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Discard sampling of Dutch bottom-trawl fisheries in 2009 and 2010

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Summary

In the European Union, the collection of discard data is enforced through the Data Collection Regulation or Framework (DCR/DCF) of the European Commission (EC). To comply with this ruling, approximately ten trips of discard-intensive beam-trawlers are being monitored annually since 1999 (Helmond and Overzee, 2010). In 2009, revisions to the DCF (2008/949/EG), required member states to increase sampling intensity to i) improve the precision of their estimates and ii) the number of sampled métiers. To meet this requirement within an affordable budget, the Institute for Marine Resources and Ecosystem Studies (IMARES, part of Wageningen University and Research) set up a collaborative project between the Dutch fishing industry and the research institute to recruit a 'reference fleet' of vessel owners willing to participate in a self-sampling programme. This programme complemented the existing observer programme.

In the observer programme, vessels were selected quarterly from a pool of available vessels, whereas in the self-sampling programme, trips were pre-determined from a reference fleet of participating vessels. Missing and/or wrong information precluded the inclusion of 17% and 13% of all self-sampled trips in 2009 and 2010. In total, 9 and 10 observer, and 63 and 132 valid self-sampling trips were completed in 2009 and 2010, respectively. For these remaining valid self-sampled trips, procedures were developed to test whether data quality was comparable with i) other self samples from the reference fleet and ii) comparable observer-collected data (i.e. temporally and spatially overlapping trips). In addressing i), there were no unusual patterns in the length frequencies of self-sampled discards of European plaice (*Pleuronectes platessa*), common dab (*Limanda limanda*), grey gurnard (*Eutrigla gurnardus*), and whiting (*Merlangius merlangus*) in 2009 and2010. In addressing ii), no significant differences in the discard rates of plaice between the two programmes were found. There was no evidence that sampling may have been biased at the vessel level, justifying the decision to present all discard estimates independent of the programme type.

While in both programmes the majority of observations were done onboard beam-trawl vessels with mesh sizes ranging between 70 and 99 mm, in the self-sampling programme data from four additional beam- and otter-trawl métiers with two 70-99 and 100-119 mesh size ranges and other target species assemblages (i.e mixed crustaceans and/or demersal fish) were collected. This lead, apart from a considerable increase in sampling effort for some métiers, to an increase in the temporal and spatial spread of sampling. Samples from previously un-sampled northern and eastern parts of the North Sea were available. The spatial distribution of sampling locations matched that of the total effort of the fleet for intensively-sampled métiers.

In all but two métiers, combined fish and benthos discards exceeded the volume of landings. In contrast, large-mesh beam- and otter trawls (100-119 mm) landed on average more than they discarded. The majority of discards was comprised by benthic (invertebrate) species such as common starfish (*Asteria rubens*); sand star (*Astropecten irregularis*); swimming crab (*Liocarcinus holsatus*); and serpent star (*Ophiura ophiura*). Most frequently discarded fish species of no commercial value included: dragonet (*Callionymus lyra*); grey gurnard (*Eutrigla gurnardus*); scaldfish (*Arnoglossus laterna*); and solenette (*Buglossidium luteum)*. Among commercially-valuable fish, common dab (*Limanda limanda*) and European plaice (*Pleuronectes platessa*) were the most frequently discarded species.

Samenvatting

In het kader van de EU Data Collectie Verordening (DCR/DCF) is iedere lidstaat verplicht gegevens te verzamelen van vangst die niet wordt aangevoerd – zogenaamde "discards" - in de belangrijkste commerciële visserijen. Om aan deze verplichting te voldoen worden sinds 1999 ieder jaar tien reizen van de boomkorvisserij door wetenschappelijk waarnemers gemonitord (Helmond en Overzee, 2010). Echter, is in 2009 een herziening van de DCF (2008/949/EG) doorgevoerd, waarin lidstaten werd verzocht bemonsteringsprogramma te intensiveren met als doel i) precisieniveau 's van discardsschattingen te verbeteren en ii) en het aantal bemonsterde vlootsegmenten te laten toenemen. Om, binnen het beschikbare budget, toch aan deze eis te kunnen voldoen heeft IMARES (Institute for Marine Resources and Ecosystem Studies, onderdeel van Wageningen University and Research) voorgesteld de visserijsector nauwer te betrekken bij het verzamelen van discardsgegevens. Door middel van een 'referentievloot', bestaande uit commerciële vissers, die zich graag willen inzetten voor het onderzoek, is een intensieve samenwerking - het 'zelfbemonsteringsprogramma' - tot stand gekomen tussen de Nederlandse visserij en het instituut. Dit zelfbemonsteringsprogramma complementeert het reeds bestaande waarnemers programma.

In tegenstelling tot het waarnemersprogramma waarbij ieder kwartaal schepen worden geselecteerd uit de beschikbare groep vaartuigen op dat moment wordt in het zelfbemonsteringsprogramma van te voren aangegeven wanneer een schip uit de referentie vloot een monster meeneemt. Incomplete en/of foutieve informatie is niet bruikbaar, in 2009 en 2010 heeft dit er toe geleid dat 17% en 13% van de verzamelde informatie in het zelfbemonsteringsprogramma is uitgesloten voor verdere analyse. In totaal zijn in 2009 en 2010 respectievelijk 9 en 10 reizen in het waarnemersprogramma en 63 en 132 reizen in het zelfbemonsteringsprogramma correct bemonsterd. Om de kwaliteit van het self-sampling programma te waarborgen zijn procedures ontwikkeld waarbij gegevens per reis worden vergeleken met i) gegevens van andere reizen van de referentievloot en ii) gegevens van het waarnemersprogramma (bij voldoende ruimtelijk en periodieke overlap). Vergelijking met referentievloot (i) is uitgevoerd voor lengte gegevens van de volgende soorten: schol (*Pleuronectes platessa*), schar (*Limanda limanda*), grauwe poon (*Eutrigla gurnardus*) en wijting (*Merlangius merlangus*). Er zijn geen afwijkende patronen waargenomen in de gegevens van het zelfbemonsteringsprogramma. Vergelijking met het waarnemersprogramma (ii) is uitgevoerd voor discardsfracties van schol (*Pleuronectes platessa*). Ook hier is geen structurele afwijking tussen beide programma's waargenomen. Omdat in beide procedures geen significant afwijkende waarden zijn gevonden, is ervoor gekozen de gegevens te stratificeren onafhankelijk van de bemonsteringsmethode: gegevens van het waarnemers- en zelfbemonsteringsprogramma zijn dus samengevoegd.

Hoewel in beide programma's het merendeel van de bemonstering is uitgevoerd op boomkorschepen met maaswijdte 70 tot 99 mm, zijn in het zelfbemonsteringsprogramma ook gegevens verzamelt van vier andere demersale vlootsegmenten, variërend van maaswijdtes tussen de 70 en 99 mm en tussen de 100 en 119 mm en met verschillende doelsoortensamenstelling (Noorse kreeft en/of demersale vis). Buiten de enorme toename in bemonsteringsintensiteit voor een aantal van deze vlootsegmenten, heeft dit ook geleid tot een toename in de verspreiding van discardsg egevens in ruimte en tijd. Zo zijn nu meer gegevens beschikbaar in de voorheen schaars bemonsterde gebieden in de noordelijke en oostelijke delen van de Noordzee. De ruimtelijke spreiding van de bemonstering komt het beste overeen met de totale spreiding van de visserijinspanning voor de meest intensief bemonsterde vlootsegmenten.

Alleen voor de twee vlootsegmenten vissend met grote maaswijdtes (boomkor met maaswijdte 100-119 mm en bordenvissers met maaswijdte 100-119 mm) is het zo dat er meer van de

vangst wordt aangevoerd dan weer overboord wordt gezet. Voor alle andere bemonsterde vlootsegmenten is over het algemeen zo dat het aandeel van de vangst dat uiteindelijk wordt aangevoerd kleiner is dan het aandeel dat weer overboord gaat. Het merendeel van discards bestaat uit benthische vertebraten (benthos), zoals zeesterren (*Asteria rubens*), kamsterren (*Astropecten irregularis*), slangsterren (*Ophiura ophiura*) en zwemkrabben (*Liocarcinus holsatus*). Frequent gediscarde vissoorten, zonder commerciële waarde, zijn: pitvis (*Callionymus lyra*); grauwe poon (*Eutrigla gurnardus*); schurftvis (*Arnoglossus laterna*); en dwergtong (*Buglossidium luteum*). Frequent gediscarde vissoorten, met commerciële waarde, zijn: schar (*Limanda limanda*) en schol (*Pleuronectes platessa*).

Introduction

Discarding of unwanted organisms at sea is considered to be an undesirable and unsustainable fishing practice causing a waste of valuable natural resources and potentially unaccounted mortalities which may negatively impact on life histories of an individual or entire populations (e.g. review by Broadhurst et al., 2006). Economic and/or regulatory pressures, however, commonly force fishers to discard parts of their catch, but without keeping records of it. Not knowing how much was discarded may, in turn, affect stock assessments. If these are based on landings and do not incorporate the proportion of fish that die as a consequence of being discarded, total fishing mortality is underestimated. With the aim to integrate estimates of discards into single-species stock assessments, at-sea monitoring programmes are required to provide accurate discard estimates by species within acceptable error limits.

In the European Union, the collection of discard data is enforced through the Data Collection Regulation or Framework (DCR/DCF) of the European Commission (EC). To comply with this ruling, approximately ten trips of discard-intensive beam trawlers have been monitored annually since 1999 in the Netherlands by scientifically-trained observers (termed hereafter 'observer-sampling programme'; Helmond and Overzee, 2010). In 2009, revisions to the DCF (2008/949/EG), required member states to increase sampling intensity to i) improve the precision of their estimates and ii) the number of sampled fishing fleets (métiers). In foresight of the expenses involved, an affordable 'self-sampling programme' was conceived at the Institute for Marine Resources and Ecosystem Studies (IMARES, part of Wageningen University and Research) in 2009. This programme was set up to complement the observer-sampling programme by involving commercial fishers to collect additional samples from monitored and previously unmonitored métiers. In both programmes, 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) were recorded. Discard samples from the self-sampling programme were returned to the laboratory to determine species composition, size and age structure of a subsample, whereas observer samples were processed onboard the commercial vessel. Under the provision of accuracy both observer- and self-sampled discard data are integrated in stock assessments.

However, considering the involvement of fishers and that their reporting of large amounts of discards is a politically contentious issue, sample and species selection may be compromised and biased, eventually leading to inaccurate data of the discard programme. For example, only those hauls may be sampled with small discard amounts, because less extra work is required to collect a sample. A lack of motivation to i) objectively document the “true” extent of onboard discarding and ii) adhere to a scientifically rigorous data collection protocol may thus outweigh the benefits of cooperative research partnerships (Hoare et al., 2011). To meet one of the common objectives of self sampling, to integrate such data into stock assessments, thus, careful validation is required to establish whether matching quality standards with observer-collected data can be achieved. Discard rates from the observer- and self-sampling programmes were compared at the species level, preceding their compilation for this report. The comparisons were made step-by-step for numbers-at-length and -age at the haul and trip level to evaluate potential differences.

In Dutch bottom-trawl fisheries, discard data were collected from six commercial ‘métiers’ which were defined based on gear type, target species assemblage, and mesh size characteristics in the DCF (EU Council Regulation 409/2009; Table 1). These métiers were from two fleet segments with two distinct mesh size ranges and two target species assemblages operating in

ICES subdivisions IVc and IVb year round, namely beam and otter trawlers with 70-99, and 100-119 mm codend meshes targeting predominantly European plaice (*Pleuronectes platessa*), common sole (*Solea solea*), and/or crustaceans (i.e. Norway lobster, *Nephrops norwegicus*, hereafter termed *Nephrops*; Table 1). Due to changes in target species abundance and/or gear configurations, some monitored trips were assigned to métiers after their completion. For example, if *Nephrops* landings from otter-trawl gears (OTB/OTT) exceeded 30%, these were subsequently classified as otter trawls targeting a mixed assemblage of crustaceans and demersal fish (MCD) as opposed to demersal fish (DEF). As a consequence, some trips initially scheduled as '*Nephrops* trips' turned out as 'demersal fish' trips, because fish predominated the landings over crustaceans.

Within the Dutch beam-trawl métier (TBB_DEF), a distinct national métier was created which is not reflected within the DCF métier classification. It is based on the engine's horse power and geographical distribution, due to regulations allowing only vessels with engines <300hp (so called "Eurocutters") to fish in a marine protected area ("plaice box"). To reflect this distributional difference of the fleet which also has implications on their discarding pattern, in the following analysis, summaries of the discard data were presented separately for Eurocutters (termed TBB_DEF_70-99mm_≤300hp) and the remaining part of the beam-trawl fleet (termed TBB_DEF_70-99mm_>300hp; Table 1).

The present study provides a summary of the observer and self-sampling programmes, their underlying methodologies, and data collected between 2009 and 2010. Sampling effort and discard data such as landed/discarded numbers and weights were presented as detailed as possible on the trip level (Appendices C-E) and subsequently grouped by relevant strata (métier, quarter, and ICES subdivision). Together with appropriate raising metrics (e.g. the proportion of sampled and total fishing duration per trip), standardized discard rates (i.e. numbers/weights per hour of fishing) were calculated. This research is part of the strategic research program WOT "Wettelijke onderzoekstaken" which is funded by the Dutch Ministry of Economic Affairs, Agriculture and Innovation, and was carried out by Wageningen University Research centre.

Methods

Discard sampling programmes: observer and self-sampling

Vessel selection and sampling allocation

In the observer-sampling programme, out of all licensed and active trawl vessels, observers were allocated to vessels where skippers consented boarding. Therefore, this selection procedure is not a true random selection from the population, because it is not mandatory for a fisher to take an observer onboard. The aim of observer allocation was to at least select two vessels in each quarter, in accordance with the raising procedures and to obtain widespread temporal coverage. All sampling was done onboard vessels of the commercially most important fleets: beam-trawlers with 70-99 mm codend meshes targeting flatfish and/or otter trawlers (70-99 mm) targeting flatfish and/or Norway lobster ('*Nephrops*'). (for details refer to Appendix F, Uhlmann et al., 2011)

In the self-sampling programme, a 'reference fleet' (12 and 24 vessels in 2009 and 2010, respectively) with protocol-instructed fishers collected discard samples according to a predefined schedule during their regular commercial operations throughout the year. Sampling was done on board vessels from five different métiers: beam trawlers (with 70-99 or 100-119 mm meshes); otter trawlers (70-99 and 100-119 mm); and Eurocutters (70-99 mm). Prior to sampling, fishers were provided with all necessary equipment (labels, plastic sampling bags, sealing cable ties, and sampling sheets) and written instructions.

It should be noted that métier definitions were not further refined here by incorporating innovative technological developments in the definitions, because this would result in a larger number of métiers with over stratified data aggregation levels that do not conform with DCF requirements. Therefore, the use of sumwings, electric pulse-beam trawls and/or the use of other selective devices was not considered within the métier definitions.

Sampling and data collection procedures

In both monitoring programmes, data were collected on the start and end times, duration, position, and weather conditions during the trawl, together with information on the volumes of catches and landings from all hauls during a sampled trip. The total volume of discards of each sampled haul were derived by subtracting the total landings from the total catch volume (estimate). The total volume of landed species were provided by both the onboard logbook and the auction sales which were split by species and quality grade categories. Ideally, the total volume and weight of landed species from these two sources corresponded with each other. All species of discards within each sample were identified. Species numbers at length were recorded for all fish species of discards in the subsample and some species of landings (i.e. plaice and sole; applicable to the observer programme; Table 2). Species numbers without length measurements were recorded for all non-fish species. Data management software was used to enter and subsequently audit all data before the data were stored in a centralised database.

In the observer-sampling programme, one or two observers sampled >60% of the hauls on each accompanied trip. For each sampled haul, the total volume of the catch (in boxes) was estimated by both the observer(s) and the skipper and an average from these estimates was used wherever possible. The crew sorted the catch by retaining the marketable portion, while observers collected a representative subsample (max. 1 box, ca. 40 kg) of the discards. The sample was comprised of five subsamples taken at intervals throughout the duration of processing. This was done by filling randomly a 10 l bucket with discards. Since 2010, samples of discarded Norway lobster were consistently length measured to calculate discard weights by applying weight-length keys. Subsamples of some landed fish and Norway lobster (between 10 and 15 kg of both target and non-target species) were measured in the observer programme. If possible, from the entire trip, at least three fish per measured size class and ICES statistical rectangle of commercially-important discarded fish species (i.e. plaice, sole, and dab) were retained and returned to the laboratory for age determination. Together with their length measurements, these were used to construct an age-length-key for observer-sampled discards.

In the self-sampling programme, on an agreed trip, ideally, two random and pre-determined hauls were sampled. One sample comprised a fixed amount of two boxes of discards (one box equals ca. 40 kg; Table 2). These boxes were filled by taking five subsamples which were ideally collected at intervals spread throughout the duration of the catch sorting. A 10-l bucket or large, rigid plastic bag was randomly filled with discards and stored in two boxes. These subsamples were then sealed off by cable ties, labelled and cool-stored until the vessel returned to port. There the discard samples were collected by IMARES staff and returned to the laboratory for analysis following the same procedures as described for the observer-sampling programme. In the self-sampling programme no samples of the landings were collected. For age determination, otoliths of at least five fish per measured size class and fished ICES statistical rectangle of commercially-important discarded fish species (i.e. plaice, sole, dab, whiting, and cod) were extracted at the laboratory and together with length measurements these were used to construct an age-length-key for self-sampled discards.

Raising procedures

Different raising procedures were used for discards (and landings) because different sources of information (i.e. age-length keys) were used for these catch components (for details, see Appendix I, Helmond and Overzee, 2010). For the landings, the total landed weight per species per trip was available from the auction list. Such data were not available for discards. A sub-sampling factor (i.e. the ratio of the estimated total discard volume per haul by the sampled volume of discards per haul) was therefore used to raise measured numbers at length for each species to the haul level. To raise these numbers to trip level, the total numbers at length per haul were summed over all sampled hauls in a trip and multiplied by the ratio of the total fishing duration of a trip by the duration of the sampled hauls to obtain the total number at length per hour per trip of each discarded species. Numbers were converted to weights using standard length-weight relationships.

Where landed fish have been measured, landings were raised from sampled numbers per haul to total numbers per trip by the ratio of total landings weight to sampled landings weight per trip. Total numbers landed were calculated by dividing total numbers in the trip by the trip duration. Landed weight per hour was calculated by dividing total landings weight by trip duration. For each sampled métier, simple averages of numbers landed and discarded at length per hour were calculated per period (quarter or year), and ICES subdivision by averaging the relevant numbers per trip for all trips in that period or area.

Fleet effort

Fleet effort data was obtained through queries of the IMARES VISSTAT database using the statistical software package R (R Development Core Team, 2005). The complete query is listed in Appendix A. The calculation of total fishing effort for TBB_DEF_70-99mm_≤300hp vessels requires a cut-off margin for kw/horse power (i.e. 221kw = 300hp, conversion: 1.36).

Comparisons of discard data

Two approaches were chosen to screen the collected discard data for unusual observations. The first approach compared samples within the self-sampling programme to test for the occurrences of any sampling bias (for details refer to Uhlmann et al., 2011). This approach involved a statistical procedure to screen self-sampled data for patterns in the mean length of commonly-discarded fish across species, hauls, vessels, and trips. The second approach was developed to establish whether consistent differences were evident among species-specific discard estimates between samples from the observer- and self-sampling programme. This approach involved two detailed exploratory data analyses of i) the percentage of estimated total discards of those hauls and trips overlapping in both space and time in the southern North Sea and ii) of the average numbers-at-length of discarded plaice step-by-step for each raising procedure from haul to trip level.

For the first part of the comparison (i, above), data was extracted from the IMARES database to provide the percentage estimates of total discards (i.e. the differences between total catch estimates and the landed amount of catch) from each sampled haul. The resulting dataset was trimmed by only including observations from large-powered beam-trawl vessels (>300hp engine power with 70-99 mm mesh sizes) that were fishing south of 53’6° latitude. This southern area of the North Sea, where a number of observer and self-sampled trips were sampled, was further stratified into four subareas (subarea 1: between latitude>=52.5 and longitude<=3; subarea 2: between latitude>=52.5 and longitude>3; subarea 3: between latitude<52.5 and longitude<=3; and subarea 4: latitude<52.5 and longitude>3). These subareas were chosen to reflect spatial differences in discard rates of plaice (Poos et al., unpubl. data). For all hauls of overlapping trips, the percentage of estimated total discards per haul were compared between the two sampling programmes.

For the second part of the step-by-step comparison (ii, above), distributions of the average numbers-at-length per haul and the average numbers-at-length per hour of discarded plaice from the TBB_DEF_70-99mm_>300hp metier were analysed at the trip level for potential inconsistencies between the observer and self-sampling programme.

Results

Comparisons of discard data

The approaches used to screen all audited discard data from 2009 and 2010 revealed no unusual patterns in mean lengths of commonly-discarded species among samples of the self-sampling programme species (Appendix F; Uhlmann, unpubl. data) and average numbers-at-length per hour of discarded plaice between both programmes.

The comparison of the percentage of estimated total discards per sampled haul revealed that estimates were significantly higher for the observer than the self-sampling programme in the southern North Sea ($p<0.05$; Appendix B, Fig. 5). There was some weak indication that in the observer programme some observers tended to overestimate total discards (Appendix B, Fig. 6). In the step-by-step comparisons of the number-at-length per hour of discarded plaice (haul to trip), no major differences in the distribution of the average numbers-at-length per haul and average numbers-at-length per hour per haul (trip level) were observed (Appendix B, Fig. 7).

Sampling effort and coverage

Compared with previous years (e.g. Helmond and Overzee, 2010), both the number of sampled métiers, trips and hauls have increased (Table 3). Furthermore, the temporal and spatial spread of sampling has increased through the self-sampling programme (Fig. 1a-f). More trips, but less hauls per trip were sampled in the self- compared to the observer programme. Sampling effort was proportional to the effort of the fleet for the most-intensely sampled métiers (Fig. 1a,b,e). Compared with the observer programme, in 2009 and 2010, the number of métiers and sampled trips per métier increased considerably through self-sampling (Table 3). In total, nine and ten compared with 63 and 132 trips were correctly sampled in the observer- and self-sampling programme in 2009 and 2010, respectively (Table 3). These numbers include explicitly those trips where no sampling errors (e.g. incomplete data forms) occurred. For example, in 2010, out of a total of 151 sampled trips in the self-sampling programme, 19 trips were excluded because of missing trawllist information, wrong sampling protocols, mismatch between mesh size and métier classifications, or lost bags of discard samples (13% of all trips; Helmond et al., 2011).

By integrating the self-sampling, observer coverage (measured as days at sea) has increased between four and seven-fold for the beam-trawl (TBB_DEF_70-99_>300hp) métier in 2009 and 2010, respectively, in comparison with the sampling coverage in 2008. In the self-sampling programme observer coverage levels of up to 11% were achieved for some métiers (i.e. TBB_DEF_100-119mm; Table 4a,b). Due to its fleet size and their large number of days spent at sea, the beam trawlers with large engine sizes and 70-99 mm mesh sizes (TBB_DEF_70-99mm_>300hp) continued to comparatively receive the least observer coverage of 1.2%-2.0% (Table 4a,b).

