).

The general comparison shows that numbers caught in the pulse trawl trips were lower compared to the numbers caught in the conventional beam trawl trips for starfish and crab. The pulse vessels caught 16% of starfish compared to the conventional beam trawl and 42% of crabs. The amount of starfish and crabs give a good indication of the caught quantities of benthos in the pulse and beam trawl fishery which means that less benthic species are caught in the pulse fishery.

Table 4.5: *Observed numbers/hour, including standard deviation, of starfish and crabs in the pulse monitoring observer trips (>300hp) and beam trawl trips from the DCF (>300hp) in 2012 (CVO, in prep).*

Type of fishery	Starfish nr/hour	Crabs nr/hour
Pulse trawl, observers	1411 (±284)	465 (±94)
Beam trawl	8753 (±2592)	1120 (±244)

Plaice and sole

The discard percentages (DC%) and the discard rates (kg/hour) of plaice and sole caught in the pulse self-sampling and observer program (>300hp, 2012) were compared to the beam trawl fishery (>300hp, 70-99mm mesh, 2012) (Table 4.6).

The average discard percentage of plaice from the pulse trawl observer program (52%) is similar to the plaice discard percentage of the beam trawl trips (49%). The average discard percentage of the pulse self-sampling program is lower (42%). The average discard rate of plaice in the pulse trawl self-sampling (27 (±45) kg/hour) and observer program (66 (±66) kg/hour) are both lower than in the beam trawl fishery (87 (±71) kg/hour)

The average discard percentage of sole from the pulse trawl self-sampling program (15%) is similar to the sole discard percentage of the beam trawl trips (17%). The average discard percentage of the pulse observer program is lower (10%). The discard rates of sole are similar in all three programs: the sole discard rate in the pulse trawl self-sampling is 6 (±26) kg/hour, for the observer program 4 (±4) kg/hour and for the beam trawl fishery 6 (±10) kg/hour.

Table 4.6: *Observed plaice and sole landings, discards (kg/hour), including standard deviation, and DC% for the pulse self-sampling trips (>300hp) monitoring observer trips (>300hp) and beam trawl trips from the DCF (>300hp) in 2012 (CVO, in prep.)*

Type of fishery	**Plaice**			**Sole**		
	L	**DC**	**%DC**	**L**	**DC**	**%DC**
Pulse trawl, self-sampling	37 ±43	27 ±45	42%	35 ±19	6 ±26	15%
Pulse trawl, observers	61 ±44	66 ±66	52%	32 ±14	4 ±4	10%
Beam trawl	90 ±86	87 ±71	49%	29 ±14	6 ±10	17%

5. Discussion

Methods

Self-sampling raising procedure
For the raising procedure a conversion factor based on sole landings was used. This was done because sole is the main target specie in the pulse fishery and was caught in almost all trips. However, when only small amounts of sole were caught in the sampled trip, a wrong measurement could influence the conversion factor and the total results. To be more certain whether this has happened, more research could be done by checking the sole raising factor with the plaice raising factor and also calculating results using the estimated total catch.

Communication
Communication with participating fishers in the self-sampling project was generally handled by the representatives of the fishery sector. This meant that there was mostly indirect communication between the fishers collecting the data and the scientists processing and analysing the data. Three times during the program the scientists had direct communication with the participating fishers, namely during the instruction days and the extra visits to the harbours in April and August/September. However, not all fishermen were present during these extra visits. The research questions and formulation of the results were only discussed with representatives of the fishery sector and not with participating fishers. Kraan et al. (2013) states that the reliability of the data will be enhanced when direct communication between scientists and participating fishers is increased.

Results

High variation in results
The results in chapter 4 show a high variation (high standard deviation) in catch composition and in landings and discards of plaice, sole and cod in both the self-sampling trips and observer trips. This could be caused by:

- The spatial variation of the species in the North Sea
- The seasonal variation of the species in the North Sea

The above mentioned reasons could cause the variation of catch per haul

In the self-sampling data, the minimum and maximum values and the standard deviation per area and season show a high variation. The very low of high numbers often originate from areas and seasons where only few samples (1 until 4) were taken. These few samples have a large effect on the average of that area and season. For example: when one of the samples is taken in an area with high plaice discards, this will influence the average plaice discards in that area and season.

Comparing self-sampling data and observer data
The results of the self-sampling trips were compared with the observer trips to check the consistency of the two monitoring approaches. Most of the catch rates of the self-sampling data were within the same range as the results of the observer program (Figures 4.7; 4.8). The only statistically significant differences were observed in the average catch rates of benthos & debris, the sole discard rates and the cod landings rates.

The confidence intervals of the observer trip data are higher than the confidence intervals found in the self-sampling program. This difference could be explained by the lower amount of trips in the observer program. A larger data set usually produces fewer errors from the average catches then a small data set. For the self-sampling analysis, 578 hauls were used, while only 10 trips were used for the observer analysis.

The results show a statistically significant difference in average catch of benthos and debris and the catch rates of sole discards and cod landings. These differences could be explained by the different spatial and seasonal coverage of the two programs: The self-sampling data are based on many individual observations throughout the year, while the observer trips are based on a substantial number of observations in short time periods (mostly four days), on a limited amount of vessels (each skipper displays a different fishing behaviour) and small areas (Annex D). This may explain why the observer trips could have 'missed' areas and seasons where large amount of benthos and debris are caught. The same could be the case for sole discards and cod landings, where significantly more sole discards and cod landings were found in the self-sampling program. In addition, sampling catches in the self-sampling program only took place during the day, whereas, samples were taken day and night during the observer trips. This could have influenced the data but this has not been verified.

The consistency of self-sampling and observer data could be checked more thoroughly when comparing each observer trip with the self-sampling trips done in the same area and around the same time. If these comparisons result in significant differences, it is less likely that this is caused by area and/or time.

Benthos and debris catches could not be compared separately. During the observer trips, benthos was only monitored as numbers present in the sample; no weights were documented. Therefore, no distinction was made between benthos bycatch and debris. The calculation of the weight of benthos and debris combined is based on the estimated total catch from which the landings and fish discards are subtracted. Since the observer program does not distinguish between benthos and debris, these could not be compared with data from the self-sampling program. In future research projects where comparisons between programs are essential, the level of details in the samples of the programs should be similar. However, in this project the self-sampling data are a good source for the benthos and debris data: in the self-sampling program the benthos and debris were weighted separately and the self-sampling data were collected weekly and in a wide spread area.

Comparing pulse trawl data and beam trawl data

The pulse trawl self-sampling and observer data were compared with the conventional beam trawl data from the DCF. In the DCF program, a distinction is made between vessels below and above 300hp. Therefore , in the comparison between pulse trawl data and DCF data, only samples from vessels with an engine power higher than 300hp were used. For vessels with an engine power below 300hp, insufficient pulse data were available to make a reliable comparison. The comparison with DCF data was not part of the original assignment, so therefore only an indicative comparison was carried out without a full statistical analysis.

The results show a high variation in absolute catches of plaice between the pulse self-sampling and observer trips. The pulse self-sampling data are collected throughout the year and are spread over different areas. Averages are therefore calculated from many datapoints. The pulse observer data are caught in relatively small areas within limited timeframes. Therefore, one trip could have had a major influence on average results. Observer trips 3, 6 and 10 showed high plaice catches (landings and discards) compared to the other trips and had a major influence on the average catches of plaice of the observer program. Table 4.6 shows the average catch rates (landings and discards) of plaice and sole. The pulse data from both the self-sampling programand the observer program had lower average catch rates of plaice (landings and discards), but since the difference in standard deviations in these programs is relatively large, an absolute conclusion with the beam trawl fishery cannot be given.

Previous work on comparative fishing trials between conventional tickler chain beam trawls, pulse wings by HFK-Engineering, and pulse trawls by the DELMECO-Group (van Marlen et al, 2011) indicated that the vessels with pulse trawls caught fewer target species, but also less fish discards and benthic discards than the vessels with tickler chains.

Table 4.7: *Observed plaice and sole landings, discards (kg/hour), and benthic discards (numbers/hour) for the DELMECO pulse vessel, HFK pulse wing and the beam trawl vessel (Van Marlen et al., 2011)*

Type of fishery	**Plaice (kg/h)**		**Sole (kg/h)**		**Benthos**
	L	**DC**	**L**	**DC**	**(nr/h)**
Pulse trawl, DELMECO	25.2	61.2	15.4	1.7	2556
Pulse trawl, HFK	24.7	49.6	14.8	1.0	3784
Beam trawl	34.9	106.8	17.9	2.8	4972

This comparative work has led to the impression that pulse gears catch substantially less fish discards and benthic discards than the tickler chain gears. The current study supports the findings by Van Marlen et al (2011) that the pulse fisheries catch less discards (plaice, sole and benthos) and less plaice landings. However, the sole landings are in the current pulse program higher than the landings in the beam trawl fishery, while in the study done by Van marlen et al., this was the other way around. This could be caused by the fact that recent years the fishermen got more experienced with the pulse trawl and learned to catch sole more efficiently. Besides, pulse vessels are able to fish on other fishing grounds then beam trawl vessels because of the lighter gear.

6. Conclusion and reccomendations

Conclusions

On average around 30% of the pulse catches consist of landings. The discards percentage varies between the self-sampling (17%) and observer program (29%). The average plaice catches (kg/h) in the self-sampling program differs from the average plaice catches (kg/h) in the pulse observer program. The observer data are collected in short time periods and areas, which may explain this difference. Besides, the observer data are based on only 8 trips, while the self-sampling data is based on a large data set. Therefore, one trip could have a major influence on average results.

The average amounts of plaice caught in the self-sampling and observer trips is lower than in the beam trawl fishery. This is consistent with earlier research done in 2011 by Van Marlen et al. Absolute sole catches are higher in both the pulse fishery, while the sole discard percentage is lower in the pulse fishery. In earlier research done by Van Marlen et al., sole landings and discards were both lower in the pulse fishery. The change in landings could be caused by the fact that recent years the fishermen got more experienced with the pulse trawl and learned to catch sole more efficiently. Besides, pulse vessels are able to fish on other fishing grounds then beam trawl vessels because of the lighter gear. However, since the difference in standard deviations in these programs is relatively large, an absolute conclusion with the beam trawl fishery cannot be given.

Overall, more than 40% of the average pulse catches consist of benthos and debris. The self-sampling data show that 1/3 of the total catches consist of benthos. The numbers of starfish and crab caught in the pulse fishery are lower than in the beam trawl fishery. This is consistent with earlier research done in 2011 by Van Marlen et al.

Recommendations

The reliability of the data could be enhanced with extra checks regarding data conversion from one haul to total catch. The chance of this going wrong will increase when only small amounts of sole are present in both the sample and landings. To increase consistency in these specific cases, more research could be directed towards using the plaice raising facor to check the sole raising factor or calculate results using the estimated total catch.

In addition, the reliability of the data will be enhanced when communication between scientists and participating fishermen is increased, for instance by organising more meetings where preliminary resuls can be discussed or the progress can be evaluated. This was done but could be improved in a next study. However, it must be kept in mind not to overlaod the fishermen with meetings.

The consistency of self-sampling and observer data could be checked more thoroughly when comparing each observer trip with the self-sampling trips done in the same area and around the same time.

Finally, there were difficulties in comparing the results of the self-sampling and observer program because of a difference in the level of details of the collected data. In future research projects where comparisons between programs are essential, the level of details in the samples of the programs should be similar. Attention should be paid to this issue when developing the work plan and protocols for the program.

Acknowledgements

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Furthermore, we would like to thank the PO's for their cooperation in collecting the forms from the fishers and sending them to Productschap Vis.

Finally, we would like to thank our colleagues from IMARES and the observers from ILVO for carrying out the observer trips.

Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 1th of April 2017 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

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Justification

Rapport number: C122/13
Project Numbers: 4301301801-pulskormonitoring deel 1
4301301802-pulskormonitoring deel 2

The scientific quality of this report has been peer reviewed by a colleague scientist and the head of the department fisheries of IMARES.

Approved: Martin Pastoors
Senior Researcher

Signature:

Date: 29 November 2013

Approved: Nathalie Steins
Department head Fisheries

Signature:

Date: 29 November 2013

Annex A Self-sampling protocol and form

Protocol catch sampling pulse

This protocol describes how fishermen can measure their catch composition. Fishermen send the forms with data from the previous month in the first week of each month to Productschap Vis. Productschap Vis sends the forms to IMARES. IMARES analyses the data and creates overviews of: percentage of discards per haul, average composition of the (sampled) catches, proportion discards versus landings for plaice, sole and cod.

1. Take each trip a catch sample of one haul on Tuesday morning between 8:00 and 12:00.

2. Register the general information about the vessel and gear. Register haul data (time in and out, positions, etc.) for the sampled haul. Use Table 1 on the form.