Numbers and weights of discarded and/or landed species

For the combined data from both the observer- and self-sampling programme in all but two métiers, on average, the proportion of discards exceeded that of landings in both weights and numbers (Fig. 2). For beam and otter trawlers with larger mesh sizes (100-119 mm) catches consisted of <50% discards, but these showed a high variation (i.e. TBB_DEF_100-119mm; Fig. 2). Discards comprised both benthic and fish species in all sampled métiers, whereby on average the proportion of numbers of benthic species discarded per hour exceeded that of discarded fish (Tables 5 and 8). In all métiers, some of the most frequently discarded benthic species include: common starfish (*Asterias rubens*); sand star (*Astropecten irregularis*); swimming crab (*Liocarcinus holsatus*); serpent star (*Ophiura ophiura*); common hermit crab (*Pagurus bernhardus*; Table 8a,c). Most frequently discarded fish species of no commercial value include: dragonet (*Callionymus lyra*); grey gurnard (*Eutrigla gurnardus*); scaldfish (*Arnoglossus laterna*); and solenette (*Buglossidium luteum*; Table 8b,d). Among the less-abundant and vulnerable elasmobranch species, the lesser-spotted dogfish (*Scyliorhinus canicula*) and starry ray (*Amblyraja radiata*) were occasionally registered within a discard sample. Among commercially-valuable species, dab followed by plaice (Minimum Landing Size, MLS=27 cm) were among the most-commonly discarded species both in numbers and weights (Table 5, Fig. 3). Other commonly-discarded species included: sole (MLS=24 cm) and whiting (MLS=27 cm), whereas less-commonly discarded species included other fish such as brill, turbot, and cod (MLS=35cm; Tables 5-7; Fig. 3). In the length-frequency distributions, little fish above MLS were found within the discard samples for most species, apart from cod. These were discarded in particular in large-meshed otter trawls in 2009 (bottom left panel, Fig. 4d). The majority of discarded Norway lobsters were above MLS (2.5cm carapax length; Fig. 4f).

Distinct catch patterns were evident for the different métiers. Large-powered beam trawlers (*TBB_DEF_70-99mm_>300hp*) which target plaice and sole, showed an increase of the average landings, and a decrease of the discards weights of plaice between 2009 and 2010 (Table 5a). Although for the last ten years, no unusual temporal trends in percentage discard rates for plaice were evident (Table 9a). For sole, a different trend was evident between the last two years: a slight increase in discards and landings for 2009 and 2010 (Table 5a). Overall, the highest landings and discard rates were observed in 2010 since 2004 (Table 9a). An increase in the number, despite a decrease in weights, indicates that smaller-sized sole were landed in 2010 (Table 5b). Like with all the other métiers, there was no apparent seasonal trend in neither discard nor landings rates (Table 6a,b). However, there was some spatial trend in both years for plaice with higher discard rates in the southern North Sea (Table 7a,b). For brill, the landing rates were considerably higher in ICES subdivision IVc compared with IVb (Table 7a). To a lesser extent, the opposite applied to turbot. For the small-powered beam trawlers (Eurocutters; *TBB_DEF_70-99mm_≤300hp*) which target plaice and sole, average landings weights per hour of plaice and dab increased and of sole decreased between 2009 and 2010; whereas discard weights decreased for all three species (Table 5a). Compared with the large-powered counterpart, the Eurocutters, both landed and discarded substantially less plaice and sole (Table 5a). There was a substantial decrease in the observed numbers of discarded dab and plaice (Table 5b). The large-meshed beam trawlers (*TBB_DEF_100-119mm*), target mainly plaice with comparatively lower discard rates than the other beam-trawl métiers. Discard rates of dab increased substantially within the last two years (Table 5a,b).

The *Nephrops* fishery (*OTB/OTT_MCD_70-99mm*) target *Nephrops*, but plaice are also landed, and occasionally make up a greater proportion of the landings than *Nephrops*. Compared with the other métiers, discard rates for dab and whiting were higher in 2009 (Table 5a,b). The otter-trawl fishery for demersal fish (*OTB/OTT_DEF_70-99mm*) target plaice, with more *Nephrops* and whiting discards than the beam-trawl métiers (Table 5a,b). Particularly in 2009, many whiting were discarded (Table 5a,b). Discard and landings rates of dab, plaice, and sole were higher in ICES sub-division IVc (Table 7a,b). The large-mesh otter-trawl fishery (*OTB/OTT_DEF_100-119mm*) target plaice and together with the large-mesh beam-trawl fleet showed the highest landings rates for plaice, but with a much higher discard rate (Table 5a,b). Dab discards increased substantially between 2009 and 2010 (Table 5a,b; Fig. 3a,b). In 2009, the highest number of discarded cod were observed (Table 5a,b).

Discussion

Comparisons of discard data

The lack of any detectable sampling bias among samples of the self-sampling programme (Uhlmann et al., 2011; IMARES, unpubl. data) and the lack of major differences in the discarded numbers-at-length (i.e. at the trip and species level: average numbers-at-length per hour of discarded plaice per trip) between the two discard sampling programmes, provided the basis for the decision to present all discard data in this report indiscriminatively of the sampling programme type (i.e. observer vs self-sampling).

Total discard volumes were derived here by subtracting total landings from estimates of total catch volumes. Both at the trip and species level, average landings per trip were comparable between both observer and self-sampled trips. While landings can be accurately measured by counting the number of equally-sized boxes onboard, accurate estimation of total catch volumes is important to approximate the volumes of total discards. But there may be differences among the observer's and between the observer's versus fisher's ability to accurately estimate the volume of the total catch. In the Dutch programmes, observers were instructed on each sampled haul to obtain estimates of the total catch by at least two independent sources (e.g. observer and skipper) to account for the potential lack of experience. A simple average of these estimates would then be used as the 'best guestimate'. However, 'guestimating' total catch volumes onboard remains a weak point in these and other at-sea discard sampling programmes (Roman et al., 2011).

Not all records from self-sampled trips were complete and valid. Missing and/or wrong information disqualified a number of trips and rendered them as invalid. To avoid this in the future, the continuous collection of samples throughout the year requires rigorous and regular data audits; ideally, on a real-time basis. For example, before the next departure and data collection event (Roman et al., 2011). However, current lag times in returning logbook records, etc. preclude timely error detections. Thus, the same vessel may complete a number of trips repeating the same mistakes all over again. Apart from slowing down data audits and analyses, incomplete or wrong records, which, for example, do not allow to match biological information from sampled hauls with logbook records are a waste of budget resources. Especially, if no further motivational incentives exist for fishers to operate flawlessly during data collection and/or recording. In an Eastern U.S. groundfish self-sampling programme, quality of data reporting were improved by offering monetary compensation to only those participants who provided complete sampling records (Roman et al., 2011).

Concluding from the exercises to screen both observer and self-sampled data, it was decided to more closely match observer with self-sampled trips in the future. Such a sampling design will allow to apply statistically less elaborate techniques for meaningful comparisons of observer- and self-sampled data. To avoid an observer effect when simultaneous observations are carried out onboard the same trip and hauls (Roman et al., 2011), estimates from the fisher have to remain independent from that by an observer.

Sampling effort and coverage

Together with the self-sampling programme, more samples from more trips and métiers were sampled than ever before in Dutch bottom-trawl fisheries. Self-sampling has greatly improved both the spatial and temporal spread of sampling at lower costs. Although an increase of sampling effort will most likely improve precision levels of discard estimates, it does not necessarily improve their accuracy. Precision levels of species-specific discard estimates as required under DCF targets, were calculated in another project, and will be reported elsewhere.

Implicit to any robust sampling design and raising procedures are assumptions associated with the representativeness of the sampled population (Cotter and Pilling, 2007). However, the selection of vessels in both programmes may be biased and may not represent the overall population of active vessels with respect of their overall discarding patterns, landings profile, and temporal distribution of fishing effort. Within the sampled métiers of the self-sampling programme, a variety of conventional and innovative fishing gears were used. These include five vessels with sumwing (n=3), hydrorig (1), and electric pulse (1) trawl gears, whereas in the observer programme explicitly conventional beam-trawl gears were sampled. Thus, the pooled population of sampled vessels from both programmes reflects to some extent the gear-type composition in the beam-trawl fleet: many vessels with conventional gears and an increasing proportion with modified gears. The potential of modified gears to reduce catches of non-target species and hence, generate different discard patterns compared with conventional beam-trawl configurations, further justifies the pooling of discard estimates from both these sampling programmes to best reflect the true composition of the fleet. Notwithstanding the above, the magnitude of bias in vessel selection needs to be quantified for both programmes.

Numbers and weights of discarded and/or landed species

For all métiers, the majority of discards were comprised by benthic species, which clearly reflects the nature of bottom-trawl fisheries (Bergmann et al., 2002; Borges et al.,2005). The majority of discards were small in size. Thus, these were to a lesser extent retained in métiers with larger-meshed gears (>100 mm). However, large-meshed gears were used only in northern areas of the North Sea in areas where, for example, juvenile plaice, is less abundant (Beverton and Holt, 1957; Keeken et al., 2007). Overall, there were no major increases or reductions in the numbers and weights of discarded and/or landed species (both commercially-valuable and/or benthic species). All observations were located within the ranges measured in previous years where métier-specific data were available (Helmond and Overzee, 2010). This may be testimony to the quality and integrity of both observer- and self-sampled data. Likewise it may also be attributed to the consistency of fishing and discarding patterns, although some of the self-sampled vessels were equipped with modified (i.e. sumwing) gears. However, no further detailed statistical analyses were carried out to confirm any trends among discard estimates of the available time series.

Between-métier comparisons revealed that in otter-trawls for demersal fish, on average more plaice were discarded than in otter-trawls targeting a mixed species assemblage of fish and crustaceans (Fig. 3b). This result corresponds with a similar pattern observed for discarded plaice from otter trawls in previous years (Grift et al., 2004). The order of magnitude of discard rates (weights and numbers) of other species were also comparable with this previous work (Grift et al., 2004). Commonly-held perceptions of lower total discard amounts in otter compared with beam trawls (e.g. Grift et al., 2004) were not evident here (Fig.2).

Seasonal trends were not as clear as spatial patterns (Tables 6 and 7). This may be related to differences in size-related distributions of fish in space, but not so much time, and/or reduced fishing effort during the winter months. In combination with certain gear configurations this can lead to the observed increases in discarded plaice in the southern North Sea. Interestingly, similar patterns were detected for the landings of brill: with higher landings in ICES subdivision IVc, whereas for turbot the opposite seemed to be the case with higher landings further north.

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Tables

Table 1. List of Dutch bottom-trawl métiers sampled for discards. These were classified according to European Union (EU) definitions (EU Council Regulation 409/2009) requiring information about gear type (i.e. demersal beam – TBB; and otter trawl - OTB/OTT; level 4), target species assemblage (i.e. demersal fish - DEF, mixed crustaceans and demersal fish – MCD; level 5), and mesh size ranges (in mm; level 6).

	Level 4 **Gear type**	**Level 5** **Target assemblage**	**Level 6** **Mesh size**
1	TBB (>300 hp)	DEF	70-99
2	TBB (≤300 hp)*	DEF	70-99
3	TBB	DEF	100-119
4	OTB/OTT	MCD	70-99
5	OTB/OTT	DEF	70-99
6	OTB/OTT	DEF	100-119

* Note that the TBB métier is further subdivided on a national level in the Netherlands based on engine size (horse power, hp): vessels with ≤ 300hp engine power are so called “Eurocutters”.

Table 2. Methods used to sample total catch, discards and landings in the observer- and self-sampling programme, respectively.

Method		**Observer sampling**	**Self sampling**
SAMPLING		>10 hauls/trip	2 hauls/trip
TOTAL CATCH			
	Estimate: total catch volume	onboard	onboard
DISCARDS			
	Collect: discard subsample	1 box	2 boxes
	Sorting: discards by species	onboard	laboratory
	Measuring: fish by species	onboard	laboratory
	Counting: Invertebrates by species	onboard	laboratory
	Sampling: Otoliths from discards	onboard	laboratory
LANDINGS			
	Collect: landings subsample	onboard	none
	Measuring: fish by species	onboard	none
	Estimate: total landings	onboard	onboard
OPERATIONAL/ENVIRONMENTAL PARAMETERS			
	Position of hauls, duration, weather, etc.	onboard	onboard

Table 3. Summary of the total number of valid trips sampled in each métier and programme (observer- and/or the self-sampling programme) in 2009 and 2010.

Prog	Métier	2009	2010
obs	TBB_DEF_70-99mm_>300hp	8	8
obs	OTB/OTT_MCD_70-99mm	0	0
obs	OTB/OTT_DEF_70-99mm	1	2
	Total	9	10
self	TBB_DEF_70-99mm_>300hp	40	66
self	TBB_DEF_70-99mm_≤300hp	2	21
self	TBB_DEF_100-119mm	10	12
self	OTB/OTT_MCD_70-99mm	4	6
self	OTB/OTT_DEF_70-99mm	4	18
self	OTB/OTT_DEF_100-119mm	3	9
	Total	63	132

Table 4a. Sampling and fleet effort, and sampling coverage (% days at sea, D.A.S) per métier in 2009.

Métier	**Sampling effort D.A.S.**	**Fleet effort D.A.S**	**Sampling coverage D.A.S**
TBB_DEF_70-99mm_>300hp	191	15527	1.2 %
TBB_DEF_70-99mm_≤300hp	14	4268	0.3 %
TBB_DEF_100-119mm	48	529	9.1 %
OTB/OTT_MCD_70-99mm	19	1240	1.5 %
OTB/OTT_DEF_70-99mm	23	1443	1.6 %
OTB/OTT_DEF_100-119mm	19	1010	1.9 %

Table 4b. Sampling and fleet effort, and sampling coverage (% days at sea, D.A.S) per métier in 2010.

Métier	**Sampling effort D.A.S.**	**Fleet effort D.A.S**	**Sampling coverage D.A.S**
TBB_DEF_70-99mm_>300hp	314	15743	2.0 %
TBB_DEF_70-99mm_≤300hp	76	3560	2.1 %
TBB_DEF_100-119mm	51	455	11.2%
OTB/OTT_MCD_70-99mm	32	1379	2.3 %
OTB/OTT_DEF_70-99mm	90	1766	5.1 %
OTB/OTT_DEF_100-119mm	48	810	5.9 %

Table 5a. Average weights (kg) per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier in 2009 and 2010. Nm, not measured (i.e. missing sufficient lengths measurements for discards of *Nephrops*, NEP, to apply length-weight keys).

Year	Métier	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	61.9	32.9	75.7	61.1	3.0	24.5	0.1	1.4	0.0	5.4	0.4	1.5	4.8	0.6	Nm	0.0
	TBB_DEF_70-99mm_≤300hp	46.3	1.6	63.9	7.8	8.1	13.6	0.6	0.1	0.0	1.2	0.0	0.0	2.2	0.0	0.0	0.0
	TBB_DEF_100-119mm	13.2	6.0	8.6	170.4	0.0	6.8	0.0	0.2	0.0	6.9	0.0	0.3	0.1	0.1	Nm	0.0
	OTB/OTT_MCD_70-99mm	88.7	0.9	62.6	17.9	0.0	0.3	0.0	0.2	0.0	2.1	0.6	2.5	16.5	0.7	Nm	46.8
	OTB/OTT_DEF_70-99mm	33.5	0.7	32.1	27.3	0.0	0.6	0.0	0.2	0.0	2.0	0.4	2.8	30.1	3.7	Nm	10.8
	OTB/OTT_DEF_100-119mm	16.4	7.0	37.6	105.4	0.0	0.0	0.0	2.0	0.0	6.1	5.6	4.8	0.3	0.0	0.0	0.0
2010	TBB_DEF_70-99mm_>300hp	65.2	9.5	67.8	81.5	3.7	22.4	0.2	2.1	0.0	4.8	0.9	2.3	4.7	1.0	Nm	0.1
	TBB_DEF_70-99mm_≤300hp	34.4	5.5	28.7	10.0	3.0	9.4	0.3	0.8	0.1	1.3	0.1	0.7	3.1	0.2	Nm	0.0
	TBB_DEF_100-119mm	79.8	10.8	7.9	323.0	0.0	1.1	0.0	0.2	0.0	3.3	0.5	0.2	0.7	0.4	Nm	0.0
	OTB/OTT_MCD_70-99mm	45.0	0.7	30.7	18.4	0.0	0.3	0.0	0.4	0.0	2.2	1.5	1.4	8.2	0.1	22.8	23.0
	OTB/OTT_DEF_70-99mm	43.2	3.1	44.2	50.2	1.4	4.6	0.2	0.8	0.1	1.6	1.5	4.0	6.7	2.4	9.4	9.0
	OTB/OTT_DEF_100-119mm	77.3	12.0	66.5	188.7	0.0	0.1	0.0	0.2	0.2	3.2	0.6	1.8	0.7	0.0	Nm	0.0

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Table 5b. Average numbers per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier in 2009 and 2010. Nm, no landings were measured.

Year	Métier	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	1221	31	917	189	34	113	1	Nm	0	Nm	1	Nm	58	Nm	39	Nm
	TBB_DEF_70-99mm_≤300hp	1177	Nm	1127	Nm	116	Nm	4	Nm	0	Nm	0	Nm	20	Nm	0	Nm
	TBB_DEF_100-119mm	207	Nm	87	Nm	0	Nm	0	Nm	0	Nm	0	Nm	1	Nm	1	Nm
	OTB/OTT_MCD_70-99mm	1323	Nm	489	Nm	0	Nm	0	Nm	0	Nm	2	Nm	178	Nm	2057	Nm
	OTB/OTT_DEF_70-99mm	527	8	281	72	0	Nm	0	Nm	0	Nm	2	Nm	274	18	1203	778
	OTB/OTT_DEF_100-119mm	207	Nm	259	Nm	0	Nm	0	Nm	0	Nm	11	Nm	2	Nm	0	Nm
2010	TBB_DEF_70-99mm_>300hp	1178	48	872	201	42	132	1	Nm	0	Nm	3	Nm	70	Nm	31	Nm
	TBB_DEF_70-99mm_≤300hp	635	Nm	425	Nm	38	Nm	3	Nm	1	Nm	1	Nm	31	Nm	23	Nm
	TBB_DEF_100-119mm	1023	Nm	57	Nm	0	Nm	0	Nm	0	Nm	4	Nm	7	Nm	2	Nm
	OTB/OTT_MCD_70-99mm	573	Nm	289	Nm	0	Nm	0	Nm	0	Nm	8	Nm	67	Nm	1096	Nm
	OTB/OTT_DEF_70-99mm	625	12	428	106	12	1	1	Nm	1	Nm	7	Nm	62	7	626	403
	OTB/OTT_DEF_100-119mm	939	Nm	546	Nm	0	Nm	0	Nm	1	Nm	2	Nm	6	Nm	2	Nm

Table 6a. Average weights (kg) per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier and quarter (Q) in 2009 and 2010. Nm, not measured (i.e. missing sufficient lengths measurements for discards of *Nephrops*, NEP, to apply length-weight keys).

Year	Métier	Q	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	1	105.8	3.8	70.9	41.3	3.4	33.5	0.0	1.3	0.0	2.6	0.1	7.1	10.0	2.9	Nm	0.0
	TBB_DEF_70-99mm_>300hp	2	38.9	33.1	48.0	44.8	2.3	19.5	0.2	0.6	0.0	5.9	0.2	0.7	8.2	1.1	0.0	0.1
	TBB_DEF_70-99mm_>300hp	3	111.1	42.6	98.3	50.2	2.7	28.1	0.0	1.5	0.0	5.1	0.4	0.8	0.8	0.1	Nm	0.1
	TBB_DEF_70-99mm_>300hp	4	25.5	25.8	82.3	95.2	4.0	24.7	0.0	2.2	0.0	5.8	0.5	2.5	4.9	0.1	Nm	0.0
	TBB_DEF_70-99mm_≤300hp	2	46.3	1.6	63.9	7.8	8.0	13.6	0.6	0.1	0.0	1.2	0.0	0.0	2.2	0.0	0.0	0.0
	TBB_DEF_100-119mm	2	20.0	10.0	8.4	247.9	0.0	0.3	0.0	0.1	0.0	3.8	0.1	0.3	0.2	0.3	0.0	0.0
	TBB_DEF_100-119mm	3	10.3	4.3	8.6	137.2	0.0	9.6	0.0	0.2	0.0	8.3	0.0	0.2	0.0	0.0	Nm	0.1
	OTB/OTT_MCD_70-99mm	2	56.5	0.4	93.6	8.7	0.0	0.2	0.0	0.1	0.0	1.8	0.0	6.7	59.2	2.9	Nm	22.7
	OTB/OTT_MCD_70-99mm	3	113.3	1.6	65.7	13.6	0.1	0.4	0.0	0.3	0.0	2.8	0.5	0.0	2.8	0.0	Nm	67.6
	OTB/OTT_MCD_70-99mm	4	71.7	0.0	25.5	35.5	0.0	0.1	0.0	0.0	0.0	0.9	1.3	3.1	0.9	0.0	Nm	29.5
	OTB/OTT_DEF_70-99mm	2	47.3	0.3	15.6	4.2	0.0	1.2	0.0	0.1	0.0	0.9	0.0	7.6	100.5	12.3	Nm	11.2
	OTB/OTT_DEF_70-99mm	3	36.8	1.1	42.2	20.9	0.0	0.4	0.0	0.3	0.0	2.0	0.7	1.6	9.0	1.4	Nm	9.3
	OTB/OTT_DEF_70-99mm	4	9.9	0.0	18.4	69.6	0.0	0.8	0.0	0.0	0.0	3.1	0.0	1.7	22.7	2.3	0.0	14.6
	OTB/OTT_DEF_100-119mm	2	7.9	10.0	14.4	99.7	0.0	0.0	0.0	2.8	0.0	7.6	0.4	0.4	0.0	0.0	0.0	0.0
	OTB/OTT_DEF_100-119mm	4	33.4	1.0	83.9	116.8	0.0	0.0	0.0	0.3	0.0	3.2	17.0	13.6	0.8	0.0	0.0	0.0

Table 6a. (cont.)