3. Register the total catch of the sampled haul. Total catch can be estimated in two ways:
   i. OR: count the total number of baskets (50 liters) with waste (discards, benthos, stones, etc.) using the valves in the chute. Record this in Table 2 on the form. Also note ALL landings by species in weight (kg) of the sampled haul.
   ii. OR (only if no valves are installed!): estimate the total number of baskets (50 liters) with catch in the boxes. Record this in Table 2 on the form. Also note ALL landings by species in weight (kg) of the sampled haul.

4. Take a representative sample of 1 basket (50 liters) of unsorted catch. It is important that this is done by filling a bucket of 10 liters with unsorted catch five times during the processing of the whole catch. Take these samples at the beginning of the conveyor belt, when the landed sized fish is still part of the catch.

5. Sort the sample in the following categories:
   - Plaice - Landings
   - Plaice - Discards
   - Sole - Landings
   - Sole - Discards
   - Cod - Landings
   - Cod - Discards
   - Other fish species - Landings (incl. marketable Crabs etc.)
   - Other fish species - Discards (including non-commercial species)
   - Benthic species (benthos)
   - Stones, peat, shells etc.

6. Weigh the different categories and record the data in kg per category in Table 3 of the form. Use a scale if present, otherwise an estimate is sufficient.

7. Use the Comments box to note additional data / information which may be of interest to the research.

8. In the first week of each month send the forms with data from the previous month to puls@pvis.nl or (no stamp required):
   Productschap Vis
   For the attention of Pulskor monitoring
   Answer ID 10387
   2280 WB Rijswijk

9. You can also give the forms to your PO, they will send the forms to the above mentioned address.

Form catch sampling puls

Catch sampled with / without* valves

** Remove / delete what is not applicable to your vessel*

Table 1: General information	
Ship:	
Engine power *(kW)*:	
Power puls *(kW)*:	
Pulsfrequency *(Hz)*:	
Pulsduration *(burst/µs)*:	
Meshsize *(mm)*:	
Date *(dd-mm-yy)*:	
Time in *(hhmm)*:	
Time out *(hhmm)*:	
Position in: (N/Z & E/W)	**Lat:**
	Lon:
Position out: (N/Z & E/W)	**Lat:**
	Lon:

Table 2: Haul information	
OR: Amount of baskets (~50 liter) **waste (discards, benthos and stones etc.)** (counted with valves):	
OR: Amount of baskets (~50 liter) **catch** (estimated):	
Landings in sampled haul	
Plaice	*kg*
Sole	*kg*
Cod	*kg*
	kg
	kg
	kg
Remaining fish	*kg*

Table 3: Catch sample information

		Weight *(kg)*
Plaice	Landings	
	Discards	
Sole	Landings	
	Discards	
Cod	Landings	
	Discards	
Remaining fish	Landings	
	Discards	
Benthos		
Stones, etc.		

Annex B Detailed description of the raising procedure

Annex B1: Raising procedure self-sampling data

In a first step, the landing ratio (LR) per haul is determined:

$$LRsole = \frac{Landings_{sole,haul}}{Landings_{sole,sample}} \ (1)$$

where, LR_{sole} represents the landing ratio, $Landings_{sole,haul}$ represents the total amount (kg) of sole landed in the sampled haul and $Landings_{sole,sample}$ represents the total amount (kg) of landed sole in the sample.

All weights from the catch sample have been raised to haul level by multiplying weights with LR_{sole}:

$$Discards_{spec,haul} = Discards_{spec,sample} \times LRsole \ (2)$$

$$Landings_{spec,haul} = Landings_{spec,sample} \times LRsole \ (3)$$

where, $Discards_{spec,haul}$ and $Landings_{spec,haul}$ represent the discarded and landed amount(kg) of a species raised to haul level and $Discards_{spec,sample}$ and $Landings_{spec,sample}$ represent the discarded and landed amount (kg) of a species in the catch sample.

If no sole landings were present in the sample, a plaice landing ratio was used instead. This was the case in 4 hauls (Annex F: Ss_96, Ss_153, Ss_282, Ss_504). The landing ratio was then based on the amount (kg) of landed plaice (in the haul and in the sample):

$$LRplaice = \frac{Landings_{plaice,haul}}{Landings_{plaice,sample}} \ (4)$$

where, LR_{plaice} represents the landing ratio, $Landings_{plaice,haul}$ represents the total amount (kg) of plaice landed in the sampled haul and $Landings_{plaice,sample}$ represents the total amount (kg) of landed plaice in the sample.

Raised discards and landings (kg) for plaice and sole on haul level have been converted into weight per fishing hour (kg/hour):

$$Discards_{spec}/hour = \frac{Discards_{spec,haul}}{(HaulDuration/60)} \ (5)$$

$$Landings_{spec}/hour = \frac{Landings_{spec,haul}}{(HaulDuration/60)} \ (6)$$

where, $Discards_{spec}$/hour and $Landings_{spec}$/hour represent the discard and landings rate per fishing hour and HaulDuration represents the total haul duration of the sampled haul in minutes.

The amount of discards and landings per fishing hour was averaged by year, quarter and fishing area.

Annex B2: Raising procedure observer data

Discards

Whenever a fraction of discards was sampled, a sub-sampling factor was used to expand measured observations from a sample to haul level. This sub-sampling factor is the ratio between the estimated total and sub-sampled volumes of discards.

These sampled discard numbers per haul were summed over all sampled hauls ($SampDiscards_{spec,trip}$) and converted to numbers per fishing hour:

$$Discards_{spec,trip}/hour = \frac{SampDiscards_{spec,trip}}{(HaulDuration_{sampled}/60)} \quad (7)$$

where, $Discards_{spec,trip}/hour$ represents the discard rate per fishing hour and $HaulDuration_{sampled}$ represents the total haul duration of the sampled hauls in minutes (summation of all sampled hauls). The calculated discards/fishing hour was used to calculate the total discards per species per trip:

$$Discards_{spec,trip} = Discards_{spec,trip}/hour \times HaulDuration_{tot}/60 \quad (8)$$

where, $Discards_{spec,trip}$ represent the total discards (kg) per species per trip and $HaulDuration_{tot}$ represents the total haul duration of all hauls in the sampled trip in minutes.

In the next step, existing species-specific length-weight relationships were used to convert numbers-at-length into weight-at-length. Unfortunately benthos could not be converted to weights because for the majority of these species no length-weight relationship is available.

The total weight (kg) of benthos and debris is calculated by subtracting the weight of landings and fish discards from the total catch.

Landings

The total landed weight (kg) per species per trip that is available from the auction lists ($TotLand_{spec,trip}$) was converted to weight (kg) per fishing hour:

$$Landings_{spec,trip}/hour = \frac{TotLand_{spec,trip}}{(HaulDuration_{tot}/60)} \quad (9)$$

where, $Landings_{spec,trip}/hour$ represents the landings rate per fishing hour.

Annex C Specifications of the ships participating in the self-sampling program and the observer program

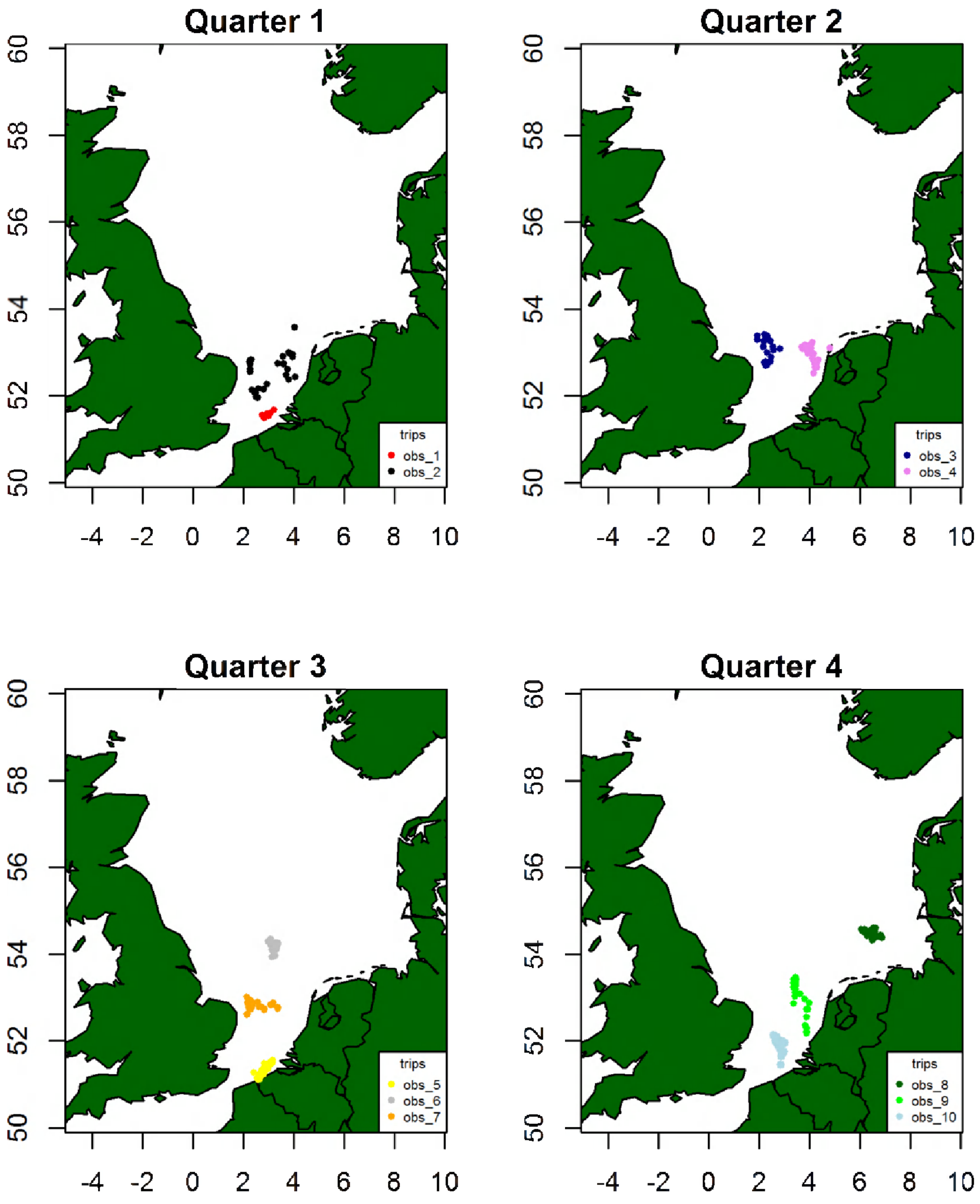
Annex C1: Vessel characteristics and fishing area(s) for vessels participating in self-sampling program

Vessel nr.	Engine Power (hp)	Meshsize	Fishing area(s) and corresponding nr of trips
Vessel 1	≤300	80	Southern North Sea (8)
Vessel 2	≤300	80	Southern North Sea (27)
Vessel 3	>300	80	Southern North Sea (13)
Vessel 4	>300	80	Southern North Sea (14)
Vessel 5	>300	80	Central North Sea (1), "English Banks" (2), Southern North Sea (51)
Vessel 6	>300	80	Southern North Sea (38)
Vessel 7	>300	80	Central North Sea (6), German Bight (1), "English Banks" (1), Southern North Sea (8)
Vessel 8	≤300	80	Southern North Sea (4)
Vessel 9	>300	80	Central North Sea (5), "English Banks" (7), Southern North Sea (14)
Vessel 10	>300	80	Central North Sea (8), "English Banks" (1), Southern North Sea (7)
Vessel 11	>300	80	Southern North Sea (10)
Vessel 12	≤300	80	Southern North Sea (28)
Vessel 13	≤300	80	Southern North Sea (16)
Vessel 14	>300	80	Southern North Sea (19)
Vessel 15	≤300	80	Southern North Sea (13)
Vessel 16	>300	80	"English Banks" (5), Southern North Sea (35)
Vessel 17	>300	80	Central North Sea (4), "English Banks (3), Southern North Sea (3)
Vessel 18	>300	80	Central North Sea (24), Doggerbank (2), "English Banks" (1), Southern North Sea (18)
Vessel 19	>300	80	Central North Sea (7), Doggerbank (1), "English Banks" (2), Southern North Sea (33)
Vessel 20	>300	80	Central North Sea (3), "English Banks" (2), Southern North Sea (29)
Vessel 21	>300	80	Central North Sea (8), Doggerbank (1), "English Banks" (1), Southern North Sea (16)
Vessel 22	>300	80	Central North Sea (12), Doggerbank (2), "English Banks" (6), Southern North Sea (3)
Vessel 23	>300	80	Central North Sea (4), German Bight (6)
Vessel 24	>300	80	Central North Sea (5), German Bight (8), Southern North Sea (2)
Vessel 25	>300	80	Central North Sea (1), Doggerbank (1), German Bight (11), Southern North Sea (18)

Annex C2: Vessel characteristics and fishing area(s) for vessels participating in observer program

Tripnr.	Engine Power (hp)	Meshsize	Fishing area(s)
Obs_1	≤300	80	Southern North Sea
Obs_2	>300	80	Southern North Sea, Central North Sea
Obs_3	>300	80	Southern North Sea, "English Banks"
Obs_4	>300	80	Southern North Sea, Central North Sea
Obs_5	≤300	80	Southern North Sea
Obs_6	>300	80	Central North Sea, Doggerbank
Obs_7	>300	80	Southern North Sea, "English Banks"
Obs_8	>300	80	German Bight
Obs_9	>300	80	Southern North Sea, Central North Sea
Obs_10	>300	80	Southern North Sea

Annex D Haul positions per quarter for the observer trips



Annex E Overview of the average catch composition of the self-sampling trips and observer trips in 2012 with vessels >300hp and vessels ≤300hp

Annex E1: Overview of average catch composition self-sampling trips ≤ 300hp per fishing area for 2012: landings (L%), fish discards ($DC\%_{fish}$), benthic discards ($DC\%_{bent}$) and debris ($DC\%_{deb}$).