Year	Métier	Q	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2010	TBB_DEF_70-99mm_>300hp	1	74.0	9.2	85.7	68.1	5.5	27.4	0.3	1.7	0.0	3.1	1.4	4.3	2.8	1.7	Nm	0.0
	TBB_DEF_70-99mm_>300hp	2	62.9	12.3	37.7	51.4	2.2	18.3	0.3	2.0	0.0	4.0	1.6	2.1	6.8	1.5	Nm	0.0
	TBB_DEF_70-99mm_>300hp	3	79.4	8.3	58.8	81.5	2.7	22.7	0.0	2.1	0.0	5.4	0.1	0.9	4.8	0.1	Nm	0.2
	TBB_DEF_70-99mm_>300hp	4	50.9	8.5	78.9	116.1	3.7	20.6	0.0	2.4	0.0	6.5	0.5	1.3	4.9	0.5	Nm	0.1
	TBB_DEF_70-99mm_≤300hp	1	23.0	3.4	23.5	17.6	1.0	6.3	0.2	0.5	0.0	0.8	0.1	1.5	0.6	0.0	Nm	0.0
	TBB_DEF_70-99mm_≤300hp	2	41.1	7.9	30.0	4.6	4.4	12.9	0.5	1.0	0.1	0.5	0.1	0.5	1.1	0.2	0.0	0.0
	TBB_DEF_70-99mm_≤300hp	3	57.9	3.1	47.2	13.2	2.2	7.1	0.1	0.6	0.1	1.2	0.3	0.1	14.2	0.7	Nm	0.0
	TBB_DEF_70-99mm_≤300hp	4	13.3	4.8	16.5	8.0	3.5	7.3	0.2	0.9	0.5	5.0	0.2	0.6	3.1	0.1	0.0	0.0
	TBB_DEF_100-119mm	1	36.8	13.1	12.5	359.4	0.0	2.8	0.0	1.4	0.0	9.0	0.0	0.5	0.0	0.0	0.0	0.0
	TBB_DEF_100-119mm	2	64.1	5.4	7.7	346.6	0.0	0.2	0.0	0.1	0.0	1.8	0.5	0.1	0.7	0.6	0.0	0.0
	TBB_DEF_100-119mm	3	122.8	25.1	7.9	235.4	0.0	3.0	0.0	0.4	0.0	5.7	0.2	0.5	1.1	0.0	Nm	0.1
	TBB_DEF_100-119mm	4	162.9	22.4	4.8	272.9	0.0	3.0	0.0	0.0	0.0	5.1	2.2	0.0	0.0	0.0	0.0	0.0
	OTB/OTT_MCD_70-99mm	2	22.9	0.0	7.2	6.8	0.0	0.0	0.0	0.0	0.0	2.5	4.3	5.9	36.0	0.5	8.6	19.7
	OTB/OTT_MCD_70-99mm	3	65.1	1.5	45.3	16.7	0.0	0.2	0.0	0.5	0.0	2.6	1.0	0.0	1.8	0.0	20.0	26.1
	OTB/OTT_MCD_70-99mm	4	26.1	0.0	20.5	26.8	0.0	0.6	0.0	0.4	0.0	1.5	1.0	1.3	3.9	0.0	34.1	20.0
	OTB/OTT_DEF_70-99mm	1	36.2	4.7	31.5	39.5	2.5	8.3	0.4	0.9	0.2	0.7	0.2	6.4	7.8	2.0	2.2	4.5
	OTB/OTT_DEF_70-99mm	2	47.0	0.9	19.6	12.2	0.0	0.2	0.0	0.5	0.0	2.1	1.4	9.1	21.5	15.5	19.9	11.8
	OTB/OTT_DEF_70-99mm	3	52.1	1.1	54.1	36.3	0.0	0.2	0.0	0.1	0.3	1.5	1.8	2.9	4.3	0.7	7.1	14.7
	OTB/OTT_DEF_70-99mm	4	45.0	3.0	54.9	66.9	1.4	4.1	0.2	1.0	0.0	2.1	2.2	1.7	3.7	0.4	12.1	10.0
	OTB/OTT_DEF_100-119mm	1	58.3	22.5	165.6	70.9	0.0	0.0	0.0	1.0	0.4	2.1	1.5	1.0	0.3	0.0	0.1	0.1
	OTB/OTT_DEF_100-119mm	2	74.6	12.6	44.4	186.6	0.0	0.2	0.0	0.2	0.3	3.1	0.5	0.4	0.5	0.0	0.0	0.0
	OTB/OTT_DEF_100-119mm	3	88.0	7.5	70.3	231.4	0.0	0.0	0.0	0.0	0.0	3.5	0.3	4.4	1.2	0.0	0.1	0.1

Table 6b. Average numbers per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier and quarter (Q) in 2009 and 2010. Nm, no landings were measured.

Year	Métier	Q	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	1	1839	15	826	133	32	124	0	Nm	0	Nm	0	Nm	87	Nm	33	Nm
	TBB_DEF_70-99mm_>300hp	2	823	43	694	132	28	67	1	Nm	0	Nm	1	Nm	74	Nm	0	Nm
	TBB_DEF_70-99mm_>300hp	3	2203	24	1172	235	32	141	0	Nm	0	Nm	2	Nm	11	Nm	16	Nm
	TBB_DEF_70-99mm_>300hp	4	463	Nm	893	255	43	120	0	Nm	0	Nm	1	Nm	89	Nm	112	Nm
	TBB_DEF_70-99mm_≤300hp	2	1177	Nm	1127	Nm	116	Nm	4	Nm	0	Nm	0	Nm	20	Nm	0	Nm
	TBB_DEF_100-119mm	2	240	Nm	62	Nm	0	Nm	0	Nm	0	Nm	0	Nm	2	Nm	0	Nm
	TBB_DEF_100-119mm	3	192	Nm	98	Nm	1	Nm	0	Nm	0	Nm	0	Nm	1	Nm	2	Nm
	OTB/OTT_MCD_70-99mm	2	1114	Nm	808	Nm	0	Nm	0	Nm	0	Nm	0	Nm	609	Nm	3648	Nm
	OTB/OTT_MCD_70-99mm	3	1631	Nm	512	Nm	0	Nm	0	Nm	0	Nm	3	Nm	36	Nm	1368	Nm
	OTB/OTT_MCD_70-99mm	4	918	Nm	124	Nm	0	Nm	0	Nm	0	Nm	4	Nm	32	Nm	1845	Nm
	OTB/OTT_DEF_70-99mm	2	644	Nm	144	Nm	0	Nm	0	Nm	0	Nm	0	Nm	863	Nm	1909	Nm
	OTB/OTT_DEF_70-99mm	3	618	8	388	72	0	Nm	0	Nm	0	Nm	4	Nm	90	18	1000	778
	OTB/OTT_DEF_70-99mm	4	137	Nm	98	Nm	0	Nm	0	Nm	0	Nm	0	Nm	237	Nm	1108	Nm
	OTB/OTT_DEF_100-119mm	2	67	Nm	103	Nm	0	Nm	0	Nm	0	Nm	1	Nm	0	Nm	0	Nm
	OTB/OTT_DEF_100-119mm	4	487	Nm	572	Nm	0	Nm	0	Nm	0	Nm	33	Nm	7	Nm	0	Nm

Table 6b. (cont.)

Year	Métier	Q	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2010	TBB_DEF_70-99mm_>300hp	1	1163	97	1119	131	63	113	2	Nm	0	Nm	2	Nm	28	Nm	46	Nm
	TBB_DEF_70-99mm_>300hp	2	1132	Nm	549	129	24	127	2	Nm	0	Nm	7	Nm	68	Nm	5	Nm
	TBB_DEF_70-99mm_>300hp	3	1800	Nm	768	177	33	135	0	Nm	0	Nm	0	Nm	108	Nm	2	Nm
	TBB_DEF_70-99mm_>300hp	4	876	23	943	368	41	152	0	Nm	0	Nm	3	Nm	88	Nm	53	Nm
	TBB_DEF_70-99mm_≤300hp	1	445	Nm	368	Nm	13	Nm	1	Nm	0	Nm	1	Nm	7	Nm	2	Nm
	TBB_DEF_70-99mm_≤300hp	2	741	Nm	437	Nm	55	Nm	4	Nm	0	Nm	0	Nm	10	Nm	0	Nm
	TBB_DEF_70-99mm_≤300hp	3	1096	Nm	639	Nm	31	Nm	1	Nm	1	Nm	2	Nm	132	Nm	159	Nm
	TBB_DEF_70-99mm_≤300hp	4	236	Nm	288	Nm	46	Nm	3	Nm	3	Nm	1	Nm	43	Nm	0	Nm
	TBB_DEF_100-119mm	1	484	Nm	95	Nm	0	Nm	0	Nm	0	Nm	0	Nm	0	Nm	0	Nm
	TBB_DEF_100-119mm	2	828	Nm	52	Nm	0	Nm	0	Nm	0	Nm	5	Nm	8	Nm	0	Nm
	TBB_DEF_100-119mm	3	1690	Nm	66	Nm	0	Nm	0	Nm	0	Nm	1	Nm	14	Nm	15	Nm
	TBB_DEF_100-119mm	4	1786	Nm	39	Nm	0	Nm	0	Nm	0	Nm	9	Nm	0	Nm	0	Nm
	OTB/OTT_MCD_70-99mm	2	315	Nm	66	Nm	0	Nm	0	Nm	0	Nm	16	Nm	238	Nm	538	Nm
	OTB/OTT_MCD_70-99mm	3	828	Nm	478	Nm	0	Nm	0	Nm	0	Nm	5	Nm	19	Nm	797	Nm
	OTB/OTT_MCD_70-99mm	4	319	Nm	117	Nm	0	Nm	0	Nm	0	Nm	7	Nm	56	Nm	1823	Nm
	OTB/OTT_DEF_70-99mm	1	505	Nm	322	Nm	14	Nm	3	Nm	1	Nm	2	Nm	63	Nm	166	Nm
	OTB/OTT_DEF_70-99mm	2	775	Nm	184	Nm	0	Nm	0	Nm	0	Nm	9	Nm	157	Nm	1188	Nm
	OTB/OTT_DEF_70-99mm	3	822	Nm	433	Nm	0	Nm	0	Nm	1	Nm	14	Nm	34	Nm	333	Nm
	OTB/OTT_DEF_70-99mm	4	629	12	539	106	14	1	1	Nm	0	Nm	9	Nm	47	7	847	403
	OTB/OTT_DEF_100-119mm	1	555	Nm	1541	Nm	0	Nm	0	Nm	2	Nm	4	Nm	3	Nm	3	Nm
	OTB/OTT_DEF_100-119mm	2	880	Nm	360	Nm	0	Nm	0	Nm	1	Nm	2	Nm	4	Nm	0	Nm
	OTB/OTT_DEF_100-119mm	3	1166	Nm	524	Nm	0	Nm	0	Nm	0	Nm	1	Nm	11	Nm	3	Nm

30 **Table 7a.** Average weights (kg) per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier and ICES subdivison (IVb,c) in 2009 and 2010. Nm, not measured (i.e. missing sufficient lengths measurements for discards of *Nephrops*, NEP, to apply length-weight keys).

Year	Métier	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	IVb	57.9	64.7	47.6	53.7	1.6	24.7	0.0	0.3	0.0	7.0	0.1	0.9	1.6	0.5	Nm	0.1
	TBB_DEF_70-99mm_>300hp	IVc	65.5	3.7	101.6	68.0	4.2	24.3	0.2	2.4	0.0	4.0	0.6	2.1	7.8	0.6	0.0	0.0
	TBB_DEF_70-99mm_≤300hp	IVb	21.9	1.5	34.3	5.4	2.4	17.0	0.6	0.3	0.0	0.9	0.0	0.0	4.1	0.0	0.0	0.0
	TBB_DEF_70-99mm_≤300hp	IVc	70.8	1.7	93.6	10.3	12.6	10.2	0.6	0.0	0.0	1.4	0.0	0.0	0.4	0.0	0.0	0.0
	TBB_DEF_100-119mm	IVb	13.2	6.0	8.6	170.4	0.0	6.8	0.0	0.2	0.0	6.9	0.0	0.3	0.1	0.1	Nm	0.0
	OTB/OTT_MCD_70-99mm	IVb	88.7	0.9	62.6	17.9	0.0	0.3	0.0	0.2	0.0	2.1	0.6	2.5	16.5	0.7	Nm	46.8
	OTB/OTT_DEF_70-99mm	IVb	33.5	0.7	32.1	27.3	0.0	0.6	0.0	0.2	0.0	2.0	0.4	2.8	30.1	3.7	Nm	10.8
	OTB/OTT_DEF_100-119mm	IVb	16.4	7.0	37.6	105.4	0.0	0.0	0.0	2.0	0.0	6.1	5.8	4.8	0.3	0.0	0.0	0.0
2010	TBB_DEF_70-99mm_>300hp	IVb	72.1	12.9	49.3	91.4	3.6	20.1	0.0	0.6	0.0	7.0	0.3	0.9	1.9	0.5	Nm	0.1
	TBB_DEF_70-99mm_>300hp	IVc	59.0	6.5	84.4	72.7	3.8	24.4	0.3	3.4	0.0	2.8	1.5	3.5	7.3	1.4	0.0	0.0
	TBB_DEF_70-99mm_≤300hp	IVb	59.1	2.5	49.5	23.9	0.4	4.2	0.0	0.2	0.0	1.5	0.3	0.9	11.0	0.5	Nm	0.0
	TBB_DEF_70-99mm_≤300hp	IVc	28.6	6.2	23.8	6.8	3.6	10.6	0.4	0.9	0.1	1.3	0.1	0.7	1.3	0.1	0.0	0.0
	TBB_DEF_100-119mm	IVb	79.8	10.8	7.9	323.0	0.0	1.1	0.0	0.2	0.0	3.3	0.5	0.2	0.7	0.4	Nm	0.0
	OTB/OTT_MCD_70-99mm	IVb	45.0	0.7	30.7	18.4	0.0	0.3	0.0	0.4	0.0	2.2	1.5	1.4	8.2	0.1	22.8	23.0
	OTB/OTT_DEF_70-99mm	IVb	43.2	1.0	27.1	43.7	0.7	0.7	0.0	0.4	0.0	1.5	1.8	3.6	7.7	2.9	11.8	11.2
	OTB/OTT_DEF_70-99mm	IVc	43.5	11.4	112.7	76.0	4.3	20.0	1.0	2.7	0.4	2.2	0.2	5.4	2.7	0.5	0.0	0.0
	OTB/OTT_DEF_100-119mm	IVb	77.3	12.0	66.5	188.7	0.0	0.1	0.0	0.2	0.2	3.2	0.6	1.8	0.7	0.0	0.0	0.0

36 **Table 7b.** Average numbers per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier and ICES subdivison (IVb,c) in 2009 and 2010. Nm, no landings were measured.

Year	Métier	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	IVB	1208	46	651	208	22	118	0	Nm	0	Nm	1	Nm	33	Nm	82	Nm
	TBB_DEF_70-99mm_>300hp	IVC	1233	16	1161	177	44	110	1	Nm	0	Nm	1	Nm	81	Nm	0	Nm
	TBB_DEF_70-99mm_≤300hp	IVB	603	Nm	613	Nm	35	Nm	4	Nm	0	Nm	0	Nm	36	Nm	0	Nm
	TBB_DEF_70-99mm_≤300hp	IVC	1752	Nm	1641	Nm	198	Nm	3	Nm	0	Nm	0	Nm	3	Nm	0	Nm
	TBB_DEF_100-119mm	IVB	207	Nm	87	Nm	0	Nm	0	Nm	0	Nm	0	Nm	1	Nm	1	Nm
	OTB/OTT_MCD_70-99mm	IVB	1323	Nm	489	Nm	0	Nm	0	Nm	0	Nm	2	Nm	178	Nm	2057	Nm
	OTB/OTT_DEF_70-99mm	IVB	527	8	281	72	0	Nm	0	Nm	0	Nm	2	Nm	274	18	1203	778
	OTB/OTT_DEF_100-119mm	IVB	207	Nm	259	Nm	0	Nm	0	Nm	0	Nm	11	Nm	2	Nm	0	Nm
2010	TBB_DEF_70-99mm_>300hp	IVB	1403	97	735	225	43	84	0	Nm	0	Nm	3	Nm	41	Nm	66	Nm
	TBB_DEF_70-99mm_>300hp	IVC	977	23	994	193	41	148	2	Nm	0	Nm	4	Nm	95	Nm	0	Nm
	TBB_DEF_70-99mm_≤300hp	IVB	1036	Nm	663	Nm	6	Nm	0	Nm	0	Nm	2	Nm	101	Nm	121	Nm
	TBB_DEF_70-99mm_≤300hp	IVC	540	Nm	369	Nm	46	Nm	3	Nm	1	Nm	0	Nm	15	Nm	0	Nm
	TBB_DEF_100-119mm	IVB	1023	Nm	57	Nm	0	Nm	0	Nm	0	Nm	4	Nm	7	Nm	2	Nm
	OTB/OTT_MCD_70-99mm	IVB	573	Nm	289	Nm	0	Nm	0	Nm	0	Nm	8	Nm	67	Nm	1096	Nm
	OTB/OTT_DEF_70-99mm	IVB	624	12	214	106	3	1	0	Nm	0	Nm	9	Nm	70	7	782	403
	OTB/OTT_DEF_70-99mm	IVC	633	Nm	1282	Nm	46	Nm	7	Nm	2	Nm	1	Nm	27	Nm	0	Nm
	OTB/OTT_DEF_100-119mm	IVB	939	Nm	546	Nm	0	Nm	0	Nm	1	Nm	2	Nm	6	Nm	2	Nm

Table 8a. Numbers per hour of discarded benthic species in Dutch bottom-trawl fisheries in 2009.

Métier **Mesh size** **Species**	**TBB_DEF** **70-99**	**TBB_DEF*** **70-99**	**TBB_DEF** **100-119**	**OTB_MCD** **70-99**	**OTB_DEF** **70-99**	**OTB_DEF** **100-119**
Acanthocardia echinata	70	0	1	1	<0.5	1
Aequipecten opercularis	<0.5	0	3	0	0	0
Alcyonidium diaphanum	1	0	6	0	0	0
Alcyonium digitatum	2	0	3	6	5	15
Anthozoa	2	0	2	0	1	0
Aphrodita aculeata	121	0	21	78	126	1
Arctica islandica	3	0	1	4	0	0
Ascidiacea	8	0	0	0	0	1
Asterias rubens	3781	1619	557	292	201	6
Astropecten irregularis	5176	534	2287	210	83	<0.5
Atelecyclus rotundatus	0	0	<0.5	0	0	0
Bolocera tuediae	1	0	0	0	<0.5	0
Buccinum undatum	13	0	94	8	7	4
Cancer pagurus	5	3	1	2	2	2
Carcinus maenas	8	21	0	0	0	0
Cephalopoda	1	0	0	0	0	0
Chamelea gallina	9	0	0	0	0	0
Colus islandicus	0	0	0	1	0	0
Common mussel	3	0	0	0	<0.5	0
Common shrimp	1	5	0	0	0	0
Corystes cassivelaunus	1917	398	67	7	4	<0.5
Crangon sp.	0	0	0	411	0	0
Demospongia	0	0	<0.5	0	0	0
Diogenes pugilator	5	0	0	0	0	0
Echinidae	259	0	38	0	0	0
Echinocardium cordatum	488	2	168	1	1	0
Echinocardium sp.	1133	13	0	0	5	0
Echinus acutus	0	0	15	0	0	0
Ensis siliqua	<0.5	5	<0.5	0	0	0
Ensis sp.	4	33	<0.5	0	0	0
Geryon tridens	0	0	0	2	0	0
Goneplax rhomboides	181	0	17	7	21	0
Halichondria panicea	0	0	2	8	1	0
Hemigrapsus sanguineus	0	0	0	0	0	<0.5
Hyas sp.	0	0	0	0	0	<0.5
Inachus phalangium	<0.5	0	0	0	0	0
Laevicardium crassum	0	6	1	0	0	0
Liocarcinus depurator	170	7	39	329	108	<0.5
Liocarcinus holsatus	1266	1107	143	141	103	2
Liocarcinus marmoreus	38	0	0	0	0	0

Loligo forbesi	0	0	<0.5	0	0	0
Loligo sp.	1	0	0	0	<0.5	0
Loligo subulata	3	3	<0.5	2	<0.5	0
Luidia ciliaris	<0.5	0	0	0	0	0
Lunatia alderi	16	5	1	0	0	0
Lutraria lutraria	<0.5	0	0	0	0	0
Macoma balthica	3	0	0	0	0	0
Macropipus sp.	188	153	4	0	32	0
Macropodia rostrata	<0.5	0	0	0	0	0
Mactra corallina	2	1	<0.5	0	0	0
Necora puber	2	6	0	0	0	0
Neptunea antiqua	0	0	5	10	1	1
Nereis sp.	<0.5	0	0	0	0	0
Ophiothrix fragilis	2	0	0	0	<0.5	0
Ophiura albida	0	14	0	0	0	0
Ophiura ophiura	1401	5706	35	6	<0.5	<0.5
Pagurus bernhardus	140	150	81	150	111	9
Pagurus sp.	119	55	1	82	184	2
Panopea norvegica	0	0	0	0	<0.5	0
Pecten maximus	1	0	0	0	1	<0.5
Pholadidae	0	0	0	1	0	0
Psammechinus miliaris	219	3	<0.5	0	9	0
Sepia officinalis	1	0	0	0	0	0
Sepia sp.	1	0	0	0	<0.5	0
Spatangus purpureus	7	0	0	10	0	0
Spisula sp.	3	48	0	0	0	0
Todaropsis eblanae	<0.5	0	0	1	0	0
Turritella communis	<0.5	0	0	1	0	0

*≤300 hp segment

Table 8b. Numbers per hour of discarded non-target fish species in Dutch bottom-trawl fisheries in 2009.

Métier **Mesh size/hp power** **Species**	**TBB_DEF** **70-99**	**TBB_DEF*** **70-99**	**TBB_DEF** **100-119**	**OTB_MCD** **70-99**	**OTB_DEF** **70-99**	**OTB_DEF** **100-119**
Ammodytes sp.	6	1	5	0	0	0
Anglerfish	<0.5	0	0	1	<0.5	0
Bib	2	0	0	1	<0.5	<0.5
Bull-rout	1	5	1	0	0	<0.5
Dragonet	32	56	7	43	8	<0.5
Five-bearded rockling	<0.5	0	0	1	0	0
Flounder	1	4	0	0	0	<0.5
Four-bearded rockling	4	0	<0.5	3	5	0
Greater sand-eel	2	9	5	0	0	0
Grey gurnard	55	17	37	111	77	15
Haddock	<0.5	0	0	<0.5	0	0
Harbour porpoise	<0.5	0	0	0	0	0
Herring	3	0	0	<0.5	0	0
Hooknose	7	2	2	0	2	0
Horse mackerel	1	<0.5	0	0	0	0
John Dory	<0.5	0	0	0	0	0
Lemon sole	7	0	3	3	9	12
Lesser sand-eel	2	16	0	0	0	0
Lesser spotted dogfish	2	0	0	0	0	<0.5
Lesser weever	18	10	1	0	0	0
Long rough dab	1	0	1	54	19	1
Mackerel	0	0	0	0	<0.5	0
Norwegian topknot	0	0	0	1	0	0
Pilchard	1	0	0	0	0	0
Pomatoschistus sp.	4	3	<0.5	0	0	0
Poor cod	<0.5	0	0	0	0	0
Raja sp.	1	0	2	0	0	0
Red gurnard	0	0	0	0	<0.5	0
Roker	1	0	<0.5	11	0	0
Scaldfish	95	95	11	2	11	0
Sea bass	<0.5	0	0	0	0	0
Smelt	<0.5	0	0	0	0	0
Smoothhound	<0.5	0	0	0	0	0
Snake pipefish	<0.5	0	0	0	0	0
Solenette	115	251	16	0	1	0
Spotted ray	<0.5	0	<0.5	0	1	0
Sprat	1	0	<0.5	<0.5	0	0
Starry ray	<0.5	0	<0.5	0	1	8

Striped red mullet	4	0	<0.5	1	<0.5	0
Three-bearded rockling	1	0	0	1	0	0
Tope	<0.5	0	0	0	0	0
Tub gurnard	8	18	1	1	<0.5	<0.5
Twaite shad	<0.5	0	0	0	0	0
Witch	<0.5	0	0	0	<0.5	0

*≤300 hp segment

Table 8c. Numbers per hour of discarded benthic species in Dutch bottom-trawl fisheries in 2010.