Fishing area	Year	Nr. trips	L%	$DC\%_{fish}$	$DC\%_{bent}$	$DC\%_{deb}$
Southern North Sea	2012	85	29%	9%	13%	49%

Annex E2*:* Overview of average catch composition self-sampling trips >300hp per fishing area for 2012: landings (L%), fish discards ($DC\%_{fish}$), benthic discards ($DC\%_{bent}$) and debris ($DC\%_{deb}$).

Fishing area	Year	Nr. trips	L%	$DC\%_{fish}$	$DC\%_{bent}$	$DC\%_{deb}$
Central North Sea	2012	73	20%	15%	44%	21%
Doggerbank	2012	7	40%	12%	33%	14%
German Bight	2012	20	33%	16%	50%	1%
"English Banks"	2012	27	30%	19%	11%	40%
Southern North Sea	2012	285	31%	19%	12%	38%
Average	**2012**		**28%**	**17%**	**32%**	**20%**

Annex E3: Overview of the average catch composition for all observer trips and the average catch composition for the observer trips with vessels ≤300hp and with vessels >300hp

Engine power	L%	$DC\%_{fish}$	$DC\%_{bent}$+ $DC\%_{deb}$
≤300hp*	15%	18%	65%
>300hp	35%	33%	31%
Average	**29%**	**29%**	**42%**

** denotes that only two trips were done and data are not representative for drawing conclusions*

Annex F Overview discards (kg/hour), landings (kg/hour) and discardpercentages (DC%) for plaice, sole and cod by self-sampling trip *invalid trip

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice			Sole			Cod		
						DC	L	DC%	DC	L	DC%	DC	L	DC%
Ss_1	>300	Vessel 22	2011	4	Central North Sea	24	24	50%	5	29	14%	0	0	
Ss_2	>300	Vessel 23	2011	4	German Bight	10	0	100%	10	45	18%	0	0	
Ss_3	>300	Vessel 25	2011	4	German Bight	0	4	0%	1	40	2%	0	0	
Ss_4	>300	Vessel 25	2011	4	German Bight	0	3	0%	3	40	6%	0	0	
Ss_5	>300	Vessel 5	2011	4	Southern North Sea	59	92	39%	16	39	29%	0	0	
Ss_6	>300	Vessel 5	2011	4	Southern North Sea	116	217	35%	8	31	20%	0	0	
Ss_7	>300	Vessel 6	2011	4	Southern North Sea	133	172	44%	3	25	12%	0	0	
Ss_8	≤300	Vessel 12	2011	4	Southern North Sea	14	35	28%	0	10	0%	0	0	
Ss_9	>300	Vessel 16	2011	4	Southern North Sea	9	18	33%	4	58	7%	0	0	
Ss_10	>300	Vessel 16	2011	4	Southern North Sea	5	15	23%	5	40	10%	0	0	
Ss_11	>300	Vessel 18	2011	4	Southern North Sea	39	32	55%	<1	23	1%	0	0	
Ss_12	>300	Vessel 19	2011	4	Southern North Sea	13	53	20%	13	53	20%	0	0	
Ss_13	>300	Vessel 20	2011	4	Southern North Sea	23	15	60%	2	15	13%	60	15	80%
Ss_14	>300	Vessel 20	2011	4	Southern North Sea	3	36	8%	1	30	2%	0	0	
Ss_15	>300	Vessel 20	2011	4	Southern North Sea	4	8	33%	<1	23	2%	0	0	
Ss_16	>300	Vessel 7	2012	1	Central North Sea	165	98	63%	8	8	50%	0	0	
Ss_17	>300	Vessel 7	2012	1	Central North Sea	130	140	48%	10	10	50%	0	0	
Ss_18	>300	Vessel 7	2012	1	Central North Sea	23	5	83%	9	32	22%	0	0	
Ss_19	>300	Vessel 9	2012	1	Central North Sea	38	38	50%	0	23	0%	0	8	0%
Ss_20	>300	Vessel 17	2012	1	Central North Sea	8	32	20%	4	20	17%	0	2	0%
Ss_21	>300	Vessel 18	2012	1	Central North Sea	5	16	25%	3	27	9%	0	0	
Ss_22	>300	Vessel 18	2012	1	Central North Sea	12	8	60%	1	24	5%	0	0	
Ss_23*	>300	Vessel 18	2012	1	Central North Sea	114	23	83%	910	23	98%	0	0	
Ss_24	>300	Vessel 19	2012	1	Central North Sea	27	67	29%	0	40	0%	0	0	
Ss_25	>300	Vessel 20	2012	1	Central North Sea	37	12	75%	0	12	0%	0	0	
Ss_26	>300	Vessel 20	2012	1	Central North Sea	61	81	43%	3	12	20%	0	0	
Ss_27	>300	Vessel 21	2012	1	Central North Sea	30	75	29%	15	45	25%	0	15	0%
Ss_28	>300	Vessel 21	2012	1	Central North Sea	4	50	8%	0	22	0%	0	0	
Ss_29	>300	Vessel 22	2012	1	Central North Sea	73	31	70%	0	16	0%	0	0	
Ss_30	>300	Vessel 22	2012	1	Central North Sea	33	66	33%	0	33	0%	0	0	
Ss_31	>300	Vessel 22	2012	1	Central North Sea	17	39	31%	4	35	11%	0	0	
Ss_32	>300	Vessel 22	2012	1	Central North Sea	38	107	26%	0	31	0%	0	13	0%
Ss_33	>300	Vessel 22	2012	1	Central North Sea	60	40	60%	0	7	0%	0	0	
Ss_34	>300	Vessel 23	2012	1	Central North Sea	69	87	44%	2	21	8%	0	0	
Ss_35	>300	Vessel 23	2012	1	Central North Sea	54	56	49%	2	19	10%	0	0	
Ss_36	>300	Vessel 23	2012	1	Central North Sea	21	30	41%	3	30	9%	0	0	
Ss_37	>300	Vessel 23	2012	1	Central North Sea	33	42	44%	5	20	20%	0	0	
Ss_38	>300	Vessel 25	2012	1	Central North Sea	20	35	36%	3	25	9%	0	0	
Ss_39	>300	Vessel 19	2012	1	Doggerbank	30	40	43%	2	30	6%	0	0	
Ss_40	>300	Vessel 21	2012	1	Doggerbank	8	45	14%	5	30	13%	0	8	0%

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_41	>300	Vessel 7	2012	1	German Bight	21	35	38%	18	18	50%	0	0	
Ss_42	>300	Vessel 23	2012	1	German Bight	100	140	42%	2	40	5%	0	0	
Ss_43	>300	Vessel 23	2012	1	German Bight	11	70	13%	2	35	5%	0	0	
Ss_44	>300	Vessel 23	2012	1	German Bight	72	156	32%	2	16	13%	0	0	
Ss_45	>300	Vessel 23	2012	1	German Bight	17	20	47%	6	20	23%	0	0	
Ss_46	>300	Vessel 25	2012	1	German Bight	25	18	58%	7	25	22%	0	0	
Ss_47	>300	Vessel 25	2012	1	German Bight	25	18	58%	7	25	22%	0	0	
Ss_48	>300	Vessel 5	2012	1	"English Banks"	11	11	50%	11	32	25%	0	0	
Ss_49	>300	Vessel 7	2012	1	"English Banks"	47	28	63%	19	14	57%	0	0	
Ss_50	>300	Vessel 9	2012	1	"English Banks"	14	32	30%	5	23	17%	0	0	
Ss_51	>300	Vessel 9	2012	1	"English Banks"	33	87	27%	4	43	9%	0	0	
Ss_52	>300	Vessel 16	2012	1	"English Banks"	2	6	26%	4	13	25%	0	0	
Ss_53	>300	Vessel 16	2012	1	"English Banks"	12	47	20%	0	18	0%	0	12	0%
Ss_54	>300	Vessel 16	2012	1	"English Banks"	13	27	33%	4	40	9%	0	0	
Ss_55	>300	Vessel 16	2012	1	"English Banks"	6	11	33%	3	55	6%	0	0	
Ss_56	>300	Vessel 16	2012	1	"English Banks"	50	50	50%	5	30	14%	0	0	
Ss_57	≤300	Vessel 2	2012	1	"English Banks"	65	11	86%	11	43	20%	0	0	
Ss_58	>300	Vessel 5	2012	1	Southern North Sea	2	6	25%	6	27	18%	0	7	0%
Ss_59	>300	Vessel 5	2012	1	Southern North Sea	54	34	62%	3	34	9%	0	7	0%
Ss_60	>300	Vessel 5	2012	1	Southern North Sea	39	20	67%	33	92	26%	0	13	0%
Ss_61	>300	Vessel 5	2012	1	Southern North Sea	74	32	70%	5	63	8%	0	32	0%
Ss_62	>300	Vessel 5	2012	1	Southern North Sea	31	23	57%	4	23	14%	0	15	0%
Ss_63	>300	Vessel 5	2012	1	Southern North Sea	42	32	57%	5	37	13%	0	0	
Ss_64	>300	Vessel 5	2012	1	Southern North Sea	329	247	57%	27	192	13%	0	82	0%
Ss_65	>300	Vessel 5	2012	1	Southern North Sea	76	43	64%	5	54	9%	0	0	
Ss_66	>300	Vessel 5	2012	1	Southern North Sea	83	33	71%	4	42	9%	0	0	
Ss_67	>300	Vessel 5	2012	1	Southern North Sea	31	13	70%	13	54	20%	0	0	
Ss_68	>300	Vessel 5	2012	1	Southern North Sea	121	43	74%	4	26	14%	0	0	
Ss_69	>300	Vessel 6	2012	1	Southern North Sea	170	357	32%	3	43	7%	0	0	
Ss_70	>300	Vessel 6	2012	1	Southern North Sea	43	60	42%	5	33	14%	0	27	0%
Ss_71	>300	Vessel 6	2012	1	Southern North Sea	170	120	59%	2	10	17%	0	0	
Ss_72	>300	Vessel 6	2012	1	Southern North Sea	81	88	48%	3	25	9%	0	0	
Ss_73	>300	Vessel 6	2012	1	Southern North Sea	57	71	44%	4	43	9%	0	0	
Ss_74	>300	Vessel 6	2012	1	Southern North Sea	23	30	44%	7	30	18%	0	0	
Ss_75	>300	Vessel 6	2012	1	Southern North Sea	55	55	50%	1	28	3%	0	0	
Ss_76	>300	Vessel 6	2012	1	Southern North Sea	70	20	78%	10	35	22%	0	0	
Ss_77	>300	Vessel 6	2012	1	Southern North Sea	47	36	56%	5	29	15%	0	0	
Ss_78	>300	Vessel 7	2012	1	Southern North Sea	3	10	20%	0	35	0%	0	0	
Ss_79	>300	Vessel 7	2012	1	Southern North Sea	26	5	84%	6	10	38%	0	13	0%
Ss_80	≤300	Vessel 8	2012	1	Southern North Sea	0	3	0%	<1	13	2%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice			Sole			Cod		
						DC	L	DC%	DC	L	DC%	DC	L	DC%
Ss_81	>300	Vessel 9	2012	1	Southern North Sea	5	15	25%	3	20	11%	3	10	20%
Ss_82	>300	Vessel 11	2012	1	Southern North Sea	5	50	9%	5	50	9%	3	20	11%
Ss_83	>300	Vessel 11	2012	1	Southern North Sea	1	27	5%	<1	16	2%	0	19	0%
Ss_84	>300	Vessel 11	2012	1	Southern North Sea	3	34	9%	2	24	7%	0	17	0%
Ss_85	>300	Vessel 11	2012	1	Southern North Sea	1	15	6%	<1	8	1%	0	3	0%
Ss_86	>300	Vessel 11	2012	1	Southern North Sea	<1	8	2%	<1	31	1%	0	4	0%
Ss_87	>300	Vessel 11	2012	1	Southern North Sea	6	108	5%	3	24	11%	0	60	0%
Ss_88	>300	Vessel 11	2012	1	Southern North Sea	2	16	11%	2	28	7%	0	2	0%
Ss_89	>300	Vessel 11	2012	1	Southern North Sea	1	7	11%	2	26	7%	0	0	
Ss_90	>300	Vessel 11	2012	1	Southern North Sea	8	56	13%	<1	16	2%	0	8	0%
Ss_91	>300	Vessel 11	2012	1	Southern North Sea	2	15	11%	2	17	10%	0	0	
Ss_92	≤300	Vessel 12	2012	1	Southern North Sea	4	36	10%	0	16	0%	0	0	
Ss_93	≤300	Vessel 12	2012	1	Southern North Sea	8	45	15%	0	14	0%	0	0	
Ss_94	≤300	Vessel 12	2012	1	Southern North Sea	42	7	86%	0	18	0%	0	0	
Ss_95	≤300	Vessel 12	2012	1	Southern North Sea	7	17	30%	0	17	0%	0	0	
Ss_96	≤300	Vessel 12	2012	1	Southern North Sea	20	20	50%	15	0	100%	0	0	
Ss_97	≤300	Vessel 12	2012	1	Southern North Sea	11	5	67%	3	33	8%	0	0	
Ss_98	≤300	Vessel 13	2012	1	Southern North Sea	19	95	17%	4	27	13%	0	0	
Ss_99	≤300	Vessel 13	2012	1	Southern North Sea	3	33	7%	1	20	6%	0	0	
Ss_100	≤300	Vessel 13	2012	1	Southern North Sea	6	36	14%	3	30	9%	3	0	100%
Ss_101	≤300	Vessel 13	2012	1	Southern North Sea	5	20	20%	3	10	20%	0	0	
Ss_102	>300	Vessel 16	2012	1	Southern North Sea	58	18	77%	0	18	0%	0	0	
Ss_103	>300	Vessel 16	2012	1	Southern North Sea	75	200	27%	3	25	9%	0	38	0%
Ss_104	>300	Vessel 16	2012	1	Southern North Sea	6	36	14%	2	20	9%	0	8	0%
Ss_105	>300	Vessel 16	2012	1	Southern North Sea	5	25	17%	10	35	22%	0	0	
Ss_106	>300	Vessel 16	2012	1	Southern North Sea	7	34	17%	0	41	0%	0	0	
Ss_107	>300	Vessel 16	2012	1	Southern North Sea	4	9	33%	4	18	20%	0	0	
Ss_108	>300	Vessel 18	2012	1	Southern North Sea	3	51	6%	13	26	33%	0	0	
Ss_109	>300	Vessel 18	2012	1	Southern North Sea	2	15	12%	1	8	7%	7	0	100%
Ss_110	>300	Vessel 18	2012	1	Southern North Sea	6	23	20%	6	17	25%	0	46	0%
Ss_111	>300	Vessel 18	2012	1	Southern North Sea	5	22	20%	1	16	6%	0	0	
Ss_112	>300	Vessel 18	2012	1	Southern North Sea	30	15	67%	<1	6	5%	0	0	
Ss_113	>300	Vessel 19	2012	1	Southern North Sea	18	18	50%	9	35	20%	0	0	
Ss_114	>300	Vessel 19	2012	1	Southern North Sea	23	35	40%	12	35	25%	0	23	0%
Ss_115	>300	Vessel 19	2012	1	Southern North Sea	2	3	37%	4	45	8%	0	0	
Ss_116	>300	Vessel 19	2012	1	Southern North Sea	6	12	33%	6	40	12%	0	20	0%
Ss_117	>300	Vessel 19	2012	1	Southern North Sea	24	16	61%	12	38	24%	6	60	9%
Ss_118	>300	Vessel 19	2012	1	Southern North Sea	15	23	40%	1	45	2%	0	45	0%
Ss_119	>300	Vessel 19	2012	1	Southern North Sea	6	16	27%	6	35	15%	0	30	0%
Ss_120	>300	Vessel 19	2012	1	Southern North Sea	<1	8	5%	0	30	0%	0	19	0%