Métier	**TBB_DEF**	**TBB_DEF***	**TBB_DEF**	**OTB_MCD**	**OTB_DEF**	**OTB_DEF**
Mesh size	**70-99**	**70-99**	**100-119**	**70-99**	**70-99**	**100-119**
Species						
Acanthocardia echinata	38	2	14	<0.5	1	1
Aequipecten opercularis	2	<0.5	1	2	1	<0.5
Alcyonidium diaphanum	2	0	42	0	<0.5	0
Alcyonium digitatum	2	0	228	2	2	20
Angulus tenuis	<0.5	0	0	0	0	0
Anthozoa	3	<0.5	1	1	1	<0.5
Aphrodita aculeata	86	20	192	38	58	21
Arctica islandica	4	<0.5	8	1	<0.5	0
Ascidiacea	2	0	5	0	0	0
Ascidiella sp.	0	0	0	0	<0.5	0
Asterias rubens	2301	858	363	97	177	143
Astropecten irregularis	4697	89	1994	11	107	35
Atelecyclus rotundatus	<0.5	0	0	0	0	0
Buccinum undatum	13	<0.5	47	8	6	4
Callinectes sapidus	0	0	0	0	1	0
Cancer pagurus	10	1	9	7	2	7
Carcinus maenas	0	6	0	0	<0.5	0
Cerastoderma edule	<0.5	0	0	0	0	0
Chamelea gallina	3	1	0	0	0	<0.5
Chlamys varia	<0.5	0	0	0	0	0
Ciona intestinalis	1	0	1	<0.5	<0.5	0
Common mussel	9	<0.5	15	0	5	0
Common shrimp	43	9	0	0	<0.5	0
Corystes cassivelaunus	382	24	122	3	32	36
Crangon sp.	49	3	0	0	0	0
Crepidula fornicata	<0.5	<0.5	0	0	0	<0.5
Demospongia	<0.5	0	0	0	1	0
Diphasia sp.	0	0	0	0	<0.5	0
Donax vittatus	<0.5	<0.5	0	0	0	0
Dosinia lupinus	0	0	<0.5	0	0	0
Echinidae	14	<0.5	22	0	1	3
Echinocardium cordatum	292	2	10	2	25	0
Echinocardium sp.	159	1	5	0	1	<0.5
Echinocyamus pusillus	<0.5	0	0	0	0	0
Echinus esculentus	0	0	<0.5	0	0	0
Echinus sp.	0	0	<0.5	0	0	0
Echiurus echiurus	0	0	0	0	<0.5	0
Ectoprocta	<0.5	0	0	0	0	0

Eledone cirrhosa	0	0	18	0	0	0
Ensis siliqua	0	0	2	0	0	0
Ensis sp.	2	1	<0.5	0	<0.5	1
Fabulina fabula	0	<0.5	0	0	0	0
Flustra foliacea	4	0	0	<0.5	0	6
Gari fervensis	<0.5	0	0	0	0	0
Gari sp.	10	0	0	0	0	0
Gele spons	<0.5	0	<0.5	0	0	1
Geryon tridens	0	0	0	<0.5	0	0
Glycymeris glycymeris	<0.5	0	0	0	0	0
Goneplax rhomboides	1320	52	2	4	5	1
Grote rode zeekomkommer	1	0	0	0	0	0
Halichondria panicea	39	0	12	<0.5	1	24
Hinia reticulata	<0.5	<0.5	0	0	0	0
Holothuroidea	<0.5	0	0	0	0	0
Hyas araneus	<0.5	0	0	0	0	0
Hyas coarctatus	0	0	<0.5	0	<0.5	0
Hyas sp.	<0.5	0	0	0	<0.5	<0.5
Hydrallmania falcata	1	0	0	0	0	0
Laevicardium crassum	1	<0.5	<0.5	0	0	0
Lanice conchilega	<0.5	0	0	0	0	0
Leptasterias muelleri	<0.5	0	0	0	0	0
Liocarcinus depurator	174	53	14	192	131	3
Liocarcinus holsatus	1842	631	336	29	110	18
Liocarcinus marmoreus	24	<0.5	0	0	10	0
Loligo forbesi	1	1	0	0	1	0
Loligo sp.	2	<0.5	0	<0.5	<0.5	1
Loligo subulata	<0.5	0	0	0	0	0
Luidia ciliaris	<0.5	0	0	0	0	0
Luidia sarsi	<0.5	0	0	0	0	0
Lunatia alderi	3	4	4	0	0	0
Lunatia catena	<0.5	0	0	0	0	0
Lutraria lutraria	0	<0.5	0	0	<0.5	0
Macoma balthica	1	0	0	0	0	0
Macropodia tenuirostris	1	0	0	0	0	0
Mactra corallina	3	1	3	0	0	0
Mactra sp.	<0.5	0	0	0	0	0
Modiolus modiolus	0	<0.5	0	0	0	0
Mya truncata	0	0	0	<0.5	0	0
Necora puber	8	1	0	<0.5	<0.5	<0.5
Nemertesia sp.	<0.5	0	0	0	0	0
Neptunea antiqua	3	0	24	4	3	2
Nereis sp.	<0.5	0	1	0	0	<0.5
Ophiothrix fragilis	<0.5	0	27	0	2	4

Ophiura albida	3	39	<0.5	0	<0.5	0
Ophiura ophiura	1237	2225	69	8	32	2
Pagurus bernhardus	308	69	203	86	39	3
Pagurus sp.	77	60	74	0	33	15
Palaemon sp.	<0.5	0	0	0	<0.5	0
Pecten maximus	<0.5	0	0	0	0	<0.5
Pisidia longicornis	<0.5	0	0	0	<0.5	0
Psammechinus miliaris	232	18	1	0	0	8
Rossia macrosoma	0	0	0	0	<0.5	0
Scalibregma inflatum	1	0	3	0	1	0
Scaphander lignarius	<0.5	0	0	0	0	0
Sepia officinalis	2	<0.5	0	0	1	0
Sepiola atlantica	0	0	0	0	<0.5	0
Sepiola sp.	0	0	0	0	<0.5	0
Solen marginatus	<0.5	0	0	0	0	0
Spatangus purpureus	245	2	39	0	3	0
Spisula elliptica	<0.5	<0.5	1	0	0	0
Spisula solida	1	0	0	0	<0.5	0
Spisula sp.	3	37	1	0	<0.5	0
Spisula subtruncata	<0.5	1	0	0	0	0
Tubularia larynx	<0.5	<0.5	0	0	0	0
Turritella communis	3	<0.5	0	0	0	0
Venerupis sp.	0	<0.5	0	0	0	0

*≤300 hp segment

Table 8d. Average numbers per hour per trip of discarded non-target fish species in Dutch bottom-trawl fisheries in 2010.

Métier Mesh size Species	TBB_DEF 70-99	TBB_DEF* 70-99	TBB_DEF 100-119	OTB_MCD 70-99	OTB_DEF 70-99	OTB_DEF 100-119
Ammodytes sp.	11	6	15	0	0	0
Anglerfish	<0.5	<0.5	0	0	0	0
Ballan wrasse	0	<0.5	0	0	0	0
Bib	7	1	0	0	1	0
Blonde ray	3	<0.5	0	0	<0.5	1
Blue-mouth	0	0	0	<0.5	0	0
Bull-rout	11	10	10	1	4	5
Cuckoo ray	<0.5	0	0	0	0	0
Dragonet	53	14	9	6	7	2
Five-bearded rockling	2	<0.5	0	0	1	0
Flounder	11	16	0	0	3	1
Four-bearded rockling	8	<0.5	0	1	3	0
Garfish	<0.5	0	0	0	0	0
Greater pipefish	<0.5	<0.5	0	0	0	0
Greater sand-eel	5	2	3	0	0	0
Greater weever	0	<0.5	0	0	<0.5	0
Grey gurnard	81	10	109	47	52	110
Haddock	<0.5	0	0	0	<0.5	0
Hake	0	0	0	<0.5	0	0
Herring	7	1	0	0	1	1
Hooknose	11	3	4	0	<0.5	0
Horse mackerel	7	<0.5	<0.5	0	<0.5	0
Lemon sole	28	1	39	3	6	20
Lesser sand-eel	13	4	9	0	<0.5	<0.5
Lesser spotted dogfish	6	<0.5	0	1	1	1
Lesser weever	19	3	1	0	3	1
Ling	<0.5	0	0	0	0	0
Long rough dab	10	<0.5	4	17	17	8
Lumpsucker	<0.5	<0.5	<0.5	0	<0.5	0
Mackerel	1	<0.5	0	2	0	<0.5
Mustelus sp.	0	0	0	0	<0.5	0
Nilsson's pipefish	0	<0.5	0	0	0	0
Norway goby	<0.5	0	0	0	0	0
Norway pout	<0.5	0	0	0	0	0
Norwegian topknot	1	0	0	0	1	0
Pilchard	2	<0.5	0	0	<0.5	0
Pomatoschistus sp.	1	<0.5	1	0	0	0
Poor cod	<0.5	<0.5	0	0	0	0

Raitt's sand-eel	0	<0.5	0	0	0	0
Raja sp.	<0.5	0	0	0	0	0
Red gurnard	2	0	0	0	0	0
Reticulated dragonet	1	<0.5	<0.5	0	0	0
Roker	2	<0.5	1	2	<0.5	0
Sand goby	2	1	0	0	0	0
Sand sole	<0.5	<0.5	0	0	0	0
Sardinella sp.	<0.5	0	0	0	0	0
Scaldfish	102	28	13	2	11	2
Sea bass	1	<0.5	0	0	0	0
Sea scorpion	<0.5	<0.5	0	0	0	0
Sea-snail	1	<0.5	0	0	0	0
Smelt	2	<0.5	0	0	0	0
Smoothhound	<0.5	0	0	0	<0.5	0
Solenette	127	39	16	1	3	<0.5
Spotted ray	5	<0.5	0	0	1	0
Sprat	9	2	0	0	1	0
Spurdog	0	0	0	<0.5	0	0
Starry ray	1	0	34	3	<0.5	2
Starry smoothhound	<0.5	0	0	<0.5	<0.5	<0.5
Stickleback	0	<0.5	0	0	0	0
Striped red mullet	2	<0.5	0	0	1	0
Thickback sole	<0.5	0	0	0	0	0
Three-bearded rockling	1	<0.5	0	0	<0.5	0
Tub gurnard	9	3	0	2	5	0
Twaite shad	<0.5	<0.5	2	0	0	0
Witch	<0.5	0	0	1	1	0

*<300 hp segment

Table 9a. Average weights (kg) and numbers per hour per trip of landed and discarded (D) plaice (PLE) and sole (SOL) in the beam-trawl fisheries (TBB_DEF_70-99mm_>300hp) between 1976 and 2010.

Year /		PLE						SOL					
		Numbers			Weight			Numbers			Weight		
Period	N trips	L	D	% D	L	D	% D	L	D	% D	L	D	% D
1976-1979	21	253	185	42%	108	28	20%	116	8	6%	32	1	4%
1980-1983	24	309	418	57%	99	51	34%	85	24	22%	19	3	15%
1989-1990	6	392	330	46%	104	46	30%	286	83	22%	48	12	20%
1999	3	145	181	55%	42	18	29%	112	16	13%	32	2	5%
2000	12	194	601	76%	50	47	48%	90	25	22%	22	2	10%
2001	4	364	1184	76%	84	89	51%	82	17	17%	17	1	6%
2002	6	263	868	77%	69	71	51%	126	38	23%	18	3	13%
2003	9	196	945	83%	52	70	57%	95	32	25%	20	3	14%
2004	8	158	792	83%	42	57	57%	175	69	28%	31	7	17%
2005	8	143	710	83%	47	51	52%	99	29	23%	20	2	11%
2006	9	166	997	86%	57	67	54%	64	26	29%	16	2	13%
2007	10	214	700	77%	67	57	46%	94	27	23%	22	2	10%
2008	10	169	902	84%	61	69	53%	95	16	16%	23	1	6%
2009	48	189	917	83%	61	76	55%	113	34	23%	25	3	11%
2010	74	201	872	81%	82	68	45%	132	42	24%	22	4	14%

Table 9b. Average weights (kg) and numbers per hour per trip of landed and discarded (D) dab (DAB) and whiting (WHG) in the beam-trawl fisheries (TBB_DEF_70-99mm_>300hp) between 1976 and 2010. nm, landings were not measured.

Year /		DAB						WHG					
		Numbers			Weight			Numbers			Weight		
Period	N trips	L	D	% D	L	D	% D	L	D	% D	L	D	% D
1976-1979	21	12	917	99%	4	65	95%	10	34	78%	3	5	62%
1980-1983	24	31	796	96%	7	60	90%	21	89	81%	5	11	69%
1989-1990	6	15	2147	99%	2	123	98%	5	122	96%	1	17	95%
1999	3	112	1411	93%	13	106	89%	nm	77		<1	10	93%
2000	12	28	951	97%	6	49	89%	nm	117		2	9	85%
2001	4	125	2268	95%	12	97	89%	nm	69		1	9	86%
2002	6	92	934	91%	11	57	84%	14	104	88%	1	7	85%
2003	9	60	1166	95%	8	64	89%	2	40	96%	<1	3	86%
2004	8	54	1037	95%	7	51	87%	0	46	100%	<1	2	92%
2005	8	25	492	95%	6	52	90%	3	18	85%	<1	2	85%
2006	9	46	2335	98%	9	79	90%	nm	36		<1	3	74%
2007	10	81	1196	94%	12	62	83%	0	10	100%	<1	3	87%
2008	10	51	905	95%	8	49	87%	0	15	100%	<1	3	93%
2009	48	31	1221	98%	32.9	61.9	65%	nm	58		<1	4.8	89%
2010	74	48	1178	96%	9.5	65.2	87%	nm	70		1	4.7	82%

Figures

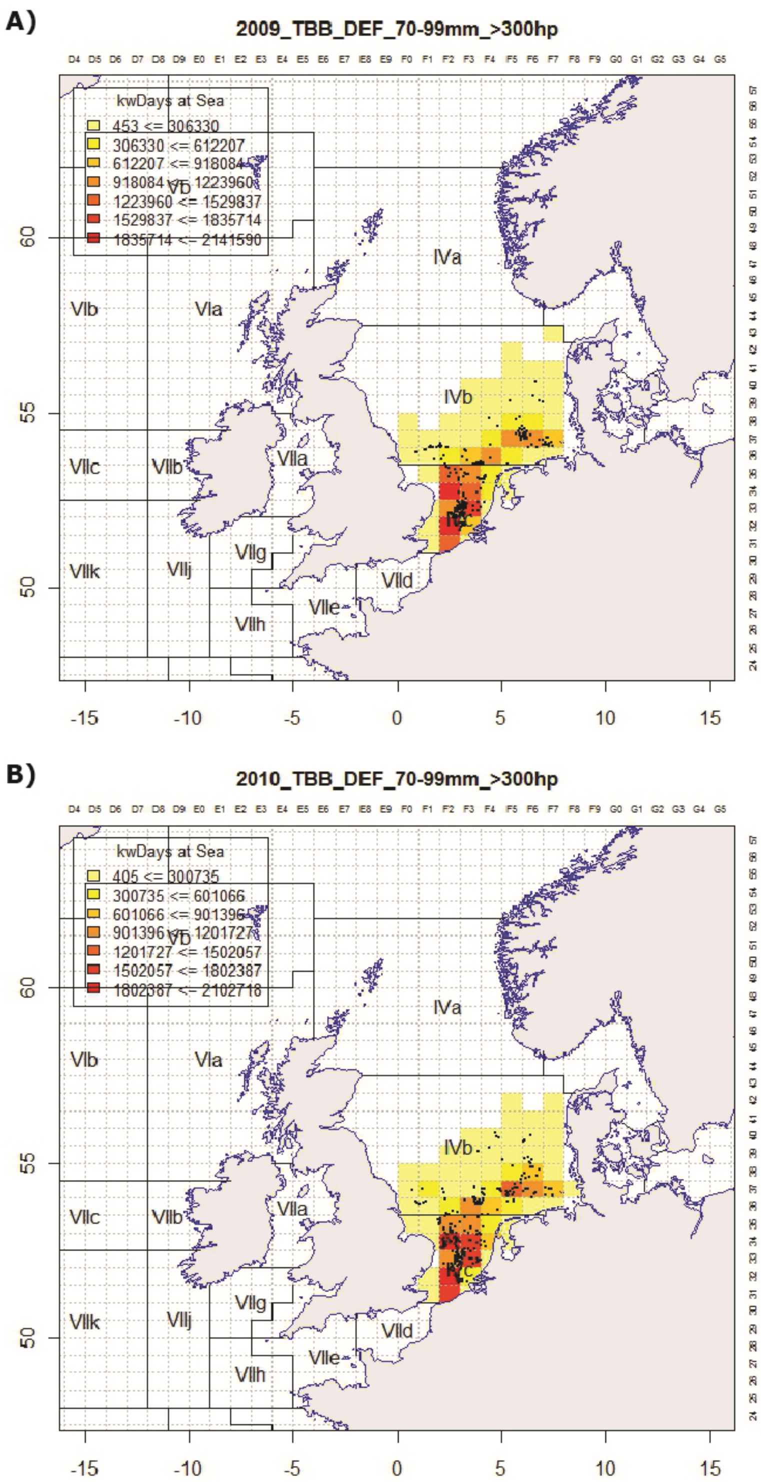
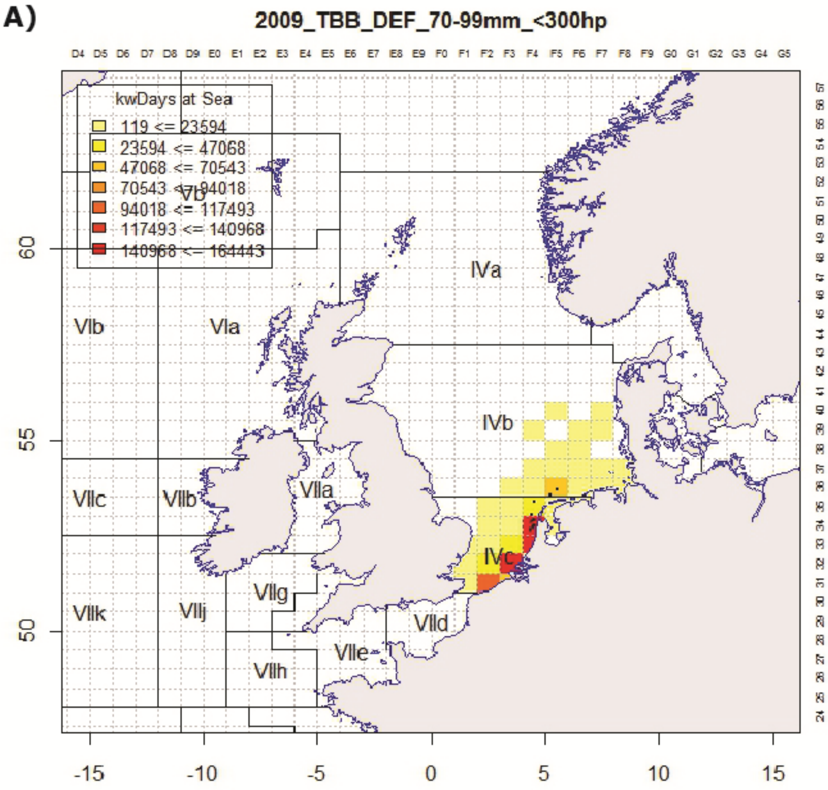


Figure 1a. Distribution of total effort and positions of sampled beam trawls in 2009 (A) and 2010 (B).

A)



B)

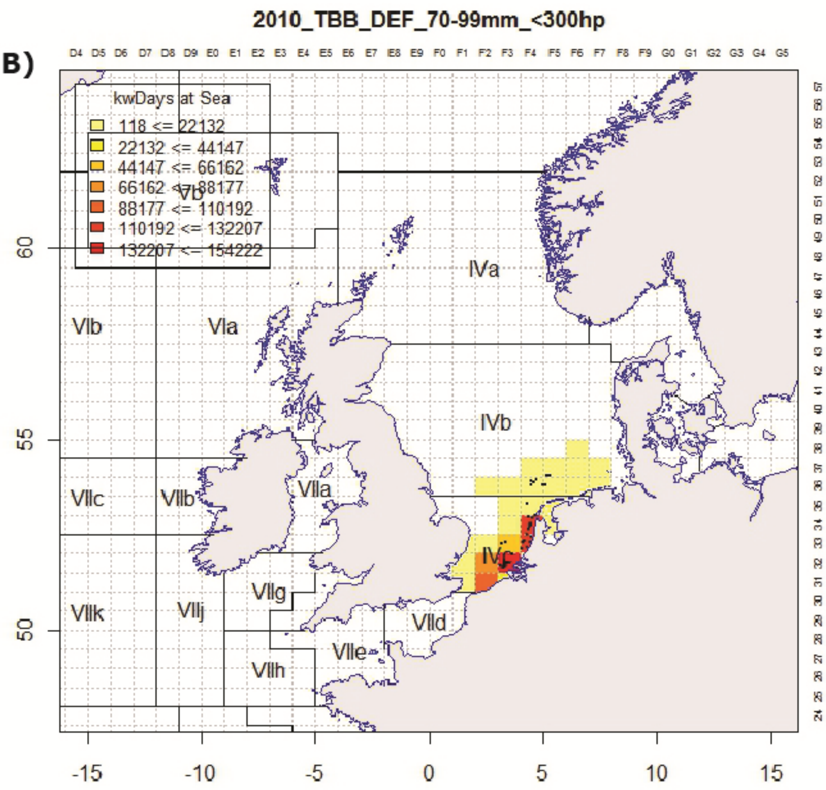


Figure 1b. Distribution of total effort and positions of sampled beam trawls in 2009 (A) and 2010 (B).