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice			Sole			Cod		
						DC	L	DC%	DC	L	DC%	DC	L	DC%
Ss_121	>300	Vessel 19	2012	1	Southern North Sea	0	2	0%	1	38	4%	0	0	
Ss_122	>300	Vessel 20	2012	1	Southern North Sea	18	48	27%	0	18	0%	0	0	
Ss_123	>300	Vessel 20	2012	1	Southern North Sea	13	11	56%	0	8	0%	0	27	0%
Ss_124	>300	Vessel 20	2012	1	Southern North Sea	71	13	85%	1	21	6%	0	0	
Ss_125	>300	Vessel 20	2012	1	Southern North Sea	63	38	63%	13	38	25%	0	0	
Ss_126	>300	Vessel 20	2012	1	Southern North Sea	45	51	47%	0	14	0%	0	0	
Ss_127	>300	Vessel 21	2012	1	Southern North Sea	2	13	14%	4	60	7%	0	6	0%
Ss_128	>300	Vessel 21	2012	1	Southern North Sea	1	8	13%	1	23	5%	0	0	
Ss_129	>300	Vessel 21	2012	1	Southern North Sea	7	20	26%	3	35	8%	0	10	0%
Ss_130	>300	Vessel 21	2012	1	Southern North Sea	7	20	24%	2	33	7%	0	8	0%
Ss_131	>300	Vessel 22	2012	1	Southern North Sea	51	13	80%	0	26	0%	0	39	0%
Ss_132	>300	Vessel 22	2012	1	Southern North Sea	21	26	45%	0	17	0%	0	9	0%
Ss_133	>300	Vessel 22	2012	1	Southern North Sea	0	7	0%	0	40	0%	0	7	0%
Ss_134	>300	Vessel 25	2012	1	Southern North Sea	2	18	9%	2	27	6%	0	0	
Ss_135	>300	Vessel 25	2012	1	Southern North Sea	8	17	33%	1	23	2%	0	0	
Ss_136	>300	Vessel 25	2012	1	Southern North Sea	73	24	75%	1	33	2%	0	0	
Ss_137	>300	Vessel 25	2012	1	Southern North Sea	1	45	2%	1	23	5%	0	0	
Ss_138	>300	Vessel 7	2012	2	Central North Sea	30	20	60%	0	10	0%	0	0	
Ss_139	>300	Vessel 18	2012	2	Central North Sea	0	1	0%	1	19	3%	0	0	
Ss_140	>300	Vessel 18	2012	2	Central North Sea	2	25	7%	1	19	3%	0	0	
Ss_141	>300	Vessel 18	2012	2	Central North Sea	1	14	5%	1	14	5%	0	0	
Ss_142	>300	Vessel 18	2012	2	Central North Sea	2	17	9%	1	26	3%	0	0	
Ss_143	>300	Vessel 18	2012	2	Central North Sea	44	87	33%	9	22	29%	0	0	
Ss_144	>300	Vessel 18	2012	2	Central North Sea	0	40	0%	0	20	0%	0	0	
Ss_145	>300	Vessel 21	2012	2	Central North Sea	2	16	10%	1	20	4%	0	0	
Ss_146	>300	Vessel 21	2012	2	Central North Sea	15	56	21%	4	19	17%	0	0	
Ss_147	>300	Vessel 22	2012	2	Central North Sea	42	54	44%	0	24	0%	0	0	
Ss_148	>300	Vessel 22	2012	2	Central North Sea	55	136	29%	0	27	0%	0	0	
Ss_149	>300	Vessel 24	2012	2	Central North Sea	70	16	82%	23	47	33%	0	0	
Ss_150	>300	Vessel 24	2012	2	Central North Sea	46	5	91%	5	23	17%	0	0	
Ss_151	>300	Vessel 24	2012	2	Central North Sea	76	69	52%	0	28	0%	0	0	
Ss_152	>300	Vessel 24	2012	2	Central North Sea	26	9	75%	17	9	67%	0	0	
Ss_153	>300	Vessel 22	2012	2	Doggerbank	107	227	32%	0	0		0	0	
Ss_154	>300	Vessel 23	2012	2	German Bight	47	43	52%	8	25	25%	0	0	
Ss_155	>300	Vessel 9	2012	2	"English Banks"	34	96	26%	0	24	0%	0	0	
Ss_156	>300	Vessel 17	2012	2	"English Banks"	<1	1	33%	0	4	9%	0	0	
Ss_157	>300	Vessel 19	2012	2	"English Banks"	1	31	4%	0	13	0%	0	0	
Ss_158	>300	Vessel 19	2012	2	"English Banks"	12	20	38%	9	40	18%	0	0	
Ss_159	>300	Vessel 20	2012	2	"English Banks"	40	39	51%	0	18	0%	0	0	
Ss_160	>300	Vessel 21	2012	2	"English Banks"	<1	9	3%	1	25	2%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_161	>300	Vessel 22	2012	2	"English Banks"	60	100	38%	0	20	0%	0	0	
Ss_162	>300	Vessel 22	2012	2	"English Banks"	36	29	56%	0	14	0%	0	0	
Ss_163	>300	Vessel 22	2012	2	"English Banks"	84	64	57%	0	26	0%	0	0	
Ss_164	>300	Vessel 22	2012	2	"English Banks"	27	81	25%	0	27	0%	0	0	
Ss_165	≤300	Vessel 2	2012	2	Southern North Sea	4	1	80%	5	30	14%	0	0	
Ss_166	≤300	Vessel 2	2012	2	Southern North Sea	5	2	71%	2	25	7%	0	0	
Ss_167	≤300	Vessel 2	2012	2	Southern North Sea	7	6	55%	6	36	14%	0	0	
Ss_168	≤300	Vessel 2	2012	2	Southern North Sea	45	120	27%	15	90	14%	0	0	
Ss_169	≤300	Vessel 2	2012	2	Southern North Sea	10	200	5%	8	40	17%	1	1	50%
Ss_170	≤300	Vessel 2	2012	2	Southern North Sea	0	2	0%	0	50	0%	0	0	
Ss_171	≤300	Vessel 2	2012	2	Southern North Sea	0	80	0%	0	70	0%	0	0	
Ss_172	>300	Vessel 5	2012	2	Southern North Sea	52	64	44%	3	29	10%	0	0	
Ss_173	>300	Vessel 5	2012	2	Southern North Sea	2	9	21%	6	46	11%	0	0	
Ss_174	>300	Vessel 5	2012	2	Southern North Sea	3	20	13%	3	23	11%	0	0	
Ss_175	>300	Vessel 5	2012	2	Southern North Sea	41	29	59%	4	41	9%	0	0	
Ss_176	>300	Vessel 5	2012	2	Southern North Sea	46	19	71%	5	33	13%	0	0	
Ss_177	>300	Vessel 5	2012	2	Southern North Sea	20	27	43%	3	48	7%	0	0	
Ss_178	>300	Vessel 5	2012	2	Southern North Sea	36	18	67%	5	23	17%	0	0	
Ss_179	>300	Vessel 5	2012	2	Southern North Sea	41	29	58%	9	35	20%	0	0	
Ss_180	>300	Vessel 5	2012	2	Southern North Sea	43	69	38%	4	30	13%	4	0	100%
Ss_181	>300	Vessel 5	2012	2	Southern North Sea	10	6	60%	6	23	22%	0	0	
Ss_182	>300	Vessel 6	2012	2	Southern North Sea	65	53	55%	1	24	2%	0	0	
Ss_183	>300	Vessel 6	2012	2	Southern North Sea	38	94	29%	1	25	2%	0	0	
Ss_184	>300	Vessel 6	2012	2	Southern North Sea	65	49	57%	3	33	9%	0	0	
Ss_185	>300	Vessel 6	2012	2	Southern North Sea	94	85	52%	9	43	17%	0	0	
Ss_186	>300	Vessel 6	2012	2	Southern North Sea	96	21	82%	11	43	20%	0	0	
Ss_187	>300	Vessel 6	2012	2	Southern North Sea	50	35	59%	30	35	46%	0	0	
Ss_188	>300	Vessel 6	2012	2	Southern North Sea	165	66	71%	1	24	4%	0	0	
Ss_189	>300	Vessel 6	2012	2	Southern North Sea	64	53	55%	1	23	3%	0	0	
Ss_190	>300	Vessel 6	2012	2	Southern North Sea	77	60	56%	2	43	5%	0	0	
Ss_191	>300	Vessel 6	2012	2	Southern North Sea	40	90	31%	2	20	9%	0	0	
Ss_192	>300	Vessel 7	2012	2	Southern North Sea	38	46	45%	4	19	17%	0	0	
Ss_193	>300	Vessel 7	2012	2	Southern North Sea	6	53	10%	1	33	4%	0	0	
Ss_194	>300	Vessel 7	2012	2	Southern North Sea	3	13	17%	3	25	9%	0	0	
Ss_195	>300	Vessel 7	2012	2	Southern North Sea	38	20	65%	13	25	33%	0	0	
Ss_196	>300	Vessel 7	2012	2	Southern North Sea	13	13	50%	4	20	17%	0	0	
Ss_197	>300	Vessel 7	2012	2	Southern North Sea	30	60	33%	3	15	17%	0	0	
Ss_198	≤300	Vessel 8	2012	2	Southern North Sea	0	1	0%	1	22	6%	0	0	
Ss_199	≤300	Vessel 8	2012	2	Southern North Sea	3	23	10%	1	24	4%	0	1	0%
Ss_200	≤300	Vessel 8	2012	2	Southern North Sea	0	0		1	14	4%	0	1	0%

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_201	>300	Vessel 9	2012	2	Southern North Sea	3	10	25%	0	26	0%	0	0	
Ss_202	>300	Vessel 9	2012	2	Southern North Sea	9	26	25%	0	17	0%	0	0	
Ss_203	>300	Vessel 9	2012	2	Southern North Sea	4	9	33%	0	17	0%	0	0	
Ss_204	>300	Vessel 9	2012	2	Southern North Sea	29	23	56%	0	34	0%	0	0	
Ss_205	>300	Vessel 9	2012	2	Southern North Sea	27	13	67%	0	40	0%	0	0	
Ss_206	>300	Vessel 9	2012	2	Southern North Sea	12	31	27%	0	28	0%	0	0	
Ss_207	>300	Vessel 9	2012	2	Southern North Sea	8	23	25%	0	19	0%	0	0	
Ss_208	>300	Vessel 10	2012	2	Southern North Sea	0	0		0	6	0%	0	0	
Ss_209	>300	Vessel 10	2012	2	Southern North Sea	0	0		0	2	0%	0	0	
Ss_210	>300	Vessel 10	2012	2	Southern North Sea	0	0		0	5	0%	0	0	
Ss_211	>300	Vessel 10	2012	2	Southern North Sea	0	1	0%	0	3	0%	0	0	
Ss_212	>300	Vessel 10	2012	2	Southern North Sea	2	1	67%	0	1	0%	0	0	
Ss_213	≤300	Vessel 12	2012	2	Southern North Sea	2	2	50%	2	30	7%	0	0	
Ss_214	≤300	Vessel 12	2012	2	Southern North Sea	0	0		2	27	6%	0	0	
Ss_215	≤300	Vessel 12	2012	2	Southern North Sea	0	0		3	29	9%	0	0	
Ss_216	≤300	Vessel 12	2012	2	Southern North Sea	0	7	0%	2	26	8%	0	0	
Ss_217	≤300	Vessel 12	2012	2	Southern North Sea	0	0		4	37	10%	0	0	
Ss_218	≤300	Vessel 12	2012	2	Southern North Sea	4	0	100%	2	41	4%	0	0	
Ss_219	≤300	Vessel 13	2012	2	Southern North Sea	5	50	9%	3	20	11%	0	3	0%
Ss_220	≤300	Vessel 13	2012	2	Southern North Sea	6	45	12%	3	30	9%	0	0	
Ss_221	≤300	Vessel 13	2012	2	Southern North Sea	5	42	10%	7	40	15%	0	0	
Ss_222	≤300	Vessel 13	2012	2	Southern North Sea	1	6	20%	3	27	10%	0	0	
Ss_223	≤300	Vessel 13	2012	2	Southern North Sea	1	5	20%	4	30	12%	0	0	
Ss_224	≤300	Vessel 13	2012	2	Southern North Sea	0	2	0%	2	32	7%	0	0	
Ss_225	≤300	Vessel 13	2012	2	Southern North Sea	5	14	27%	7	38	16%	0	0	
Ss_226	≤300	Vessel 13	2012	2	Southern North Sea	4	34	10%	4	15	20%	0	0	
Ss_227	≤300	Vessel 13	2012	2	Southern North Sea	2	5	33%	4	38	9%	0	1	0%
Ss_228	≤300	Vessel 13	2012	2	Southern North Sea	3	4	40%	7	36	17%	0	0	
Ss_229	≤300	Vessel 13	2012	2	Southern North Sea	6	13	30%	4	34	10%	0	0	
Ss_230	≤300	Vessel 13	2012	2	Southern North Sea	8	46	15%	5	63	8%	0	0	
Ss_231	>300	Vessel 14	2012	2	Southern North Sea	5	9	33%	5	23	17%	0	0	
Ss_232	>300	Vessel 14	2012	2	Southern North Sea	5	2	71%	10	51	17%	0	0	
Ss_233	>300	Vessel 14	2012	2	Southern North Sea	23	14	63%	9	46	17%	0	0	
Ss_234	>300	Vessel 14	2012	2	Southern North Sea	16	8	67%	8	40	17%	0	0	
Ss_235	>300	Vessel 14	2012	2	Southern North Sea	30	25	55%	10	46	18%	0	0	
Ss_236	>300	Vessel 14	2012	2	Southern North Sea	44	71	38%	18	80	18%	0	0	
Ss_237	>300	Vessel 14	2012	2	Southern North Sea	46	29	62%	11	51	18%	0	0	
Ss_238	>300	Vessel 16	2012	2	Southern North Sea	7	7	50%	7	28	20%	0	28	0%
Ss_239	>300	Vessel 16	2012	2	Southern North Sea	28	14	67%	7	55	11%	0	0	
Ss_240	>300	Vessel 16	2012	2	Southern North Sea	0	10	0%	4	40	9%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_241	>300	Vessel 16	2012	2	Southern North Sea	1	5	20%	3	60	4%	0	0	
Ss_242	>300	Vessel 16	2012	2	Southern North Sea	1	20	5%	1	53	2%	0	0	
Ss_243	>300	Vessel 16	2012	2	Southern North Sea	7	59	10%	2	33	6%	0	0	
Ss_244	>300	Vessel 16	2012	2	Southern North Sea	37	37	50%	0	28	0%	0	0	
Ss_245	>300	Vessel 16	2012	2	Southern North Sea	8	20	27%	5	25	17%	0	0	
Ss_246	>300	Vessel 17	2012	2	Southern North Sea	50	0	100%	5	25	17%	0	0	
Ss_247	>300	Vessel 17	2012	2	Southern North Sea	1	3	33%	8	27	23%	0	14	0%
Ss_248	>300	Vessel 18	2012	2	Southern North Sea	0	6	0%	0	21	0%	0	0	
Ss_249	>300	Vessel 18	2012	2	Southern North Sea	1	19	5%	1	29	3%	0	0	
Ss_250	>300	Vessel 18	2012	2	Southern North Sea	11	18	38%	1	18	4%	0	0	
Ss_251	>300	Vessel 18	2012	2	Southern North Sea	1	14	5%	1	21	3%	0	0	
Ss_252	>300	Vessel 18	2012	2	Southern North Sea	1	17	5%	2	26	6%	0	0	
Ss_253	>300	Vessel 18	2012	2	Southern North Sea	2	19	9%	1	37	2%	0	0	
Ss_254	>300	Vessel 19	2012	2	Southern North Sea	0	46	0%	1	30	4%	0	23	0%
Ss_255	>300	Vessel 19	2012	2	Southern North Sea	0	24	0%	2	80	2%	0	40	0%
Ss_256	>300	Vessel 19	2012	2	Southern North Sea	0	10	0%	0	50	0%	1	10	5%
Ss_257	>300	Vessel 19	2012	2	Southern North Sea	11	13	44%	2	40	4%	0	0	
Ss_258	>300	Vessel 19	2012	2	Southern North Sea	2	20	9%	3	40	7%	0	20	0%
Ss_259	>300	Vessel 19	2012	2	Southern North Sea	1	13	5%	1	38	2%	0	0	
Ss_260	>300	Vessel 19	2012	2	Southern North Sea	3	60	5%	2	23	6%	0	0	
Ss_261	>300	Vessel 20	2012	2	Southern North Sea	0	0		1	23	5%	0	37	0%
Ss_262	>300	Vessel 20	2012	2	Southern North Sea	380	170	69%	14	35	29%	0	0	
Ss_263	>300	Vessel 20	2012	2	Southern North Sea	73	18	80%	1	48	2%	0	0	
Ss_264	>300	Vessel 20	2012	2	Southern North Sea	10	0	100%	6	43	13%	0	0	
Ss_265	>300	Vessel 21	2012	2	Southern North Sea	0	3	0%	1	44	2%	0	0	
Ss_266	>300	Vessel 21	2012	2	Southern North Sea	6	29	18%	3	29	10%	0	3	0%
Ss_267	>300	Vessel 21	2012	2	Southern North Sea	3	26	10%	3	30	8%	0	0	
Ss_268	>300	Vessel 21	2012	2	Southern North Sea	10	40	20%	4	40	9%	0	0	
Ss_269	>300	Vessel 21	2012	2	Southern North Sea	11	62	16%	4	38	9%	0	0	
Ss_270	>300	Vessel 21	2012	2	Southern North Sea	2	8	20%	4	46	8%	0	0	
Ss_271	>300	Vessel 24	2012	2	Southern North Sea	45	45	50%	15	30	33%	0	0	
Ss_272	>300	Vessel 24	2012	2	Southern North Sea	45	23	67%	2	23	7%	0	0	
Ss_273	>300	Vessel 25	2012	2	Southern North Sea	2	20	9%	2	30	6%	0	0	
Ss_274	>300	Vessel 25	2012	2	Southern North Sea	0	3	0%	3	28	9%	0	6	0%
Ss_275	>300	Vessel 25	2012	2	Southern North Sea	0	3	0%	2	35	5%	0	0	
Ss_276	>300	Vessel 25	2012	2	Southern North Sea	0	3	0%	0	40	0%	0	0	
Ss_277	>300	Vessel 25	2012	2	Southern North Sea	0	4	0%	<1	23	1%	0	0	
Ss_278	>300	Vessel 25	2012	2	Southern North Sea	0	3	0%	<1	50	<1%	0	0	
Ss_279	>300	Vessel 25	2012	2	Southern North Sea	0	3	0%	<1	30	1%	0	0	
Ss_280	>300	Vessel 7	2012	3	Central North Sea	25	38	40%	3	25	9%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_281	>300	Vessel 9	2012	3	Central North Sea	41	129	24%	10	26	29%	0	0	
Ss_282	>300	Vessel 10	2012	3	Central North Sea	334	111	75%	0	0		0	0	
Ss_283	>300	Vessel 10	2012	3	Central North Sea	68	85	44%	0	9	0%	0	0	
Ss_284	>300	Vessel 10	2012	3	Central North Sea	50	150	25%	0	10	0%	0	0	
Ss_285	>300	Vessel 10	2012	3	Central North Sea	19	38	33%	0	8	0%	0	0	
Ss_286	>300	Vessel 10	2012	3	Central North Sea	22	22	50%	0	11	0%	0	0	
Ss_287	>300	Vessel 10	2012	3	Central North Sea	60	120	33%	0	24	0%	0	0	
Ss_288	>300	Vessel 18	2012	3	Central North Sea	1	18	5%	1	27	3%	0	0	
Ss_289	>300	Vessel 18	2012	3	Central North Sea	0	9	0%	1	35	2%	0	0	
Ss_290	>300	Vessel 18	2012	3	Central North Sea	0	12	0%	0	35	0%	0	0	
Ss_291	>300	Vessel 18	2012	3	Central North Sea	0	4	0%	0	44	0%	0	0	
Ss_292	>300	Vessel 18	2012	3	Central North Sea	0	1	0%	0	44	0%	0	0	
Ss_293	>300	Vessel 18	2012	3	Central North Sea	0	1	0%	0	38	0%	0	0	
Ss_294	>300	Vessel 18	2012	3	Central North Sea	0	1	0%	0	35	0%	0	0	
Ss_295	>300	Vessel 18	2012	3	Central North Sea	1	5	17%	2	55	3%	0	0	
Ss_296	>300	Vessel 20	2012	3	Central North Sea	17	62	21%	0	25	0%	0	0	
Ss_297	>300	Vessel 21	2012	3	Central North Sea	15	38	29%	15	91	14%	0	23	0%
Ss_298	>300	Vessel 21	2012	3	Central North Sea	9	50	15%	<1	29	1%	0	0	
Ss_299	>300	Vessel 22	2012	3	Central North Sea	45	105	30%	0	30	0%	0	0	
Ss_300	>300	Vessel 21	2012	3	Central North Sea	42	67	38%	0	25	0%	0	0	
Ss_301	>300	Vessel 21	2012	3	Central North Sea	40	67	38%	0	27	0%	0	0	
Ss_302	>300	Vessel 21	2012	3	Central North Sea	72	54	57%	0	27	0%	9	0	100%
Ss_303	>300	Vessel 18	2012	3	Doggerbank	0	100	0%	0	30	0%	0	0	
Ss_304	>300	Vessel 18	2012	3	Doggerbank	15	87	14%	1	22	3%	0	0	
Ss_305	>300	Vessel 22	2012	3	Doggerbank	37	63	37%	0	16	0%	0	0	
Ss_306	>300	Vessel 25	2012	3	Doggerbank	25	150	14%	2	20	8%	0	0	
Ss_307	>300	Vessel 24	2012	3	German Bight	10	10	50%	5	30	14%	0	0	
Ss_308	>300	Vessel 24	2012	3	German Bight	7	7	50%	3	33	9%	0	0	
Ss_309	>300	Vessel 25	2012	3	German Bight	10	0	100%	1	20	3%	0	0	
Ss_310	>300	Vessel 25	2012	3	German Bight	3	7	33%	7	53	11%	0	0	
Ss_311	>300	Vessel 5	2012	3	"English Banks"	41	47	47%	6	59	9%	0	0	
Ss_312	>300	Vessel 9	2012	3	"English Banks"	11	21	33%	0	17	0%	0	0	
Ss_313	>300	Vessel 10	2012	3	"English Banks"	0	0		0	1	0%	0	0	
Ss_314	>300	Vessel 17	2012	3	"English Banks"	1	10	9%	10	29	25%	0	0	
Ss_315	>300	Vessel 17	2012	3	"English Banks"	24	57	29%	7	38	16%	0	0	
Ss_316	>300	Vessel 20	2012	3	"English Banks"	163	111	60%	3	40	7%	0	0	
Ss_317	>300	Vessel 22	2012	3	"English Banks"	15	53	22%	0	30	0%	0	0	
Ss_318	≤300	Vessel 1	2012	3	Southern North Sea	32	96	25%	24	40	38%	0	0	
Ss_319	≤300	Vessel 1	2012	3	Southern North Sea	24	168	13%	12	60	17%	0	0	
Ss_320	≤300	Vessel 2	2012	3	Southern North Sea	0	13	0%	0	27	0%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_321	≤300	Vessel 2	2012	3	Southern North Sea	0	60	0%	0	70	0%	0	0	