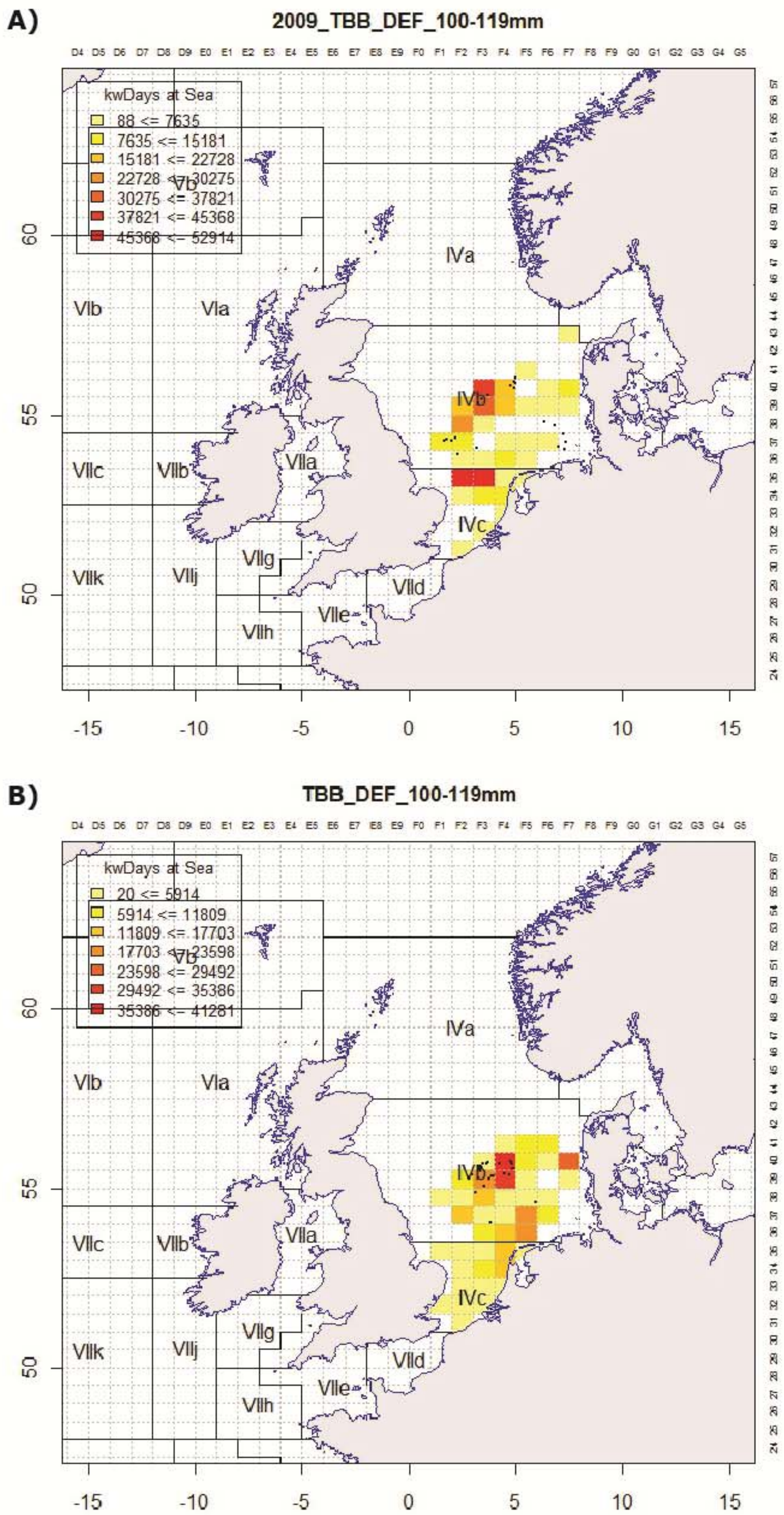


Figure 1c. Distribution of total effort and positions of sampled beam trawls in 2009 (A) and 2010 (B).

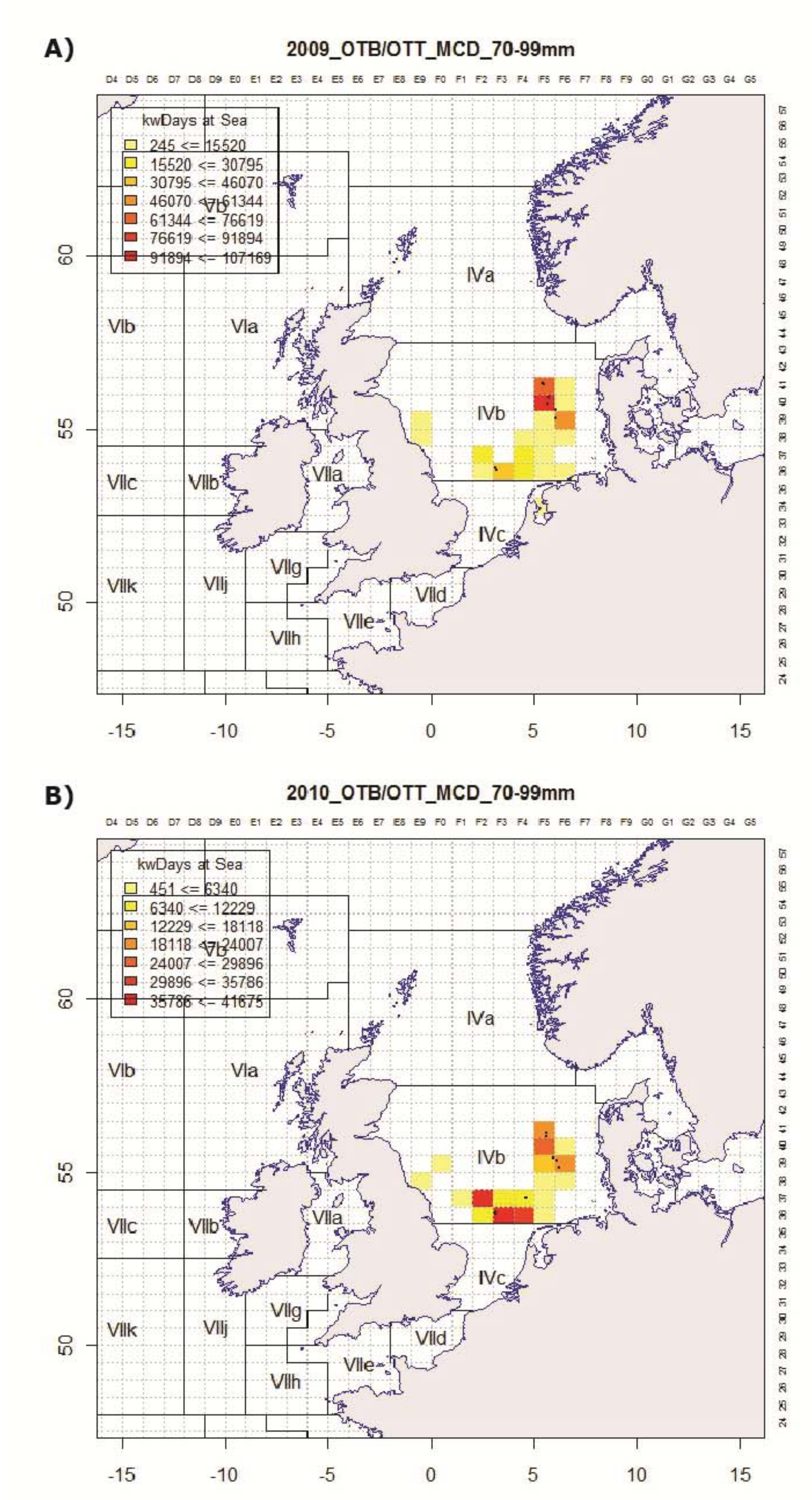


Figure 1d. Distribution of total effort and positions of sampled otter trawls in 2009 (A) and 2010 (B).

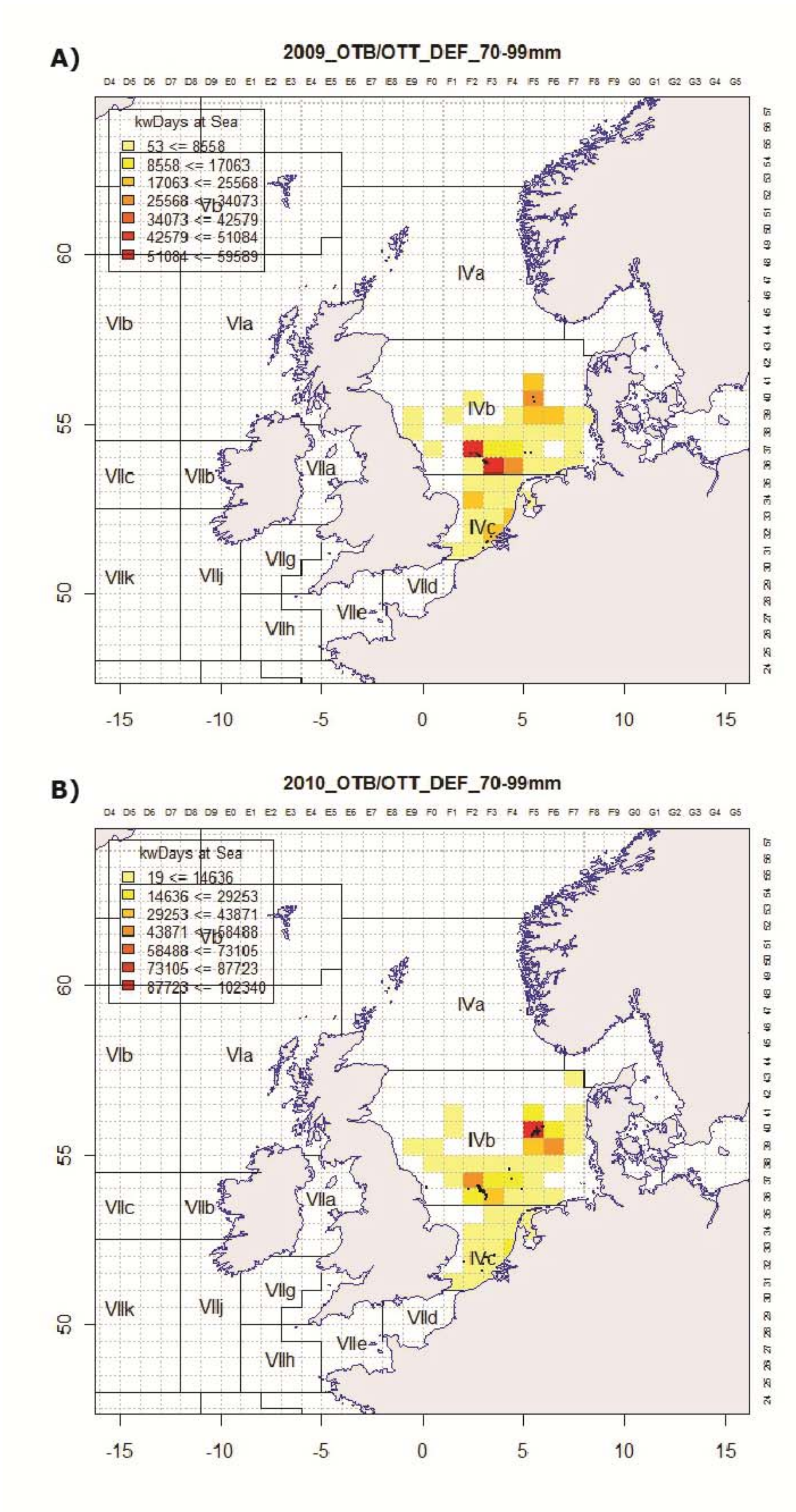


Figure 1e. Distribution of total effort and positions of sampled otter trawls in 2009 (A) and 2010 (B).

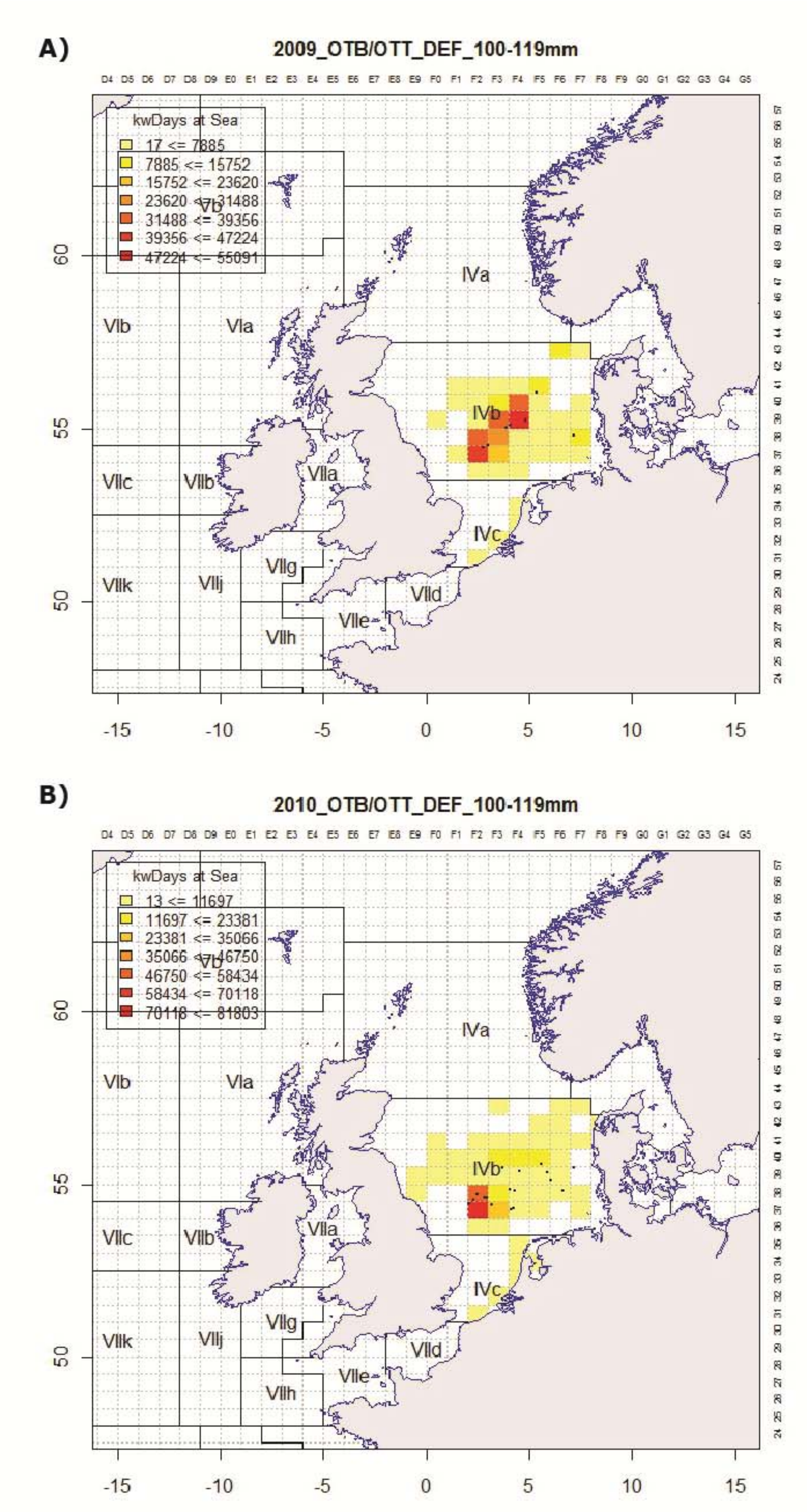


Figure 1f. Distribution of total effort and positions of sampled otter trawls in 2009 (A) and 2010 (B).

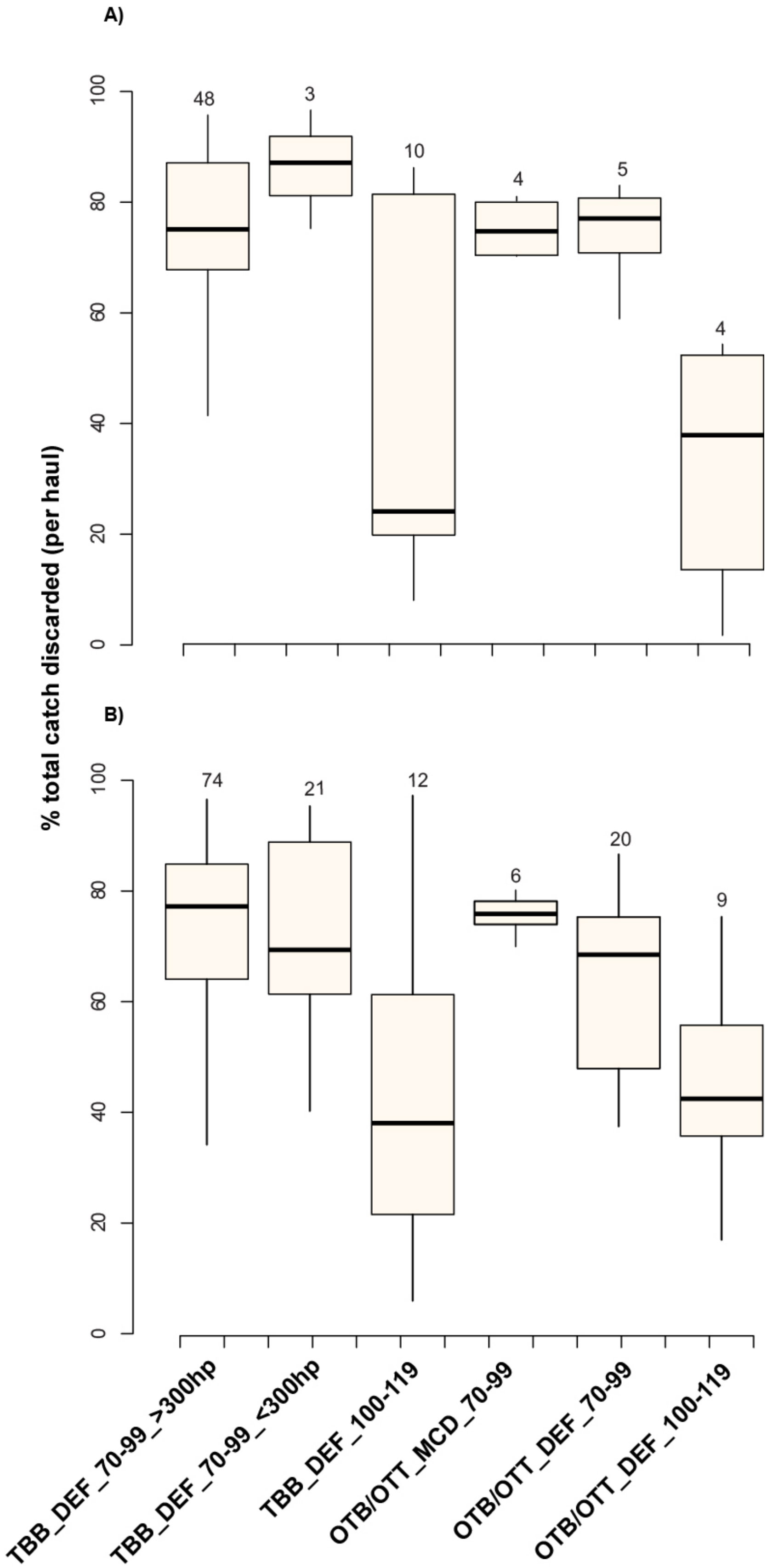


Figure 2. Proportion (in %) of the estimated total catch discarded per haul in each métier in A) 2009 and B) 2010. The number of sampled hauls are given above each boxplot.

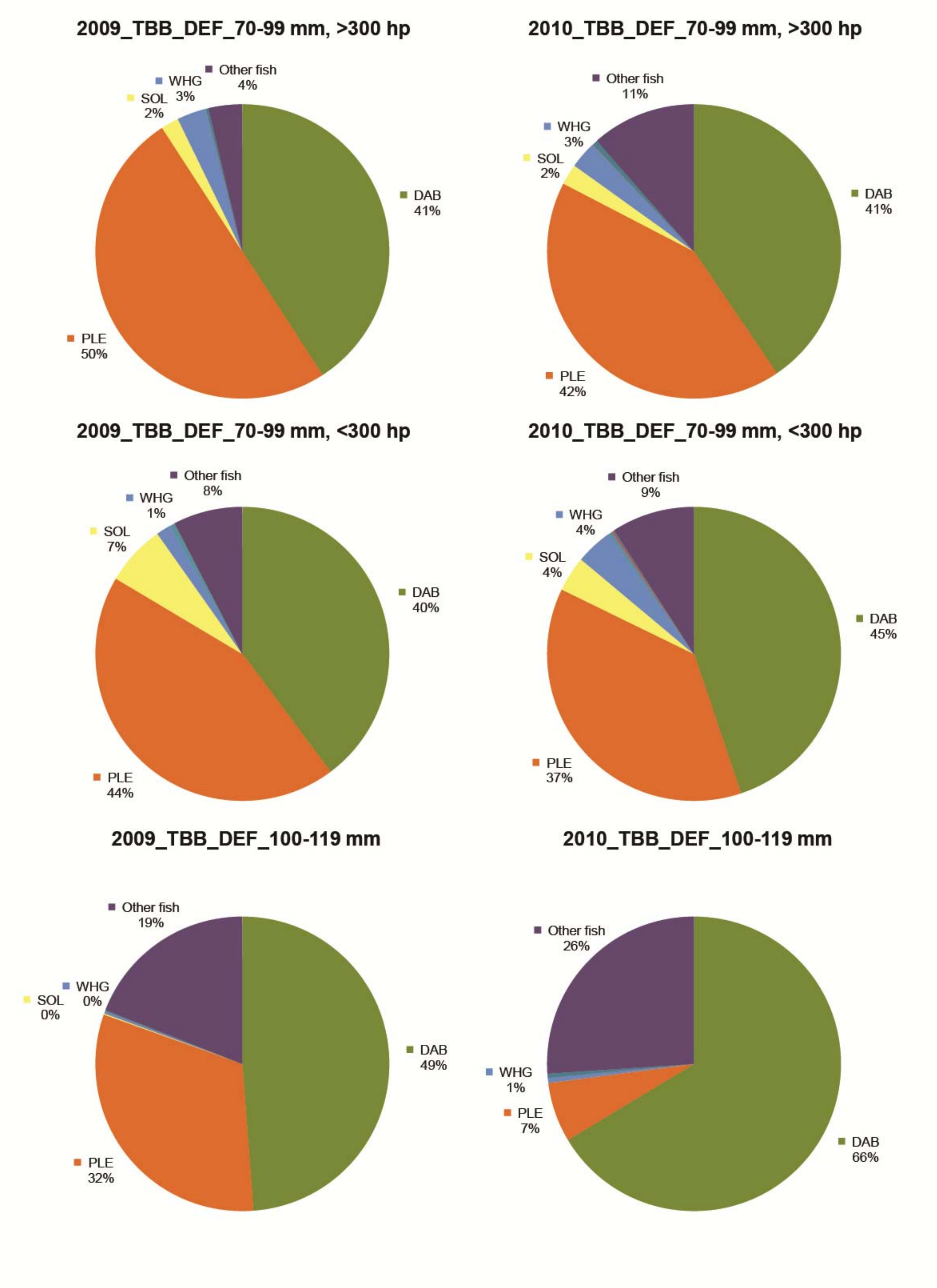


Figure 3a. Composition of average annual fish discard weights (kg per hour, in %) for beam-trawl vessels in 2009 and 2010, respectively.

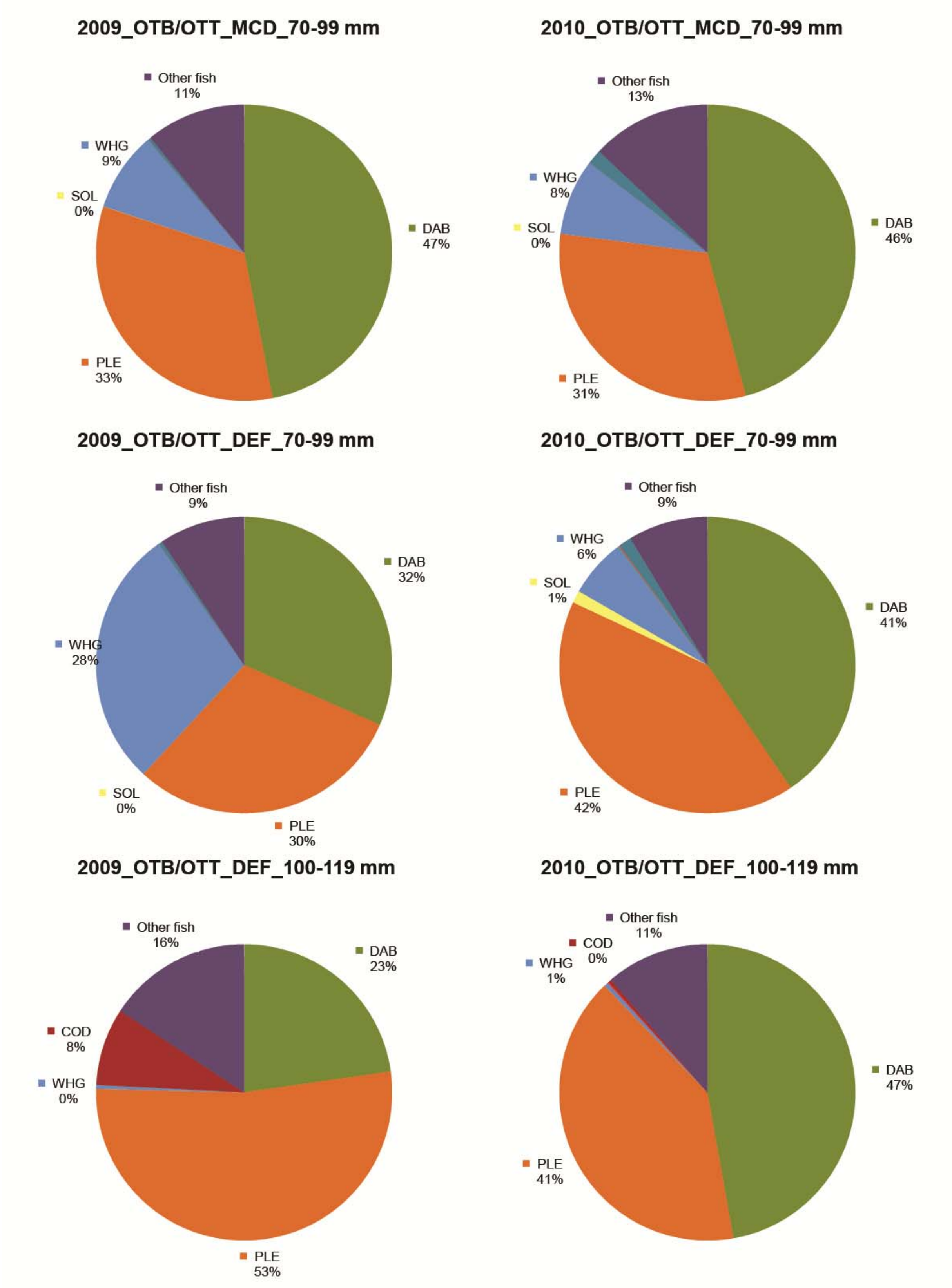


Figure 3b. Composition of average annual fish discard weights (kg per hour, in %) for otter-trawl vessels in 2009 and 2010, respectively.

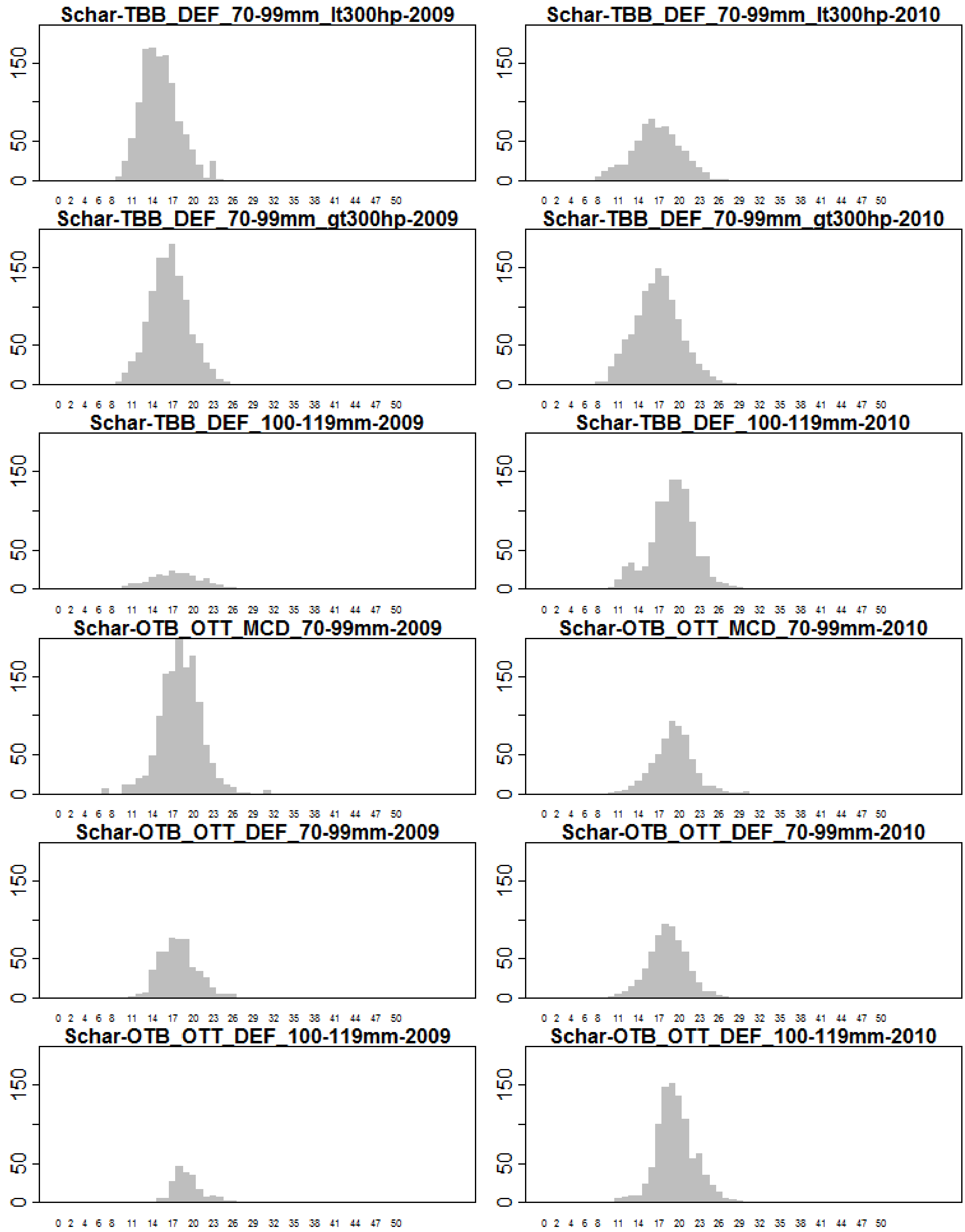


Figure 4a. Length frequency distribution of discarded dab (Dutch name: "Schar") in 2009 (left) and 2010 (right) for each of the relevant métiers. No minimum landing size.

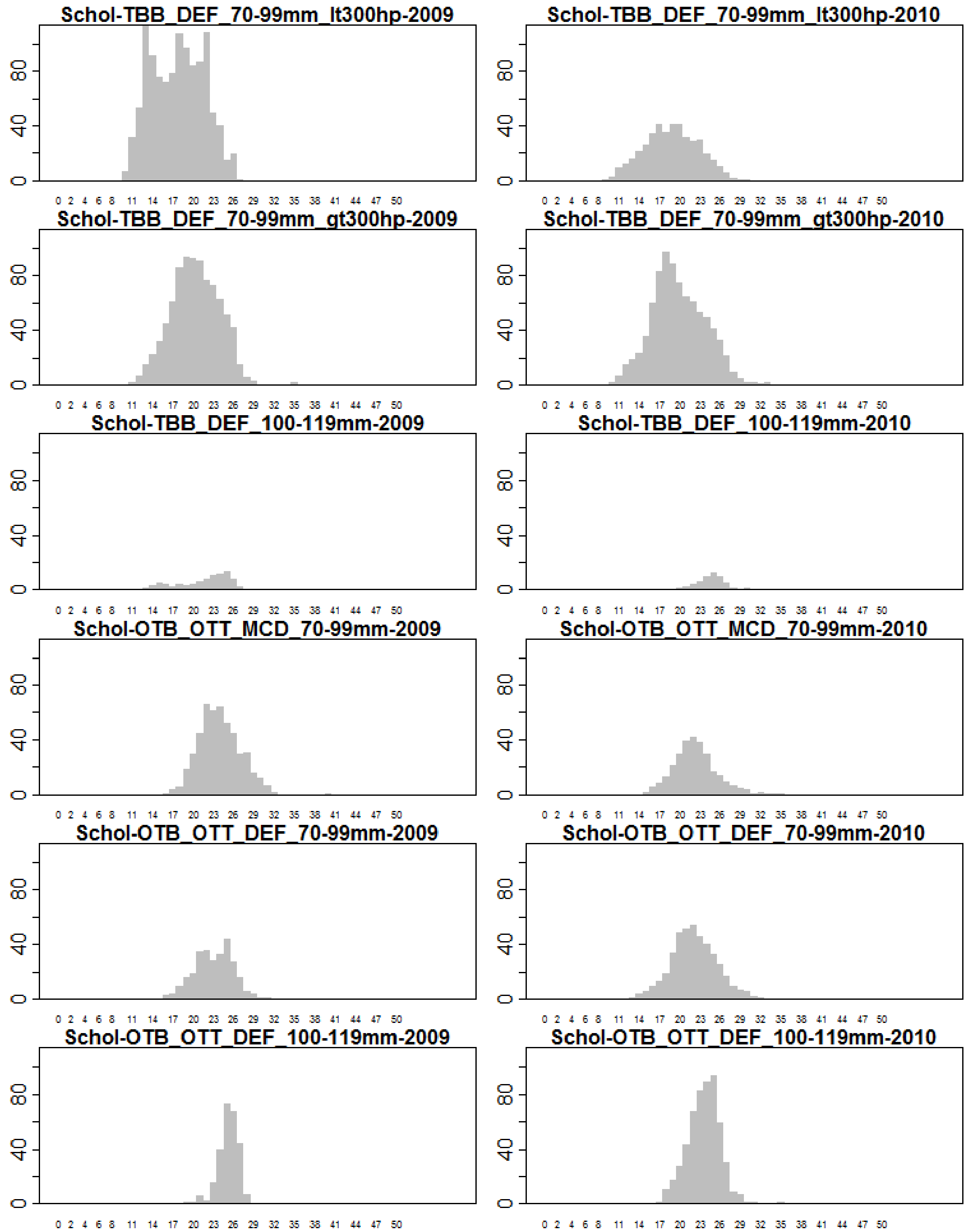


Figure 4b. Length frequency distribution of discarded plaice (Dutch name: "Schol") in 2009 (left) and 2010 (right) for each of the relevant métiers. Minimum landing size: 27 cm.

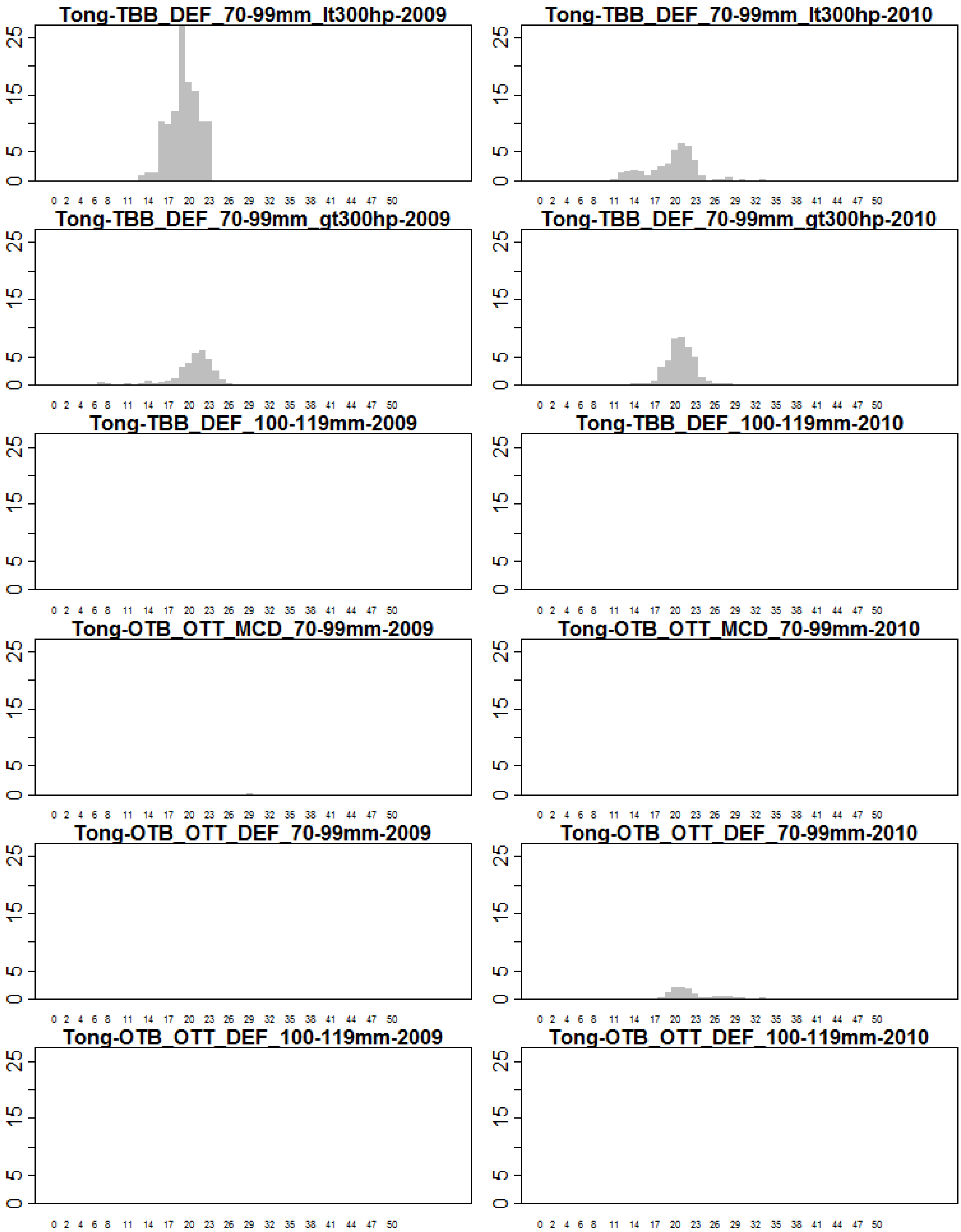


Figure 4c. Length frequency distribution of discarded sole (Dutch name: "Tong") in 2009 (left) and 2010 (right) for each of the relevant métiers. Minimum landing size: 24 cm.

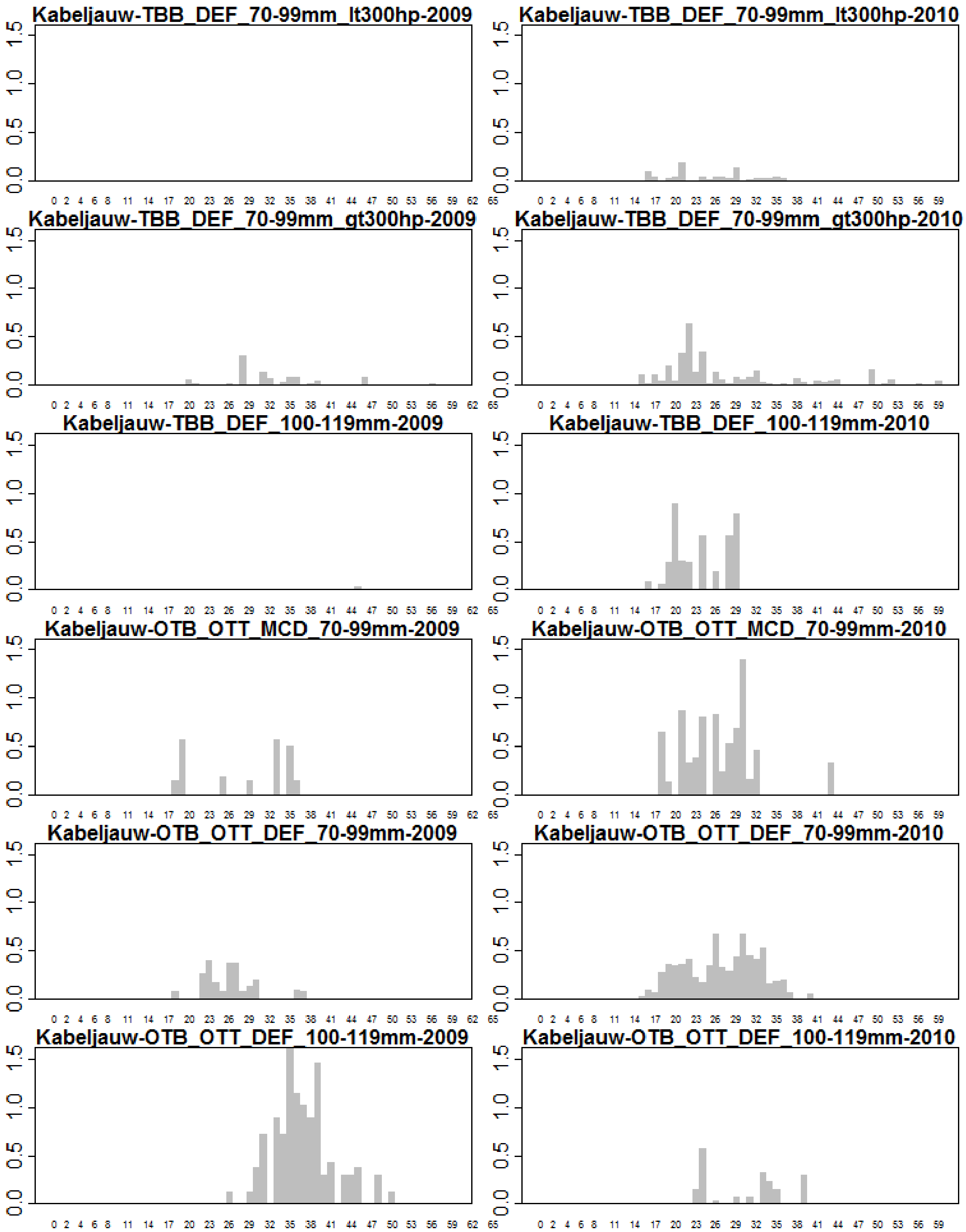


Figure 4d. Length frequency distribution of discarded cod (Dutch name: "Kabeljauw") in 2009 (left) and 2010 (right) for each of the relevant métiers. Minimum landing size: 35 cm.

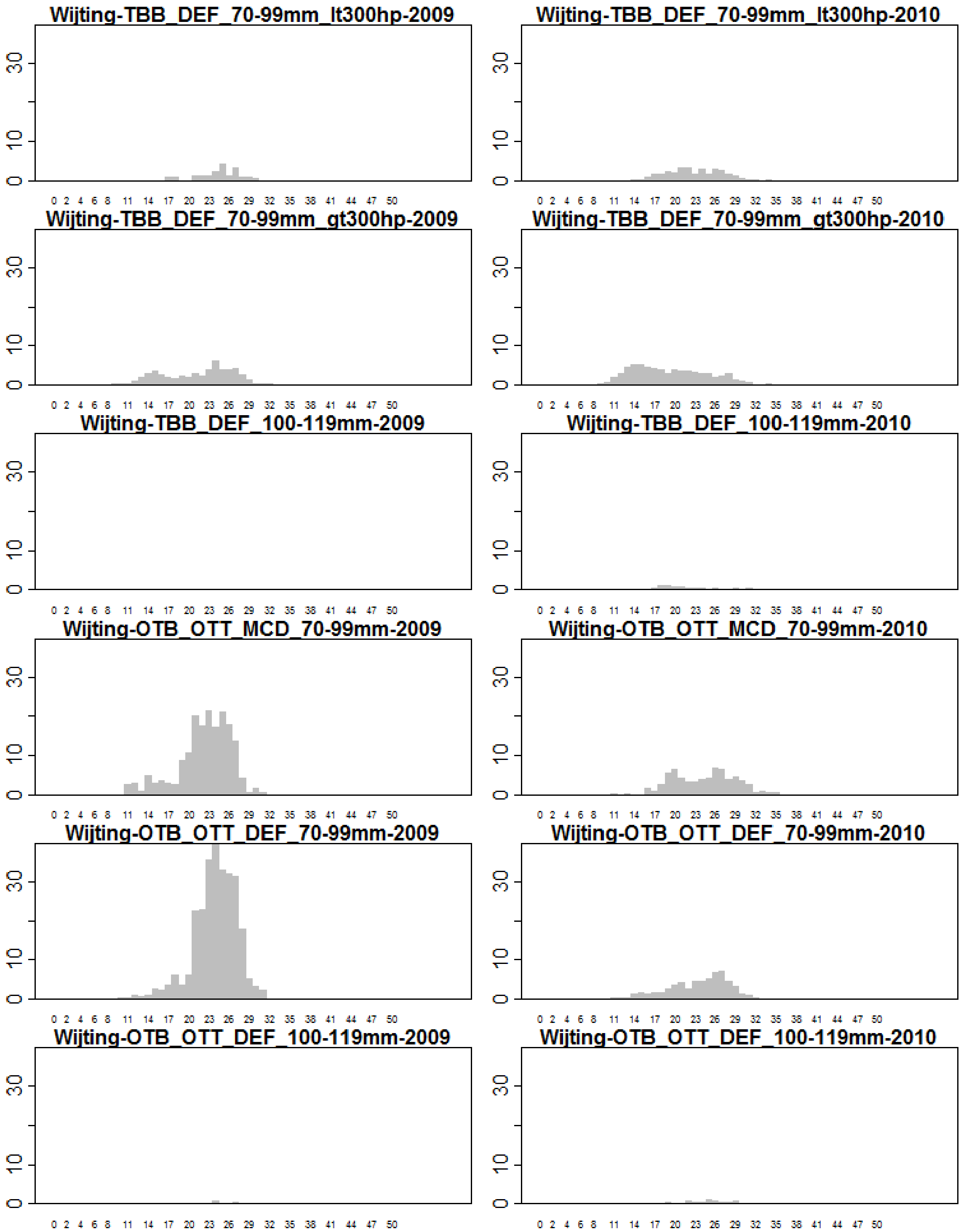


Figure 4e. Length frequency distribution of discarded whiting (Dutch name: “Wijting”) in 2009 (left) and 2010 (right) for each of the relevant métiers. Minimum landing size: 27 cm.