Ss_322	≤300	Vessel 2	2012	3	Southern North Sea	0	15	0%	0	24	0%	0	0	
Ss_323	≤300	Vessel 2	2012	3	Southern North Sea	0	40	0%	0	30	0%	0	0	
Ss_324	≤300	Vessel 2	2012	3	Southern North Sea	0	180	0%	0	60	0%	0	0	
Ss_325	≤300	Vessel 2	2012	3	Southern North Sea	20	40	33%	0	20	0%	0	0	
Ss_326	≤300	Vessel 2	2012	3	Southern North Sea	8	30	20%	3	15	17%	0	0	
Ss_327	>300	Vessel 3	2012	3	Southern North Sea	11	57	17%	6	46	11%	0	0	
Ss_328	>300	Vessel 4	2012	3	Southern North Sea	10	80	11%	10	50	17%	0	0	
Ss_329	>300	Vessel 5	2012	3	Southern North Sea	11	3	80%	8	32	20%	0	0	
Ss_330	>300	Vessel 5	2012	3	Southern North Sea	36	46	44%	5	41	10%	0	0	
Ss_331	>300	Vessel 5	2012	3	Southern North Sea	94	51	65%	7	29	20%	7	0	100%
Ss_332	>300	Vessel 5	2012	3	Southern North Sea	81	27	75%	5	54	8%	0	0	
Ss_333	>300	Vessel 5	2012	3	Southern North Sea	76	30	71%	4	19	17%	0	0	
Ss_334	>300	Vessel 5	2012	3	Southern North Sea	88	35	71%	4	22	17%	0	0	
Ss_335	>300	Vessel 5	2012	3	Southern North Sea	140	41	77%	6	35	14%	0	0	
Ss_336	>300	Vessel 5	2012	3	Southern North Sea	34	38	47%	4	15	20%	0	0	
Ss_337	>300	Vessel 5	2012	3	Southern North Sea	56	20	74%	4	48	8%	0	0	
Ss_338	>300	Vessel 5	2012	3	Southern North Sea	84	39	68%	11	45	20%	0	0	
Ss_339	>300	Vessel 6	2012	3	Southern North Sea	51	23	69%	1	20	5%	0	0	
Ss_340	>300	Vessel 6	2012	3	Southern North Sea	27	17	62%	1	20	3%	0	0	
Ss_341	>300	Vessel 6	2012	3	Southern North Sea	54	23	70%	12	43	21%	0	0	
Ss_342	>300	Vessel 6	2012	3	Southern North Sea	70	120	37%	3	40	7%	0	0	
Ss_343	>300	Vessel 6	2012	3	Southern North Sea	103	64	62%	9	30	22%	0	0	
Ss_344	>300	Vessel 6	2012	3	Southern North Sea	200	104	66%	40	40	50%	0	0	
Ss_345	>300	Vessel 6	2012	3	Southern North Sea	240	93	72%	27	40	40%	0	0	
Ss_346	>300	Vessel 6	2012	3	Southern North Sea	116	28	81%	28	65	30%	0	0	
Ss_347	>300	Vessel 9	2012	3	Southern North Sea	9	36	20%	0	18	0%	0	0	
Ss_348	>300	Vessel 9	2012	3	Southern North Sea	20	41	33%	4	29	13%	0	0	
Ss_349	>300	Vessel 9	2012	3	Southern North Sea	20	41	33%	4	29	13%	0	0	
Ss_350	>300	Vessel 10	2012	3	Southern North Sea	0	11	0%	0	11	0%	0	0	
Ss_351	≤300	Vessel 12	2012	3	Southern North Sea	8	32	20%	3	19	13%	0	0	
Ss_352	≤300	Vessel 12	2012	3	Southern North Sea	14	3	83%	6	37	13%	0	0	
Ss_353	≤300	Vessel 12	2012	3	Southern North Sea	0	0		9	31	21%	0	0	
Ss_354	≤300	Vessel 12	2012	3	Southern North Sea	5	0	100%	5	27	15%	0	0	
Ss_355	≤300	Vessel 12	2012	3	Southern North Sea	5	0	100%	3	25	10%	0	0	
Ss_356	≤300	Vessel 12	2012	3	Southern North Sea	0	0		4	14	20%	0	0	
Ss_357	≤300	Vessel 12	2012	3	Southern North Sea	10	0	100%	10	29	25%	0	0	
Ss_358	≤300	Vessel 12	2012	3	Southern North Sea	0	0		6	24	20%	0	0	
Ss_359	≤300	Vessel 12	2012	3	Southern North Sea	0	0		10	24	30%	0	0	
Ss_360	≤300	Vessel 12	2012	3	Southern North Sea	0	0		4	32	10%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_361	≤300	Vessel 12	2012	3	Southern North Sea	0	0		7	19	29%	0	0	
Ss_362	≤300	Vessel 12	2012	3	Southern North Sea	0	0		6	21	22%	0	0	
Ss_363	≤300	Vessel 12	2012	3	Southern North Sea	0	0		17	17	50%	0	0	
Ss_364	>300	Vessel 14	2012	3	Southern North Sea	15	31	33%	5	51	9%	0	0	
Ss_365	>300	Vessel 14	2012	3	Southern North Sea	45	20	69%	10	50	17%	0	0	
Ss_366	>300	Vessel 14	2012	3	Southern North Sea	27	14	67%	9	46	17%	0	0	
Ss_367	>300	Vessel 14	2012	3	Southern North Sea	27	18	60%	9	46	17%	0	0	
Ss_368	>300	Vessel 14	2012	3	Southern North Sea	40	20	67%	15	50	23%	0	0	
Ss_369	>300	Vessel 14	2012	3	Southern North Sea	25	13	67%	13	57	18%	0	0	
Ss_370	>300	Vessel 14	2012	3	Southern North Sea	43	29	59%	11	53	17%	0	0	
Ss_371	>300	Vessel 14	2012	3	Southern North Sea	46	15	75%	15	46	25%	0	0	
Ss_372	≤300	Vessel 15	2012	3	Southern North Sea	20	50	29%	10	30	25%	0	0	
Ss_373	≤300	Vessel 15	2012	3	Southern North Sea	0	7	0%	7	20	25%	0	0	
Ss_374	>300	Vessel 16	2012	3	Southern North Sea	0	7	0%	3	63	5%	0	0	
Ss_375	>300	Vessel 16	2012	3	Southern North Sea	4	8	33%	8	40	17%	0	0	
Ss_376	>300	Vessel 16	2012	3	Southern North Sea	0	2	0%	4	65	6%	0	0	
Ss_377	>300	Vessel 16	2012	3	Southern North Sea	4	9	33%	4	35	11%	0	0	
Ss_378	>300	Vessel 16	2012	3	Southern North Sea	6	46	11%	6	58	9%	0	0	
Ss_379	>300	Vessel 16	2012	3	Southern North Sea	0	0		575	58	91%	0	144	0%
Ss_380	>300	Vessel 16	2012	3	Southern North Sea	10	50	17%	20	40	33%	0	0	
Ss_381	>300	Vessel 16	2012	3	Southern North Sea	2	18	11%	9	50	15%	0	5	0%
Ss_382	>300	Vessel 16	2012	3	Southern North Sea	4	8	33%	8	50	14%	0	25	0%
Ss_383	>300	Vessel 18	2012	3	Southern North Sea	10	95	9%	2	38	6%	0	0	
Ss_384	>300	Vessel 18	2012	3	Southern North Sea	2	12	13%	2	52	4%	0	0	
Ss_385	>300	Vessel 19	2012	3	Southern North Sea	1	13	5%	1	50	2%	0	0	
Ss_386	>300	Vessel 19	2012	3	Southern North Sea	1	14	5%	1	54	2%	0	0	
Ss_387	>300	Vessel 19	2012	3	Southern North Sea	1	20	5%	2	40	5%	0	0	
Ss_388	>300	Vessel 19	2012	3	Southern North Sea	1	10	5%	2	90	2%	0	75	0%
Ss_389	>300	Vessel 19	2012	3	Southern North Sea	3	17	17%	2	25	6%	0	8	0%
Ss_390	>300	Vessel 19	2012	3	Southern North Sea	1	4	20%	2	50	4%	0	0	
Ss_391	>300	Vessel 19	2012	3	Southern North Sea	1	6	11%	1	55	2%	0	0	
Ss_392	>300	Vessel 19	2012	3	Southern North Sea	1	24	5%	2	55	4%	0	0	
Ss_393	>300	Vessel 19	2012	3	Southern North Sea	0	5	0%	1	38	3%	0	40	0%
Ss_394	>300	Vessel 19	2012	3	Southern North Sea	2	14	14%	1	90	1%	0	25	0%
Ss_395	>300	Vessel 20	2012	3	Southern North Sea	29	26	53%	0	30	0%	0	0	
Ss_396	>300	Vessel 20	2012	3	Southern North Sea	7	15	30%	2	43	4%	0	0	
Ss_397	>300	Vessel 20	2012	3	Southern North Sea	12	13	48%	0	21	0%	0	0	
Ss_398	>300	Vessel 20	2012	3	Southern North Sea	16	9	64%	14	53	21%	0	0	
Ss_399	>300	Vessel 20	2012	3	Southern North Sea	4	13	21%	4	50	7%	0	0	
Ss_400	>300	Vessel 20	2012	3	Southern North Sea	3	10	23%	6	20	23%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_401	>300	Vessel 20	2012	3	Southern North Sea	16	6	74%	16	80	17%	0	0	
Ss_402	>300	Vessel 20	2012	3	Southern North Sea	5	13	28%	2	33	6%	0	0	
Ss_403	>300	Vessel 20	2012	3	Southern North Sea	5	9	35%	20	58	26%	0	8	0%
Ss_404	>300	Vessel 21	2012	3	Southern North Sea	14	68	17%	5	45	9%	0	0	
Ss_405	>300	Vessel 21	2012	3	Southern North Sea	6	18	25%	24	120	17%	0	0	
Ss_406	>300	Vessel 21	2012	3	Southern North Sea	8	15	33%	25	100	20%	0	0	
Ss_407	>300	Vessel 21	2012	3	Southern North Sea	5	26	16%	2	45	3%	0	0	
Ss_408	>300	Vessel 21	2012	3	Southern North Sea	6	15	27%	3	46	6%	0	0	
Ss_409	>300	Vessel 21	2012	3	Southern North Sea	1	4	17%	5	50	9%	0	0	
Ss_410	>300	Vessel 25	2012	3	Southern North Sea	0	3	0%	<1	30	1%	0	0	
Ss_411	>300	Vessel 25	2012	3	Southern North Sea	0	4	0%	4	43	8%	0	0	
Ss_412	>300	Vessel 25	2012	3	Southern North Sea	0	6	0%	6	38	14%	0	0	
Ss_413	>300	Vessel 25	2012	3	Southern North Sea	8	15	33%	1	20	2%	0	0	
Ss_414	>300	Vessel 25	2012	3	Southern North Sea	10	20	33%	1	53	1%	0	0	
Ss_415	>300	Vessel 25	2012	3	Southern North Sea	25	67	27%	2	20	8%	0	0	
Ss_416	>300	Vessel 25	2012	3	Southern North Sea	15	30	33%	1	40	2%	0	0	
Ss_417	>300	Vessel 5	2012	4	Central North Sea	25	98	20%	3	45	7%	0	0	
Ss_418	>300	Vessel 7	2012	4	Central North Sea	8	40	17%	4	40	9%	0	0	
Ss_419	>300	Vessel 10	2012	4	Central North Sea	38	75	33%	0	23	0%	0	0	
Ss_420	>300	Vessel 10	2012	4	Central North Sea	67	335	17%	0	34	0%	0	0	
Ss_421	>300	Vessel 18	2012	4	Central North Sea	0	62	0%	0	52	0%	0	0	
Ss_422	>300	Vessel 18	2012	4	Central North Sea	4	46	8%	3	76	4%	0	0	
Ss_423	>300	Vessel 18	2012	4	Central North Sea	0	13	0%	0	65	0%	0	0	
Ss_424	>300	Vessel 19	2012	4	Central North Sea	2	7	25%	0	20	1%	0	0	
Ss_425	>300	Vessel 19	2012	4	Central North Sea	2	42	5%	0	21	0%	0	0	
Ss_426	>300	Vessel 19	2012	4	Central North Sea	0	9	0%	0	27	0%	0	0	
Ss_427	>300	Vessel 21	2012	4	Central North Sea	17	51	25%	13	60	18%	0	4	0%
Ss_428	>300	Vessel 21	2012	4	Central North Sea	16	65	20%	5	38	13%	0	0	
Ss_429	>300	Vessel 24	2012	4	Central North Sea	9	107	8%	2	18	11%	0	0	
Ss_430	>300	Vessel 24	2012	4	German Bight	9	73	11%	2	21	9%	0	0	
Ss_431	>300	Vessel 24	2012	4	German Bight	4	33	12%	0	22	0%	0	0	
Ss_432	>300	Vessel 24	2012	4	German Bight	3	19	14%	3	38	8%	0	0	
Ss_433	>300	Vessel 25	2012	4	German Bight	4	7	33%	7	50	13%	0	0	
Ss_434	>300	Vessel 25	2012	4	German Bight	7	14	33%	7	35	17%	0	0	
Ss_435	>300	Vessel 25	2012	4	German Bight	1	7	9%	7	43	14%	0	0	
Ss_436	>300	Vessel 25	2012	4	German Bight	1	9	9%	9	40	18%	0	0	
Ss_437	>300	Vessel 25	2012	4	German Bight	<1	4	9%	<1	8	5%	0	0	
Ss_438	≤300	Vessel 1	2012	4	Southern North Sea	44	222	17%	7	60	10%	0	11	0%
Ss_439	≤300	Vessel 1	2012	4	Southern North Sea	10	40	20%	14	86	14%	0	0	
Ss_440	≤300	Vessel 1	2012	4	Southern North Sea	0	10	0%	3	40	6%	0	10	0%

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_441	≤300	Vessel 1	2012	4	Southern North Sea	4	24	14%	16	40	29%	0	6	0%
Ss_442	≤300	Vessel 1	2012	4	Southern North Sea	26	43	38%	34	60	36%	0	9	0%
Ss_443	≤300	Vessel 1	2012	4	Southern North Sea	29	116	20%	19	68	22%	0	29	0%
Ss_444	≤300	Vessel 2	2012	4	Southern North Sea	13	38	25%	1	25	5%	0	0	
Ss_445	≤300	Vessel 2	2012	4	Southern North Sea	9	43	17%	2	21	7%	0	0	
Ss_446	≤300	Vessel 2	2012	4	Southern North Sea	5	9	33%	9	19	33%	0	0	
Ss_447	≤300	Vessel 2	2012	4	Southern North Sea	1	4	17%	4	25	14%	0	0	
Ss_448	≤300	Vessel 2	2012	4	Southern North Sea	1	3	17%	1	20	6%	0	0	
Ss_449	≤300	Vessel 2	2012	4	Southern North Sea	39	77	33%	3	13	17%	0	0	
Ss_450	>300	Vessel 3	2012	4	Southern North Sea	7	37	16%	5	46	9%	0	0	
Ss_451	>300	Vessel 3	2012	4	Southern North Sea	9	56	14%	5	47	9%	0	0	
Ss_452	>300	Vessel 3	2012	4	Southern North Sea	16	42	27%	10	73	13%	0	0	
Ss_453	>300	Vessel 3	2012	4	Southern North Sea	6	45	12%	9	60	13%	0	0	
Ss_454	>300	Vessel 3	2012	4	Southern North Sea	5	25	17%	15	84	15%	0	10	0%
Ss_455	>300	Vessel 3	2012	4	Southern North Sea	8	40	17%	2	28	7%	0	0	
Ss_456	>300	Vessel 3	2012	4	Southern North Sea	3	51	6%	7	51	12%	0	0	
Ss_457	≤300	Vessel 3	2012	4	Southern North Sea	18	67	21%	4	67	6%	0	9	0%
Ss_458	≤300	Vessel 3	2012	4	Southern North Sea	21	142	13%	7	57	11%	0	0	
Ss_459	≤300	Vessel 4	2012	4	Southern North Sea	3	17	17%	5	50	9%	0	0	
Ss_460	>300	Vessel 4	2012	4	Southern North Sea	5	36	13%	5	53	9%	0	0	
Ss_461	>300	Vessel 4	2012	4	Southern North Sea	3	51	6%	3	35	8%	0	0	
Ss_462	>300	Vessel 4	2012	4	Southern North Sea	5	68	6%	5	63	7%	0	0	
Ss_463	>300	Vessel 4	2012	4	Southern North Sea	8	40	17%	4	72	5%	0	0	
Ss_464	>300	Vessel 4	2012	4	Southern North Sea	2	19	11%	2	53	4%	0	0	
Ss_465	>300	Vessel 4	2012	4	Southern North Sea	3	31	9%	5	63	7%	0	0	
Ss_466	>300	Vessel 5	2012	4	Southern North Sea	98	54	64%	5	38	13%	0	0	
Ss_467	≤300	Vessel 5	2012	4	Southern North Sea	116	44	73%	5	29	14%	0	0	
Ss_468	≤300	Vessel 5	2012	4	Southern North Sea	245	86	74%	6	49	11%	0	0	
Ss_469	≤300	Vessel 5	2012	4	Southern North Sea	12	24	33%	20	65	24%	0	16	0%
Ss_470	>300	Vessel 5	2012	4	Southern North Sea	7	13	33%	13	65	17%	0	0	
Ss_471	>300	Vessel 5	2012	4	Southern North Sea	129	65	67%	26	78	25%	0	0	
Ss_472	>300	Vessel 5	2012	4	Southern North Sea	76	67	53%	14	48	23%	0	0	
Ss_473	>300	Vessel 5	2012	4	Southern North Sea	183	202	48%	18	55	25%	0	0	
Ss_474	>300	Vessel 5	2012	4	Southern North Sea	60	40	60%	2	23	6%	0	0	
Ss_475	>300	Vessel 5	2012	4	Southern North Sea	213	69	76%	3	55	5%	0	0	
Ss_476	>300	Vessel 5	2012	4	Southern North Sea	75	68	52%	0	38	0%	0	0	
Ss_477	>300	Vessel 5	2012	4	Southern North Sea	220	55	80%	24	55	30%	0	0	
Ss_478	≤300	Vessel 5	2012	4	Southern North Sea	105	43	71%	19	53	27%	0	19	0%
Ss_479	≤300	Vessel 6	2012	4	Southern North Sea	162	68	70%	9	43	17%	0	0	
Ss_480	≤300	Vessel 6	2012	4	Southern North Sea	84	40	68%	10	34	23%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice			Sole			Cod		
						DC	L	DC%	DC	L	DC%	DC	L	DC%
Ss_481	>300	Vessel 6	2012	4	Southern North Sea	97	58	63%	8	43	15%	0	0	
Ss_482	>300	Vessel 6	2012	4	Southern North Sea	14	37	27%	5	55	8%	0	0	
Ss_483	>300	Vessel 6	2012	4	Southern North Sea	72	52	58%	12	40	23%	0	0	
Ss_484	>300	Vessel 6	2012	4	Southern North Sea	56	56	50%	12	48	20%	0	0	
Ss_485	>300	Vessel 12	2012	4	Southern North Sea	44	0	100%	11	33	25%	0	0	
Ss_486	>300	Vessel 12	2012	4	Southern North Sea	5	0	100%	10	31	25%	0	0	
Ss_487	>300	Vessel 14	2012	4	Southern North Sea	26	51	33%	39	51	43%	0	0	
Ss_488	>300	Vessel 14	2012	4	Southern North Sea	23	14	62%	11	51	18%	0	0	
Ss_489	>300	Vessel 14	2012	4	Southern North Sea	3	3	55%	2	6	23%	0	0	
Ss_490	≤300	Vessel 15	2012	4	Southern North Sea	0	11	0%	4	35	9%	0	0	
Ss_491	≤300	Vessel 15	2012	4	Southern North Sea	12	12	50%	3	15	17%	0	0	
Ss_492	≤300	Vessel 15	2012	4	Southern North Sea	0	0		5	24	17%	0	0	
Ss_493	≤300	Vessel 15	2012	4	Southern North Sea	3	30	9%	0	12	0%	0	0	
Ss_494	≤300	Vessel 15	2012	4	Southern North Sea	8	64	11%	0	20	0%	0	0	
Ss_495	≤300	Vessel 15	2012	4	Southern North Sea	1	13	9%	3	20	12%	0	0	
Ss_496	≤300	Vessel 15	2012	4	Southern North Sea	4	20	17%	0	10	0%	0	0	
Ss_497	>300	Vessel 16	2012	4	Southern North Sea	2	14	13%	0	53	0%	0	7	0%
Ss_498	>300	Vessel 16	2012	4	Southern North Sea	0	9	0%	29	60	33%	0	0	
Ss_499	>300	Vessel 16	2012	4	Southern North Sea	15	60	20%	5	50	9%	0	10	0%
Ss_500	>300	Vessel 16	2012	4	Southern North Sea	0	19	0%	10	58	14%	0	10	0%
Ss_501	>300	Vessel 16	2012	4	Southern North Sea	12	58	17%	6	35	14%	0	0	
Ss_502	>300	Vessel 16	2012	4	Southern North Sea	14	72	16%	14	45	23%	0	5	0%
Ss_503	>300	Vessel 17	2012	4	Southern North Sea	0	16	0%	32	80	29%	0	0	
Ss_504	>300	Vessel 18	2012	4	Southern North Sea	0	22	0%	76	0	100%	0	0	
Ss_505	>300	Vessel 18	2012	4	Southern North Sea	0	25	0%	0	49	0%	0	0	
Ss_506	>300	Vessel 18	2012	4	Southern North Sea	0	10	0%	0	38	0%	0	0	
Ss_507	>300	Vessel 19	2012	4	Southern North Sea	16	17	49%	16	55	23%	0	18	0%
Ss_508	>300	Vessel 19	2012	4	Southern North Sea	0	8	0%	2	80	2%	0	0	
Ss_509	>300	Vessel 19	2012	4	Southern North Sea	8	19	29%	3	45	5%	0	0	
Ss_510	>300	Vessel 20	2012	4	Southern North Sea	4	9	31%	10	40	20%	0	24	0%
Ss_511	>300	Vessel 20	2012	4	Southern North Sea	7	8	46%	6	39	13%	0	0	
Ss_512	>300	Vessel 20	2012	4	Southern North Sea	12	69	15%	6	75	8%	0	0	
Ss_513	>300	Vessel 20	2012	4	Southern North Sea	2	16	12%	2	25	6%	0	0	
Ss_514	>300	Vessel 9	2013	1	Central North Sea	26	64	29%	0	30	0%	0	0	
Ss_515	>300	Vessel 9	2013	1	Central North Sea	20	33	38%	0	20	0%	0	0	
Ss_516	>300	Vessel 9	2013	1	Central North Sea	41	49	45%	0	25	0%	0	8	0%
Ss_517	>300	Vessel 17	2013	1	Central North Sea	1	3	20%	8	25	25%	0	0	
Ss_518	>300	Vessel 17	2013	1	Central North Sea	6	16	27%	10	30	25%	0	0	
Ss_519	>300	Vessel 17	2013	1	Central North Sea	0	9	0%	0	18	0%	0	0	
Ss_520	>300	Vessel 18	2013	1	Central North Sea	0	73	0%	0	27	0%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice DC	Plaice L	Plaice DC%	Sole DC	Sole L	Sole DC%	Cod DC	Cod L	Cod DC%
Ss_521	>300	Vessel 18	2013	1	Central North Sea	0	19	0%	0	38	0%	0	0	
Ss_522	>300	Vessel 18	2013	1	Central North Sea	0	2	0%	0	30	0%	0	0	
Ss_523	>300	Vessel 18	2013	1	Central North Sea	0	305	0%	0	23	0%	0	0	
Ss_524	>300	Vessel 19	2013	1	Central North Sea	1	17	6%	1	23	5%	0	0	
Ss_525	>300	Vessel 19	2013	1	Central North Sea	4	36	9%	1	43	3%	0	0	
Ss_526	>300	Vessel 19	2013	1	Central North Sea	28	93	23%	9	65	13%	0	0	
Ss_527	>300	Vessel 24	2013	1	German Bight	8	80	9%	2	20	9%	0	0	
Ss_528	>300	Vessel 24	2013	1	German Bight	7	102	6%	2	18	11%	0	0	
Ss_529	>300	Vessel 24	2013	1	German Bight	18	204	8%	0	11	0%	0	0	
Ss_530	>300	Vessel 9	2013	1	"English Banks"	28	75	27%	4	38	9%	0	0	
Ss_531	>300	Vessel 9	2013	1	"English Banks"	4	19	17%	0	15	0%	0	0	
Ss_532	>300	Vessel 9	2013	1	"English Banks"	15	36	30%	5	26	17%	0	0	
Ss_533	>300	Vessel 18	2013	1	"English Banks"	0	5	0%	0	33	0%	0	0	
Ss_534	≤300	Vessel 2	2013	1	Southern North Sea	6	12	33%	3	12	20%	0	0	
Ss_535	≤300	Vessel 2	2013	1	Southern North Sea	7	27	20%	3	17	17%	0	7	0%
Ss_536	≤300	Vessel 2	2013	1	Southern North Sea	13	23	36%	7	17	29%	0	3	0%
Ss_537	≤300	Vessel 2	2013	1	Southern North Sea	4	13	25%	9	27	25%	0	2	0%
Ss_538	≤300	Vessel 2	2013	1	Southern North Sea	3	8	25%	3	13	17%	13	0	100%
Ss_539	≤300	Vessel 2	2013	1	Southern North Sea	1	19	6%	1	27	3%	0	3	0%
Ss_540	>300	Vessel 3	2013	1	Southern North Sea	13	111	11%	9	67	12%	0	0	
Ss_541	>300	Vessel 3	2013	1	Southern North Sea	9	59	13%	9	54	14%	0	14	0%
Ss_542	>300	Vessel 3	2013	1	Southern North Sea	27	80	25%	13	53	20%	0	13	0%
Ss_543	>300	Vessel 4	2013	1	Southern North Sea	4	33	11%	6	90	6%	0	0	
Ss_544	>300	Vessel 4	2013	1	Southern North Sea	2	31	7%	0	36	0%	0	0	
Ss_545	>300	Vessel 4	2013	1	Southern North Sea	4	38	9%	0	76	0%	0	0	
Ss_546	>300	Vessel 4	2013	1	Southern North Sea	2	24	8%	2	43	4%	0	0	
Ss_547	>300	Vessel 4	2013	1	Southern North Sea	2	17	9%	2	43	4%	0	0	
Ss_548	>300	Vessel 4	2013	1	Southern North Sea	0	11	0%	2	42	5%	0	0	
Ss_549	>300	Vessel 5	2013	1	Southern North Sea	194	68	74%	17	57	23%	0	0	
Ss_550	>300	Vessel 5	2013	1	Southern North Sea	120	13	90%	7	40	14%	0	0	
Ss_551	>300	Vessel 5	2013	1	Southern North Sea	84	21	80%	11	53	17%	0	0	
Ss_552	>300	Vessel 5	2013	1	Southern North Sea	190	67	74%	6	34	14%	0	0	
Ss_553	>300	Vessel 5	2013	1	Southern North Sea	27	17	62%	3	24	13%	0	0	
Ss_554	>300	Vessel 5	2013	1	Southern North Sea	75	23	77%	4	45	8%	0	0	
Ss_555	>300	Vessel 6	2013	1	Southern North Sea	140	75	65%	1	35	3%	0	0	
Ss_556	>300	Vessel 6	2013	1	Southern North Sea	83	101	45%	1	28	3%	0	0	
Ss_557	>300	Vessel 6	2013	1	Southern North Sea	60	45	57%	4	30	11%	0	0	
Ss_558	>300	Vessel 6	2013	1	Southern North Sea	75	53	59%	11	45	20%	0	0	
Ss_559	>300	Vessel 9	2013	1	Southern North Sea	15	91	14%	0	23	0%	0	0	
Ss_560	>300	Vessel 9	2013	1	Southern North Sea	9	26	25%	0	17	0%	0	0	