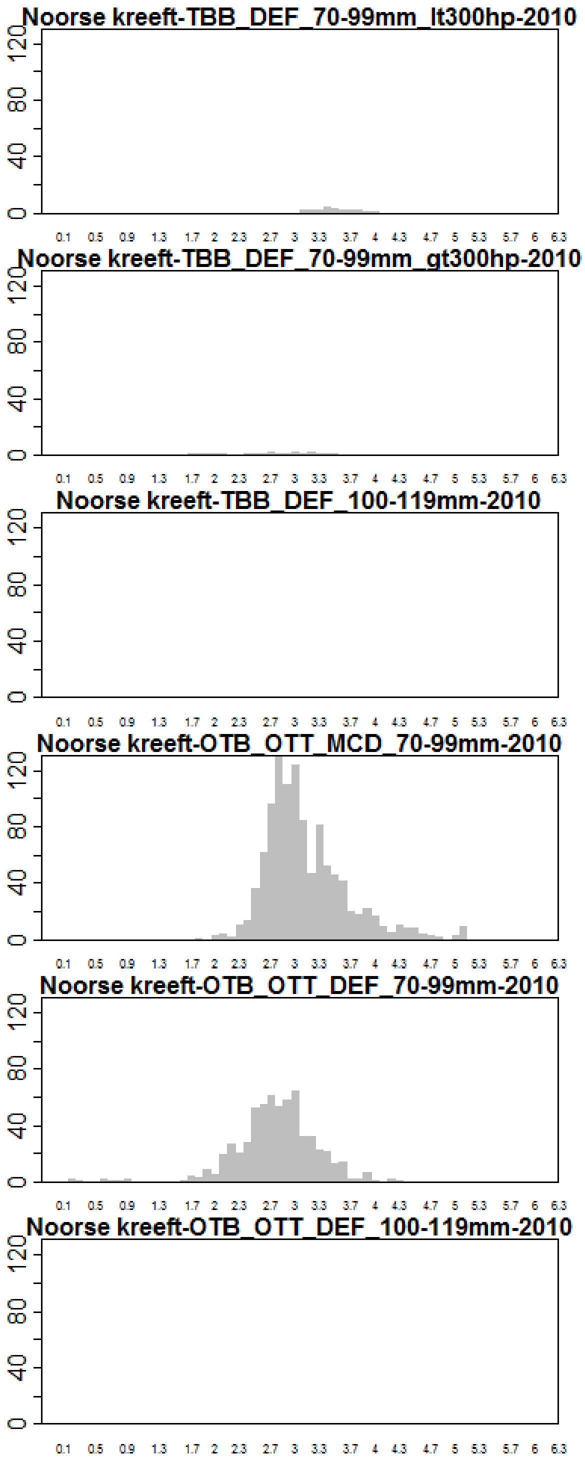


Figure 4f. Carapax length frequency distribution of discarded Norway lobster (Dutch name: "Noorse kreeft") in 2010 (right) for each of the relevant métiers. Minimum landing size: 2.5 cm.

Appendix A:

Query used in the statistical software package R to obtain métier-specific subsets of data:

```
dis_TBB_DEF80 <- eflalo.09[eflalo.09$LE_MET_level6 %in% c('TBB_DEF_70-89_0_0', 'TBB_DEF_70-99_0_0', 'TBB_DEF_90-119_0_0') & eflalo.09$LE_DIV %in% c('IVc', 'IVb'),];

dis_TBB_DEF100 <- eflalo.09[eflalo.09$LE_MET_level6 %in% c('TBB_DEF_100-119_0_0') & eflalo.09$LE_DIV %in% c('IVc', 'IVb'),]

dis_OTB_MCD_80 <- eflalo.09[eflalo.09$LE_MET_level6 %in% c('OTB_MCD_70-99_0_0', 'OTT_MCD_70-99_0_0') & eflalo.09$LE_DIV %in% c('IVc', 'IVb'),]

dis_OTB_DEF_80 <- eflalo.09[eflalo.09$LE_MET_level6 %in% c('OTB_DEF_70-99_0_0', 'OTT_DEF_70-99_0_0', 'OTB_DEF_90-119_0_0') & eflalo.09$LE_DIV %in% c('IVc', 'IVb'),]

dis_OTB_DEF_100 <- eflalo.09[eflalo.09$LE_MET_level6 %in% c('OTB_DEF_100-119_0_0', 'OTT_DEF_100-119_0_0') & eflalo.09$LE_DIV %in% c('IVc', 'IVb'),]
```

Appendix B:

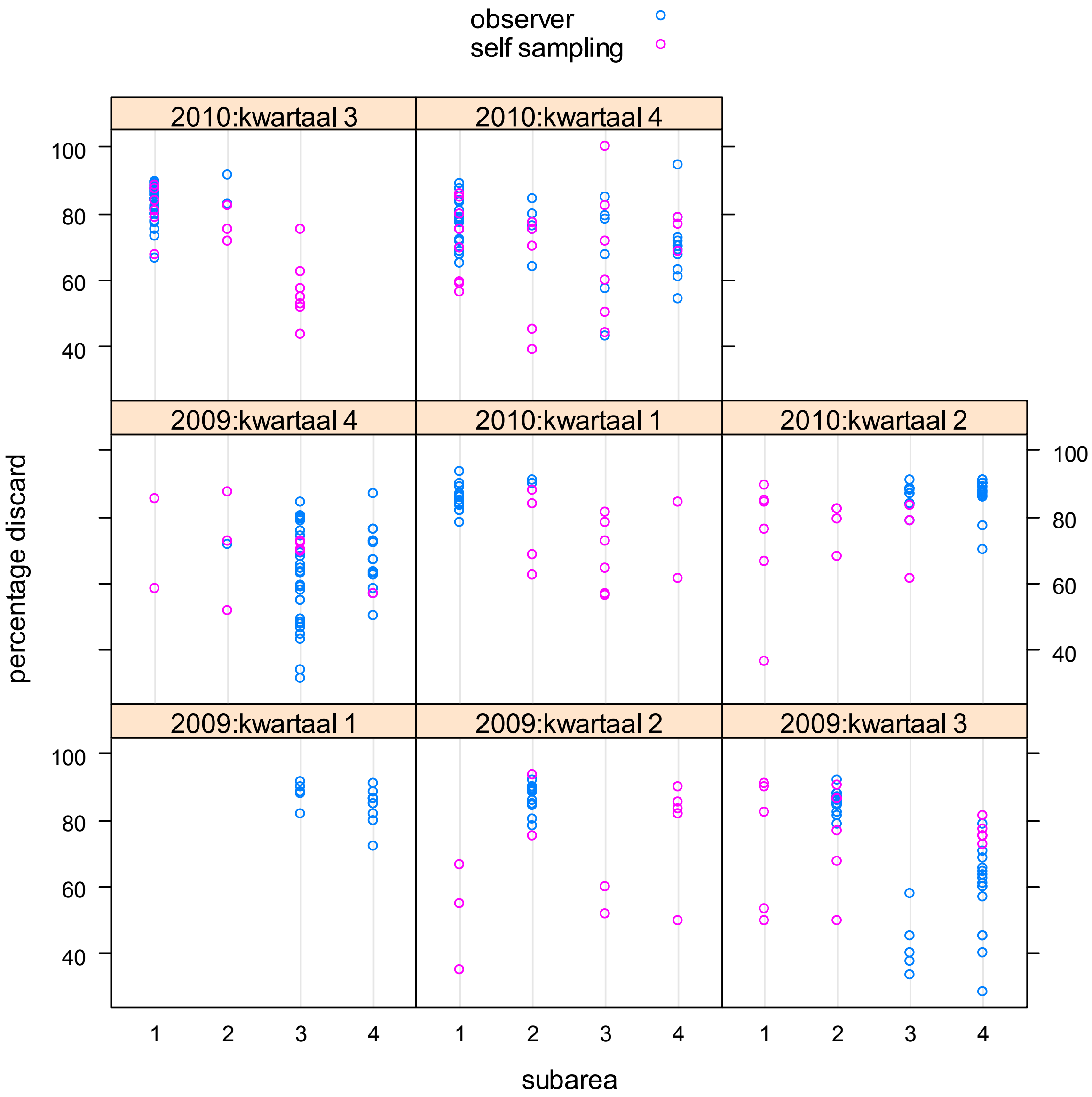


Figure 5. Scatterplot of the estimated percentage of total discards per haul (TBB_DEF_70-99mm_>300hp métier) by discard sampling programme type (observer – blue open circles; self sampling – pink open circles) for each year, quarter (Dutch "kwartaal") and subarea combination in 2009 and 2010. Subareas were defined as: subarea 1 - between latitude>=52.5 and longitude<=3; subarea 2 - between latitude>=52.5 and longitude>3; subarea 3 - between latitude<52.5 and longitude<=3; and subarea 4 - between latitude<52.5 and longitude>3.

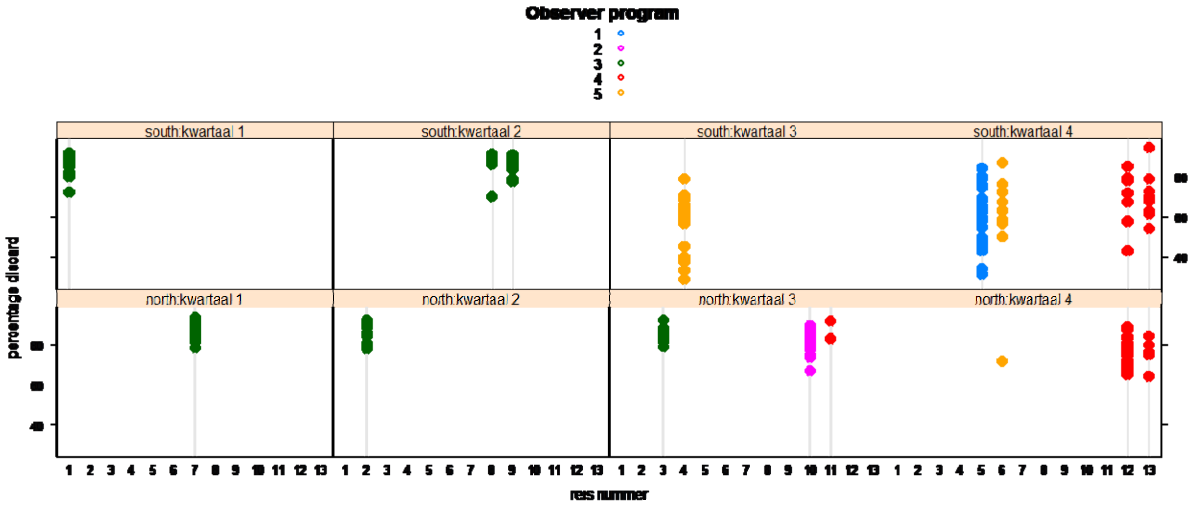


Figure 6. Scatterplot of the estimated percentage of total discards from observed hauls of the TBB_DEF_70-99mm_>300hp métier by subarea and quarter (Dutch "kwartaal") for each of the sea-going observers in the observer programme for both years, 2009 and 2010, combined.

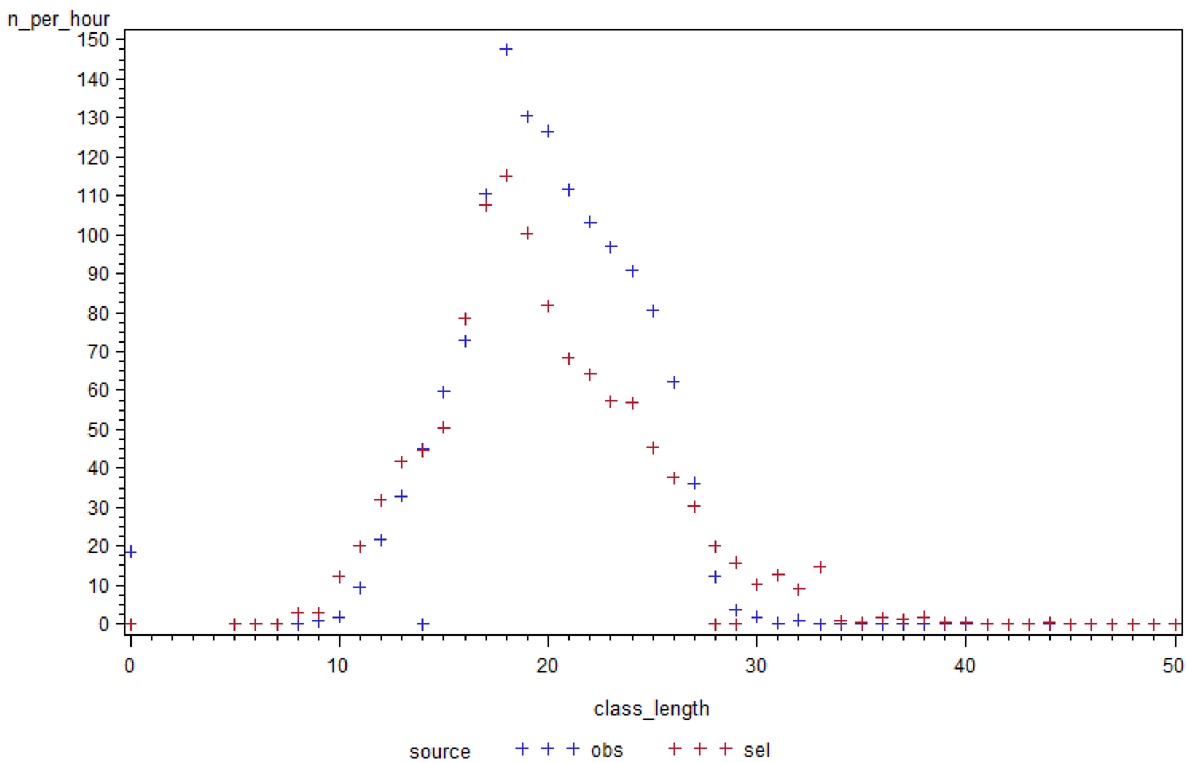


Figure 7. Average numbers-at-length per hour of discarded plaice over all areas and quarters for samples from the observer (blue crosses) and self-sampling programme (red crosses) of the TBB_DEF_70-99_>300hp métier in 2010.

Appendix C:

Table 10a. Characteristics of sampled trips (by TBB_DEF métier) of the observer (obs) and self-sampling programme (self) in 2009. For each trip, the quarter of observation (Q), the total number of hauls (Hauls), the total number of fishing hours (Fish_h), the hours of sampling for landings (Lan_h) and discards (Dis_h) is given. Blank cells, no landings were measured.

TripID	Métier	Prog	Q	Hauls	Fish_h	Lan_h	Dis_h
R107	TBB_DEF_70-99mm_>300hp	obs	1	40	77	16	32
R108	TBB_DEF_70-99mm_>300hp	obs	1	38	69	45	45
R109	TBB_DEF_70-99mm_>300hp	obs	2	44	77	16	28
R110	TBB_DEF_70-99mm_>300hp	obs	2	39	73	54	54
R111	TBB_DEF_70-99mm_>300hp	obs	3	45	75	15	32
R112	TBB_DEF_70-99mm_>300hp	obs	3	48	84	35	35
R113	TBB_DEF_70-99mm_>300hp	obs	4	43	78	46	50
R114	TBB_DEF_70-99mm_>300hp	obs	4	41	77	27	27
S124	TBB_DEF_70-99mm_>300hp	self	1	40	81		4
S146	TBB_DEF_70-99mm_>300hp	self	1	48	80		4
S155	TBB_DEF_70-99mm_>300hp	self	1	44	71		4
S125	TBB_DEF_70-99mm_>300hp	self	2	41	80		4
S126	TBB_DEF_70-99mm_>300hp	self	2	39	80		4
S147	TBB_DEF_70-99mm_>300hp	self	2	46	68		3
S148	TBB_DEF_70-99mm_>300hp	self	2	30	49		2
S149	TBB_DEF_70-99mm_>300hp	self	2	42	70		4
S156	TBB_DEF_70-99mm_>300hp	self	2	45	79		4
S157	TBB_DEF_70-99mm_>300hp	self	2	46	109		4
S164	TBB_DEF_70-99mm_>300hp	self	2	39	73		4
S165	TBB_DEF_70-99mm_>300hp	self	2	47	81		3
S166	TBB_DEF_70-99mm_>300hp	self	2	45	88		2
S173	TBB_DEF_70-99mm_>300hp	self	2	53	72		3
S174	TBB_DEF_70-99mm_>300hp	self	2	49	73		3
S175	TBB_DEF_70-99mm_>300hp	self	2	40	75		4
S127	TBB_DEF_70-99mm_>300hp	self	3	40	81		4
S128	TBB_DEF_70-99mm_>300hp	self	3	39	76		4
S129	TBB_DEF_70-99mm_>300hp	self	3	40	80		4
S150	TBB_DEF_70-99mm_>300hp	self	3	45	76		4
S151	TBB_DEF_70-99mm_>300hp	self	3	46	77		3
S152	TBB_DEF_70-99mm_>300hp	self	3	36	63		4
S158	TBB_DEF_70-99mm_>300hp	self	3	42	71		4
S159	TBB_DEF_70-99mm_>300hp	self	3	46	77		4
S160	TBB_DEF_70-99mm_>300hp	self	3	45	78		3
S170	TBB_DEF_70-99mm_>300hp	self	3	45	93		4
S176	TBB_DEF_70-99mm_>300hp	self	3	37	75		4

S177	TBB_DEF_70-99mm_>300hp	self	3	37	76		3
S178	TBB_DEF_70-99mm_>300hp	self	3	31	66		4
S179	TBB_DEF_70-99mm_>300hp	self	3	41	74		3
S122	TBB_DEF_70-99mm_>300hp	self	4	30	77		7
S130	TBB_DEF_70-99mm_>300hp	self	4	38	77		4
S131	TBB_DEF_70-99mm_>300hp	self	4	37	95		4
S132	TBB_DEF_70-99mm_>300hp	self	4	38	76		4
S153	TBB_DEF_70-99mm_>300hp	self	4	42	75		3
S161	TBB_DEF_70-99mm_>300hp	self	4	45	75		3
S162	TBB_DEF_70-99mm_>300hp	self	4	39	69		4
S163	TBB_DEF_70-99mm_>300hp	self	4	44	77		3
S171	TBB_DEF_70-99mm_>300hp	self	4	32	76		5
S180	TBB_DEF_70-99mm_>300hp	self	4	35	73		4
S138	TBB_DEF_70-99mm_≤300hp	self	2	53	129		5
S139	TBB_DEF_70-99mm_≤300hp	self	2	60	135		5
S117	TBB_DEF_100-119mm	self	2	29	72		5
S182	TBB_DEF_100-119mm	self	2	33	83		4
S183	TBB_DEF_100-119mm	self	2	36	72		4
S118	TBB_DEF_100-119mm	self	3	31	79		5
S119	TBB_DEF_100-119mm	self	3	27	57		4
S167	TBB_DEF_100-119mm	self	3	48	95		4
S168	TBB_DEF_100-119mm	self	3	45	85		4
S169	TBB_DEF_100-119mm	self	3	39	80		4
S184	TBB_DEF_100-119mm	self	3	37	75		4
S185	TBB_DEF_100-119mm	self	3	37	82		5

Table 10b. Characteristics of sampled trips (by OTB/OTT métier) of the observer (obs) and self-sampling programme (self) in 2009. For each trip, the quarter of observation (Q), the total number of hauls (Hauls), the total number of fishing hours (Fish_h), the hours of sampling for landings (Lan_h) and discards (Dis_h). Blank cells, no landings were measured.

TripID	Métier	Prog	Q	Hauls	Fish_h	Lan_h	Dis_h
S187	OTB/OTT_MCD_70-99mm	self	2	13	75		14
S141	OTB/OTT_MCD_70-99mm	self	3	20	102		10
S189	OTB/OTT_MCD_70-99mm	self	3	6	32		10
S191	OTB/OTT_MCD_70-99mm	self	4	10	56		12
R116	OTB/OTT_DEF_70-99mm	obs	3	12	70	70	70
S186	OTB/OTT_DEF_70-99mm	self	2	14	77		4
S140	OTB/OTT_DEF_70-99mm	self	3	17	82		11
S188	OTB/OTT_DEF_70-99mm	self	3	12	72		13
S190	OTB/OTT_DEF_70-99mm	self	4	15	93		13
S133	OTB/OTT_DEF_100-119mm	self	2	22	80		7
S137	OTB/OTT_DEF_100-119mm	self	2	29	143		9
S142	OTB/OTT_DEF_100-119mm	self	3	23	103		9

Table 10c. Characteristics of sampled trips (by TBB_DEF métier) of the observer (obs) and self-sampling programme (self) in 2010. For each trip, the quarter of observation (Q), the total number of hauls (Hauls), the total number of fishing hours (Fish_h), the hours of sampling for landings (Lan_h) and discards (Dis_h) is given. Blank cells, no landings were measured.