Annex F: Continued

Tripnr	Engine power	Vessel nr	Year	Q	Fishing area	Plaice			Sole			Cod		
						DC	L	DC%	DC	L	DC%	DC	L	DC%
Ss_561	>300	Vessel 9	2013	1	Southern North Sea	5	15	25%	3	20	11%	3	10	20%
Ss_562	>300	Vessel 10	2013	1	Southern North Sea	12	35	25%	0	12	0%	0	0	
Ss_563	>300	Vessel 14	2013	1	Southern North Sea	23	57	29%	11	46	20%	0	0	
Ss_564	≤300	Vessel 15	2013	1	Southern North Sea	13	50	21%	3	17	17%	0	0	
Ss_565	≤300	Vessel 15	2013	1	Southern North Sea	3	17	17%	0	17	0%	0	0	
Ss_566	≤300	Vessel 15	2013	1	Southern North Sea	0	7	0%	2	23	9%	0	0	
Ss_567	≤300	Vessel 15	2013	1	Southern North Sea	0	0		0	23	0%	0	0	
Ss_568	>300	Vessel 16	2013	1	Southern North Sea	0	11	0%	6	40	13%	0	57	0%
Ss_569	>300	Vessel 16	2013	1	Southern North Sea	20	50	29%	5	20	20%	0	50	0%
Ss_570	>300	Vessel 16	2013	1	Southern North Sea	6	19	25%	3	50	6%	0	6	0%
Ss_571	>300	Vessel 16	2013	1	Southern North Sea	10	18	36%	1	15	3%	0	13	0%
Ss_572	>300	Vessel 18	2013	1	Southern North Sea	0	261	0%	0	104	0%	0	0	
Ss_573	>300	Vessel 19	2013	1	Southern North Sea	1	60	2%	<1	43	1%	0	0	
Ss_574	>300	Vessel 19	2013	1	Southern North Sea	3	39	6%	5	43	11%	0	0	
Ss_575	>300	Vessel 19	2013	1	Southern North Sea	15	26	38%	1	23	3%	0	0	
Ss_576	>300	Vessel 20	2013	1	Southern North Sea	58	84	41%	3	25	9%	0	0	
Ss_577	>300	Vessel 20	2013	1	Southern North Sea	6	42	13%	8	40	16%	0	0	
Ss_578	>300	Vessel 20	2013	1	Southern North Sea	2	4	29%	11	19	36%	0	0	
Ss_579	>300	Vessel 20	2013	1	Southern North Sea	6	9	41%	0	18	2%	0	0	

Annex G Average numbers/hour discarded benthic species in the pulse trawl observer trips

A distinction has been made between trips ≤300hp (2 trips) and >300hp (8 trips)

Species	English name	≤300hp	>300hp	Average
Acanthocardia echinata	Prickly Cockle	0	<0.7	0.1
Alcyonium digitatum	Dead man's finger	0	4.4	3.5
Alloteuthis subulata	European com. squid	0	0.2	0.2
Anthozoa	Anthozoans	3.8	0.8	1.4
Aphrodita aculeata	Sea mouse	0.6	7.1	5.8
Arctica islandica	Ocean quahog	0	<0.1	<0.1
Ascidiacea	Sea squirts	0	<0.1	<0.1
Asterias rubens	Common starfish	5049.7	687.9	1560.3
Astropecten irregularis	Sand star	0	324.7	259.7
Atelecyclus rotundatus	Circular crab	0	0.7	0.5
Buccinum undatum	Common whelk	2.4	7.8	6.7
Cancer pagurus	Edible crab	0	3.0	2.4
Chlamys varia	Variegated scallop	0	1.6	1.3
Common mussel	Common mussel	12.3	1.0	3.3
Common shrimp	Common shrimp	9.1	1.5	3.0
Corystes cassivelaunus	Helmet crab	0.7	54.5	43.8
Diogenes pugilator	Small hermit crab	0	1.0	0.8
Echinidae	Sea urchin	473.3	205.7	259.2
Echinocardium cordatum	Sea-potato	36.8	75.1	67.4
Ensis directus	Atlantic jack knife clam	0	0.2	0.1
Ensis siliqua	Pod razor shell	0	<0.1	<0.1
Ensis sp.	Razor shell	0.9	0	0.2
Goneplax rhomboides	Angular crab	0	<0.1	<0.1
Hyas araneus	Great spider crab	0	<0.1	<0.1
Hyas coarctatus	Contracted crab	0	<0.1	0.1
Hyas sp.		0	0.2	0.2
Laevicardium crassum	Norway cockle	0.6	1.3	1.2
Liocarcinus depurator	Blueleg swimming crab	21.5	21.2	21.3
Liocarcinus holsatus	Swimming crab	320.0	357.0	349.6
Liocarcinus marmoreus	Marbled swimming crab	5.5	10.7	9.6
Loligo forbesi	Common squid	0	0.9	0.7
Luidia ciliaris		0	<0.1	<0.1
Lunatia catena		0.3	<0.1	0.1
Lutraria lutraria	Common otter shell	0	<0.1	<0.1
Macropodia rostrata	Long legged spider crab	1.7	0.7	0.9
Nassarius reticlatus	Netted dog whelk	28.2	0	5.6
Necora puber	Velvet swimming crab	1.0	16.1	13.1
Neptunea antiqua	Red whelk	0	<0.1	0.1
Octopus vulgaris	Common octopus	0	<0.1	<0.1
Ophiothrix fragilis	Common brittlestar	0	1.4	1.1
Ophiura albida	Brittlestar	6.0	0.3	1.4
Ophiura ophiura	Serpent star	5654.0	396.9	1448.3
Pagurus bernhardus	Common hermit crab	241.1	77.9	110.5
Palaemon sp.		0	<0.1	<0.1
Pilumnus hirtellus	Hairy crab	0	<0.1	<0.1
Psammechinus miliaris	Green sea urchin	5.0	0	1.0
Pseudomussium septemradiatum		0	<0.1	<0.1
Sepia officinalis	Common cuttlefish	0	0.2	0.1
Spatangus purpureus	Violet heart-urchin	0	0.5	0.4
Spisula sp.		0.2	0.1	0.1
Spisula subtruncata	Cut through shell	0	0.3	0.2
Urticina felina	Dahlia anemone	0.4	0	0.1
Venerupis corrugata	Pullet carpet shell	0	<0.1	<0.1
Xantho pilipes	Risso's crab	0	0.1	0.1

Annex H Average numbers/hour of discarded fish species in the pulse trawl observer trips

A distinction has been made between trips ≤300hp (2 trips) and >300hp (8 trips)

Species	≤300hp	>300hp	Average
Ammodytes sp.	0.2	4.1	3.3
Bib	0.9	2.5	2.2
Blonde ray	0	0.4	0.3
Brill	1.3	0.1	0.3
Bull rout	19.7	7.1	9.6
Cod	0.4	1.1	1.0
Cuckoo ray	0	<0.1	<0.1
Dab	705.8	426.6	482.4
Dragonet	11.1	36.5	31.4
Five-bearded rockling	0.2	0	<0.1
Flounder	0.6	0.5	0.5
Four-bearded rockling	0	0.9	0.8
Greater pipefish	0	<0.1	0.0
Greater sand-eel	0.8	3.7	3.1
Greater weever	0	<0.1	<0.1
Grey gurnard	4.6	22.3	18.8
Herring	0	<0.1	0.0
Hooknose	17.4	8.5	10.3
Horse mackerel	0	<0.1	0.1
John Dory	0	0.3	0.2
Lemon sole	5.1	12.6	11.1
Lesser sand-eel	0	<0.1	0.0
Lesser spotted dogfish	0	3.5	2.8
Lesser weever	0.5	6.0	4.9
Long rough dab	0	0.1	0.1
Mustelus sp.	0	<0.1	<0.1
Plaice	545.5	729.8	692.9
Pomatoschistus sp.	5.3	1.5	2.3
Poor cod	0	0.2	0.1
Reticulated dragonet	0	0.2	0.1
Roker	<0.1	1.0	0.8
Sand sole	0	<0.1	<0.1
Scaldfish	9.8	39.0	33.2
Sea bass	0	<0.1	<0.1
Sea scorpion	0	0.2	0.2
Smoothhound	0	0.1	0.1
Sole	140.3	29.8	51.9
Solenette	4.4	43.5	35.7
Spotted ray	0	1.5	1.2
Sprat	0.2	0.2	0.2
Starry smoothhound	0	0.2	0.1
Streaked gurnard	0	<0.1	0.1
Striped red mullet	0	<0.1	<0.1
Topknot	0	0.1	0.1
Tub gurnard	0.5	2.2	1.8
Turbot	0.3	0.2	0.2
Twaite shad	0	<0.1	<0.1
Whiting	9.8	54.8	45.8