TripID	Métier	Prog	Q	Hauls	Fish_h	Lan_h	Dis_h
R192	TBB_DEF_70-99mm_>300hp	obs	1	38	82	17	37
R193	TBB_DEF_70-99mm_>300hp	obs	1	42	79	16	33
R194	TBB_DEF_70-99mm_>300hp	obs	2	38	75	14	30
R195	TBB_DEF_70-99mm_>300hp	obs	2	32	59	10	25
R196	TBB_DEF_70-99mm_>300hp	obs	3	37	66	31	56
R197	TBB_DEF_70-99mm_>300hp	obs	3	41	84	46	46
R198	TBB_DEF_70-99mm_>300hp	obs	4	43	81	55	55
R199	TBB_DEF_70-99mm_>300hp	obs	4	39	78	28	30
S202	TBB_DEF_70-99mm_>300hp	self	1	35	80		5
S203	TBB_DEF_70-99mm_>300hp	self	1	35	84		5
S204	TBB_DEF_70-99mm_>300hp	self	1	32	69		4
S213	TBB_DEF_70-99mm_>300hp	self	1	46	72		3
S221	TBB_DEF_70-99mm_>300hp	self	1	29	59		5
S222	TBB_DEF_70-99mm_>300hp	self	1	41	82		4
S223	TBB_DEF_70-99mm_>300hp	self	1	40	79		4
S230	TBB_DEF_70-99mm_>300hp	self	1	47	82		4
S231	TBB_DEF_70-99mm_>300hp	self	1	47	80		4
S232	TBB_DEF_70-99mm_>300hp	self	1	41	72		4
S244	TBB_DEF_70-99mm_>300hp	self	1	67	125		4
S245	TBB_DEF_70-99mm_>300hp	self	1	39	83		4
S293	TBB_DEF_70-99mm_>300hp	self	1	36	63		4
S294	TBB_DEF_70-99mm_>300hp	self	1	37	63		4
S297	TBB_DEF_70-99mm_>300hp	self	1	35	61		3
S298	TBB_DEF_70-99mm_>300hp	self	1	46	86		3
S305	TBB_DEF_70-99mm_>300hp	self	1	40	89		4
S306	TBB_DEF_70-99mm_>300hp	self	1	38	89		5
S314	TBB_DEF_70-99mm_>300hp	self	1	31	60		4
S315	TBB_DEF_70-99mm_>300hp	self	1	31	66		5
S205	TBB_DEF_70-99mm_>300hp	self	2	31	76		5
S214	TBB_DEF_70-99mm_>300hp	self	2	48	80		3
S233	TBB_DEF_70-99mm_>300hp	self	2	47	83		4
S234	TBB_DEF_70-99mm_>300hp	self	2	34	57		2
S246	TBB_DEF_70-99mm_>300hp	self	2	43	86		4
S247	TBB_DEF_70-99mm_>300hp	self	2	42	76		4
S295	TBB_DEF_70-99mm_>300hp	self	2	40	71		3
S299	TBB_DEF_70-99mm_>300hp	self	2	48	79		4
S307	TBB_DEF_70-99mm_>300hp	self	2	45	86		4
S308	TBB_DEF_70-99mm_>300hp	self	2	50	101		4
S316	TBB_DEF_70-99mm_>300hp	self	2	40	67		3
S317	TBB_DEF_70-99mm_>300hp	self	2	36	66		4

S215	TBB_DEF_70-99mm_>300hp	self	3	39	76		4
S216	TBB_DEF_70-99mm_>300hp	self	3	38	76		4
S226	TBB_DEF_70-99mm_>300hp	self	3	33	66		4
S235	TBB_DEF_70-99mm_>300hp	self	3	47	81		4
S236	TBB_DEF_70-99mm_>300hp	self	3	46	81		3
S237	TBB_DEF_70-99mm_>300hp	self	3	48	84		3
S248	TBB_DEF_70-99mm_>300hp	self	3	45	85		4
S284	TBB_DEF_70-99mm_>300hp	self	3	26	86		4
S296	TBB_DEF_70-99mm_>300hp	self	3	40	62		3
S300	TBB_DEF_70-99mm_>300hp	self	3	43	71		3
S301	TBB_DEF_70-99mm_>300hp	self	3	47	72		3
S309	TBB_DEF_70-99mm_>300hp	self	3	46	87		4
S318	TBB_DEF_70-99mm_>300hp	self	3	37	72		4
S319	TBB_DEF_70-99mm_>300hp	self	3	34	70		4
S210	TBB_DEF_70-99mm_>300hp	self	4	30	68		2
S211	TBB_DEF_70-99mm_>300hp	self	4	68	171		5
S218	TBB_DEF_70-99mm_>300hp	self	4	36	68		2
S219	TBB_DEF_70-99mm_>300hp	self	4	44	74		3
S227	TBB_DEF_70-99mm_>300hp	self	4	39	77		4
S228	TBB_DEF_70-99mm_>300hp	self	4	33	67		4
S229	TBB_DEF_70-99mm_>300hp	self	4	29	57		4
S238	TBB_DEF_70-99mm_>300hp	self	4	48	84		4
S249	TBB_DEF_70-99mm_>300hp	self	4	39	80		4
S302	TBB_DEF_70-99mm_>300hp	self	4	43	77		3
S303	TBB_DEF_70-99mm_>300hp	self	4	46	77		3
S304	TBB_DEF_70-99mm_>300hp	self	4	96	143		3
S311	TBB_DEF_70-99mm_>300hp	self	4	30	63		5
S312	TBB_DEF_70-99mm_>300hp	self	4	34	79		5
S313	TBB_DEF_70-99mm_>300hp	self	4	35	80		5
S320	TBB_DEF_70-99mm_>300hp	self	4	35	71		4
S321	TBB_DEF_70-99mm_>300hp	self	4	32	73		4
S322	TBB_DEF_70-99mm_>300hp	self	4	35	72		4
S328	TBB_DEF_70-99mm_>300hp	self	4	36	76		4
S329	TBB_DEF_70-99mm_>300hp	self	4	44	88		5
S253	TBB_DEF_70-99mm_≤300hp	self	1	19	46		3
S254	TBB_DEF_70-99mm_≤300hp	self	1	63	174		5
S265	TBB_DEF_70-99mm_≤300hp	self	1	23	50		5
S266	TBB_DEF_70-99mm_≤300hp	self	1	35	75		5
S267	TBB_DEF_70-99mm_≤300hp	self	1	25	49		5
S345	TBB_DEF_70-99mm_≤300hp	self	1	36	61		4
S346	TBB_DEF_70-99mm_≤300hp	self	1	22	43		4
S220	TBB_DEF_70-99mm_≤300hp	self	2	28	44		3
S239	TBB_DEF_70-99mm_≤300hp	self	2	43	79		4
S240	TBB_DEF_70-99mm_≤300hp	self	2	19	40		3
S242	TBB_DEF_70-99mm_≤300hp	self	2	19	130		11
S250	TBB_DEF_70-99mm_≤300hp	self	2	50	88		2

S257	TBB_DEF_70-99mm_≤300hp	self	2	38	80		4
S268	TBB_DEF_70-99mm_≤300hp	self	2	35	71		5
S269	TBB_DEF_70-99mm_≤300hp	self	2	40	86		5
S347	TBB_DEF_70-99mm_≤300hp	self	2	27	47		4
S348	TBB_DEF_70-99mm_≤300hp	self	2	44	77		4
S270	TBB_DEF_70-99mm_≤300hp	self	3	38	84		4
S271	TBB_DEF_70-99mm_≤300hp	self	3	39	93		5
S272	TBB_DEF_70-99mm_≤300hp	self	4	17	36		4
S349	TBB_DEF_70-99mm_≤300hp	self	4	15	27		4
S285	TBB_DEF_100-119mm	self	1	28	65		5
S206	TBB_DEF_100-119mm	self	2	29	73		5
S207	TBB_DEF_100-119mm	self	2	31	76		5
S281	TBB_DEF_100-119mm	self	2	27	61		5
S282	TBB_DEF_100-119mm	self	2	30	67		4
S283	TBB_DEF_100-119mm	self	2	30	61		4
S286	TBB_DEF_100-119mm	self	2	24	57		4
S287	TBB_DEF_100-119mm	self	2	37	66		4
S323	TBB_DEF_100-119mm	self	2	26	61		6
S208	TBB_DEF_100-119mm	self	3	40	89		4
S289	TBB_DEF_100-119mm	self	3	31	64		4
S327	TBB_DEF_100-119mm	self	4	28	74		5

Table 10d. Characteristics of sampled trips (by OTB/OTT métier) of the observer (obs) and self-sampling programme (self) in 2010. For each trip, the quarter of observation (Q), the total number of hauls (Hauls), the total number of fishing hours (Fish_h), the hours of sampling for landings (Lan_h) and discards (Dis_h). Blank cells, no landings were measured.

TripID	Métier	Prog	Q	Hauls	Fish_h	Lan_h	Dis_h
S332	OTB/OTT_MCD_70-99mm	self	2	13	74		11
S259	OTB/OTT_MCD_70-99mm	self	3	10	60		12
S260	OTB/OTT_MCD_70-99mm	self	3	21	123		11
S261	OTB/OTT_MCD_70-99mm	self	3	18	81		9
S333	OTB/OTT_MCD_70-99mm	self	4	12	75		13
S334	OTB/OTT_MCD_70-99mm	self	4	8	47		12
R200	OTB/OTT_DEF_70-99mm	obs	4	5	36	36	36
R201	OTB/OTT_DEF_70-99mm	obs	4	6	43	43	43
S273	OTB/OTT_DEF_70-99mm	self	1	36	81		5
S274	OTB/OTT_DEF_70-99mm	self	1	25	55		2
S330	OTB/OTT_DEF_70-99mm	self	1	10	66		14
S331	OTB/OTT_DEF_70-99mm	self	1	9	66		13
S335	OTB/OTT_DEF_70-99mm	self	1	12	64		12
S336	OTB/OTT_DEF_70-99mm	self	1	10	63		13
S337	OTB/OTT_DEF_70-99mm	self	2	13	73		11
S338	OTB/OTT_DEF_70-99mm	self	2	12	118		9
S341	OTB/OTT_DEF_70-99mm	self	2	12	61		11
S342	OTB/OTT_DEF_70-99mm	self	2	12	56		10
S262	OTB/OTT_DEF_70-99mm	self	4	13	68		11
S263	OTB/OTT_DEF_70-99mm	self	4	10	57		11
S279	OTB/OTT_DEF_70-99mm	self	4	36	94		5
S280	OTB/OTT_DEF_70-99mm	self	4	36	80		5
S339	OTB/OTT_DEF_70-99mm	self	4	10	56		12
S340	OTB/OTT_DEF_70-99mm	self	4	18	173		12
S343	OTB/OTT_DEF_70-99mm	self	4	6	42		11
S344	OTB/OTT_DEF_70-99mm	self	4	13	88		14
S255	OTB/OTT_DEF_100-119mm	self	1	30	141		7
S256	OTB/OTT_DEF_100-119mm	self	2	28	135		9
S258	OTB/OTT_DEF_100-119mm	self	2	33	142		7
S275	OTB/OTT_DEF_100-119mm	self	2	10	37		4
S276	OTB/OTT_DEF_100-119mm	self	2	15	57		8
S277	OTB/OTT_DEF_100-119mm	self	2	13	52		8
S291	OTB/OTT_DEF_100-119mm	self	2	20	67		7
S278	OTB/OTT_DEF_100-119mm	self	3	14	56		8
S292	OTB/OTT_DEF_100-119mm	self	3	22	78		7

Appendix D:

Table 11a. Weights (kg) per hour of discarded (Dis) and landed (Lan) dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) for each sampled trip in the demersal beam-trawl métiers (TBB_DEF), by programme (observer – obs; and self-sampling - self), and ICES Subdivision (IVb and IVc) in 2009.

TripID	Métier	Prog	Q	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
R108	TBB_DEF_70-99mm_>300hp	Obs	1	IVb	81	4	19	51	1	29	0	0	0	3	0	3	3	5	0	0
R107	TBB_DEF_70-99mm_>300hp	Obs	1	IVc	131	4	123	31	6	38	0	2	0	2	0	11	17	1	0	0
R110	TBB_DEF_70-99mm_>300hp	Obs	2	IVb	19	10	17	71	0	15	0	1	0	5	0	2	1	2	0	1
R109	TBB_DEF_70-99mm_>300hp	Obs	2	IVc	61	3	83	23	1	17	0	1	0	3	0	1	3	2	0	0
R111	TBB_DEF_70-99mm_>300hp	Obs	3	IVb	167	5	267	82	8	37	0	1	0	5	0	1	1	0	0	0
R112	TBB_DEF_70-99mm_>300hp	Obs	3	IVc	20	3	42	62	3	21	0	5	0	3	0	0	1	0	0	0
R113	TBB_DEF_70-99mm_>300hp	Obs	4	IVc	14	8	34	90	2	32	0	6	0	5	3	7	16	0	0	0
R114	TBB_DEF_70-99mm_>300hp	Obs	4	IVc	27	1	142	118	10	22	0	5	0	3	0	3	10	0	0	0
S147	TBB_DEF_70-99mm_>300hp	Self	2	IVb	57	2	82	107	1	19	0	0	0	1	0	1	1	3	0	0
S155	TBB_DEF_70-99mm_>300hp	Self	2	IVb	113	5	104	66	12	19	0	0	0	2	0	0	4	0	0	0
S164	TBB_DEF_70-99mm_>300hp	Self	2	IVb	13	15	13	87	0	2	0	0	0	28	0	0	0	0	0	0
S165	TBB_DEF_70-99mm_>300hp	Self	2	IVb	14	0	7	20	0	22	0	0	0	5	0	0	2	0	0	0
S166	TBB_DEF_70-99mm_>300hp	Self	2	IVb	14	0	3	0	0	18	0	0	0	6	0	0	1	0	0	0
S173	TBB_DEF_70-99mm_>300hp	Self	2	IVb	27	269	10	14	1	37	0	0	0	6	0	0	1	0	0	0
S174	TBB_DEF_70-99mm_>300hp	Self	2	IVb	39	22	26	12	1	23	0	1	0	10	0	0	5	0	0	0
S175	TBB_DEF_70-99mm_>300hp	Self	2	IVb	0	185	0	13	0	27	0	0	0	5	0	0	0	0	0	0
S124	TBB_DEF_70-99mm_>300hp	Self	2	IVc	88	5	72	52	9	24	1	2	0	3	3	0	84	5	0	0
S125	TBB_DEF_70-99mm_>300hp	Self	2	IVc	40	5	71	43	3	21	1	2	0	4	1	0	27	4	0	0
S126	TBB_DEF_70-99mm_>300hp	Self	2	IVc	34	2	116	50	6	18	2	2	0	4	0	1	2	1	0	0
S146	TBB_DEF_70-99mm_>300hp	Self	2	IVc	27	2	7	61	1	21	0	0	0	3	0	4	0	0	0	0

S148	TBB_DEF_70-99mm_>300hp	Self	2	IVc	11	3	3	71	0	13	0	0	0	6	0	3	0	1	0	0
S156	TBB_DEF_70-99mm_>300hp	Self	2	IVc	65	3	155	26	2	17	0	0	0	4	0	0	1	0	0	0
S152	TBB_DEF_70-99mm_>300hp	Self	3	IVb	100	4	52	72	2	37	0	0	0	2	0	1	5	2	0	0
S158	TBB_DEF_70-99mm_>300hp	Self	3	IVb	269	4	61	77	1	27	0	1	0	5	0	1	0	0	0	1
S160	TBB_DEF_70-99mm_>300hp	Self	3	IVb	152	2	189	76	1	22	0	1	0	3	3	0	0	0	0	0
S176	TBB_DEF_70-99mm_>300hp	Self	3	IVb	12	166	5	10	0	28	0	0	0	6	0	0	0	0	0	0
S177	TBB_DEF_70-99mm_>300hp	Self	3	IVb	13	214	7	7	0	32	0	0	0	9	0	0	0	0	0	0
S178	TBB_DEF_70-99mm_>300hp	Self	3	IVb	59	237	38	5	2	38	0	0	0	13	0	0	0	0	0	0
S127	TBB_DEF_70-99mm_>300hp	Self	3	IVc	127	8	135	38	2	27	1	2	0	5	4	0	0	0	0	0
S128	TBB_DEF_70-99mm_>300hp	Self	3	IVc	139	9	150	68	13	31	0	5	0	4	0	3	0	0	0	0
S129	TBB_DEF_70-99mm_>300hp	Self	3	IVc	34	3	54	73	5	28	0	4	0	3	0	3	4	0	0	0
S149	TBB_DEF_70-99mm_>300hp	Self	3	IVc	37	7	50	64	1	21	0	0	0	8	0	0	0	0	0	0
S150	TBB_DEF_70-99mm_>300hp	Self	3	IVc	70	2	36	82	1	27	0	1	0	3	0	0	0	0	0	0
S151	TBB_DEF_70-99mm_>300hp	Self	3	IVc	123	3	11	2	2	29	0	1	0	3	0	2	0	0	0	0
S157	TBB_DEF_70-99mm_>300hp	Self	3	IVc	179	7	282	35	2	17	0	2	0	5	0	0	0	0	0	0
S159	TBB_DEF_70-99mm_>300hp	Self	3	IVc	279	8	195	51	1	28	0	2	0	3	0	1	0	0	0	0
S122	TBB_DEF_70-99mm_>300hp	Self	4	IVb	10	4	16	42	0	19	0	2	0	8	0	0	3	0	0	0
S163	TBB_DEF_70-99mm_>300hp	Self	4	IVb	83	3	101	66	5	22	0	1	0	5	0	4	1	0	0	0
S170	TBB_DEF_70-99mm_>300hp	Self	4	IVb	12	0	9	1	0	25	0	0	0	7	0	0	1	0	0	0
S171	TBB_DEF_70-99mm_>300hp	Self	4	IVb	8	0	23	144	0	15	0	0	0	13	0	0	1	0	0	0
S179	TBB_DEF_70-99mm_>300hp	Self	4	IVb	38	338	2	126	0	29	0	0	0	7	0	7	2	0	0	0
S180	TBB_DEF_70-99mm_>300hp	Self	4	IVb	31	0	44	86	2	30	0	0	0	8	0	1	6	0	0	0
S130	TBB_DEF_70-99mm_>300hp	Self	4	IVc	13	2	126	96	12	35	0	5	0	6	0	6	8	0	0	0
S131	TBB_DEF_70-99mm_>300hp	Self	4	IVc	27	1	166	92	9	17	0	4	0	3	3	0	6	0	0	0
S132	TBB_DEF_70-99mm_>300hp	Self	4	IVc	11	1	219	179	3	24	0	6	0	4	0	4	3	1	0	0
S153	TBB_DEF_70-99mm_>300hp	Self	4	IVc	27	1	54	136	3	26	0	1	0	4	0	1	4	0	0	0
S161	TBB_DEF_70-99mm_>300hp	Self	4	IVc	37	2	114	89	1	24	0	2	0	6	0	2	1	0	0	0

S162	TBB_DEF_70-99mm_>300hp	Self	4	IVc	19	0	102	68	10	26	0	1	0	3	0	2	5	0	0	0
S138	TBB_DEF_70-99mm_≤300hp	Self	2	IVb	22	1	34	5	2	17	1	0	0	1	0	0	4	0	0	0
S139	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	71	2	94	10	14	10	1	0	0	1	0	0	0	0	0	0
S117	TBB_DEF_100-119mm	Self	2	IVb	32	11	10	249	0	0	0	0	0	4	0	0	0	0	0	0
S182	TBB_DEF_100-119mm	Self	2	IVb	3	10	6	222	0	0	0	0	0	3	0	0	0	0	0	0
S183	TBB_DEF_100-119mm	Self	2	IVb	25	10	9	273	0	1	0	0	0	4	0	1	1	1	0	0
S118	TBB_DEF_100-119mm	Self	3	IVb	5	3	6	180	0	0	0	0	0	2	0	1	0	0	0	0
S119	TBB_DEF_100-119mm	Self	3	IVb	3	3	0	277	0	0	0	0	0	5	0	0	0	0	0	0
S167	TBB_DEF_100-119mm	Self	3	IVb	6	0	2	0	0	18	0	0	0	7	0	0	0	0	0	0
S168	TBB_DEF_100-119mm	Self	3	IVb	4	0	2	19	0	22	0	0	0	11	0	0	0	0	0	0
S169	TBB_DEF_100-119mm	Self	3	IVb	5	0	6	42	0	19	0	0	0	13	0	0	0	0	0	0
S184	TBB_DEF_100-119mm	Self	3	IVb	34	12	23	232	0	5	0	1	0	8	0	1	0	0	0	0
S185	TBB_DEF_100-119mm	Self	3	IVb	16	12	22	210	0	4	0	0	0	12	0	0	0	0	0	0

Table 11b. Weights (kg) per hour of discarded (Dis) and landed (Lan) dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) for each sampled trip in the demersal otter-trawl métiers (OTB/OTT), by programme (observer – obs; and self-sampling - self), and ICES Subdivision (IVb and IVc) in 2009.

TripID	Métier	Prog	Q	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
S187	OTB/OTT_MCD_70-99mm	Self	2	IVb	56	0	94	9	0	0	0	0	0	2	0	7	59	3	0	23
S141	OTB/OTT_MCD_70-99mm	Self	3	IVb	98	3	26	10	0	1	0	1	0	2	0	0	3	0	0	48
S189	OTB/OTT_MCD_70-99mm	Self	3	IVb	129	0	106	17	0	0	0	0	0	3	1	0	3	0	0	88
S191	OTB/OTT_MCD_70-99mm	Self	4	IVb	72	0	26	36	0	0	0	0	0	1	1	3	1	0	0	30
R116	OTB/OTT_DEF_70-99mm	Obs	3	IVb	55	1	27	27	0	1	0	1	0	2	0	5	22	4	0	28
S186	OTB/OTT_DEF_70-99mm	Self	2	IVb	47	0	16	4	0	1	0	0	0	1	0	8	100	12	0	11
S140	OTB/OTT_DEF_70-99mm	Self	3	IVb	22	2	78	32	0	0	0	0	0	1	2	0	2	0	0	0
S188	OTB/OTT_DEF_70-99mm	Self	3	IVb	34	0	21	4	0	1	0	0	0	2	0	0	3	0	0	0
S190	OTB/OTT_DEF_70-99mm	Self	4	IVb	10	0	18	70	0	1	0	0	0	3	0	2	23	2	0	15
S133	OTB/OTT_DEF_100-119mm	Self	2	IVb	5	4	18	184	0	0	0	0	0	4	1	1	0	0	0	0
S137	OTB/OTT_DEF_100-119mm	Self	2	IVb	11	16	11	15	0	0	0	5	0	12	0	0	0	0	0	0
S142	OTB/OTT_DEF_100-119mm	Self	4	IVb	33	1	84	117	0	0	0	0	0	3	17	14	1	0	0	0

Table 11c. Weights (kg) per hour of discarded (Dis) and landed (Lan) dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) for each sampled trip in the demersal beam-trawl métiers (TBB_DEF), by programme (observer – obs; and self-sampling - self), and ICES Subdivision (IVb and IVc) in 2010.

TripID	Métier	Prog	Q	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
R192	TBB_DEF_70-99mm_>300hp	Obs	1	IVb	58	11	84	62	8	24	0	2	0	4	0	4	1	0	0	1
R193	TBB_DEF_70-99mm_>300hp	Obs	1	IVc	83	2	194	40	3	37	0	2	0	1	0	1	1	0	0	0
R194	TBB_DEF_70-99mm_>300hp	Obs	2	IVc	269	4	154	37	7	29	2	3	0	2	2	8	23	3	0	0
R195	TBB_DEF_70-99mm_>300hp	Obs	2	IVc	81	5	56	52	6	22	1	2	0	3	2	2	10	4	0	0
R197	TBB_DEF_70-99mm_>300hp	Obs	3	IVb	113	2	110	106	1	17	0	3	0	5	1	1	14	1	0	0
R196	TBB_DEF_70-99mm_>300hp	Obs	3	IVc	59	9	13	21	14	48	0	3	0	1	0	0	29	0	0	0
R198	TBB_DEF_70-99mm_>300hp	Obs	4	IVc	38	5	36	77	2	25	0	5	0	2	0	1	7	0	0	0
R199	TBB_DEF_70-99mm_>300hp	Obs	4	IVc	76	5	211	201	16	38	0	4	0	3	1	3	27	8	0	1
S202	TBB_DEF_70-99mm_>300hp	Self	1	IVb	8	10	8	178	1	13	0	0	0	7	0	2	0	0	0	0
S203	TBB_DEF_70-99mm_>300hp	Self	1	IVb	10	7	7	193	0	12	0	3	0	6	0	0	1	0	0	0
S204	TBB_DEF_70-99mm_>300hp	Self	1	IVb	25	10	6	37	2	19	0	1	0	10	0	0	0	0	0	0
S244	TBB_DEF_70-99mm_>300hp	Self	1	IVb	42	5	48	139	4	36	0	0	0	4	0	7	1	0	0	0
S293	TBB_DEF_70-99mm_>300hp	Self	1	IVb	160	11	27	2	6	36	0	0	0	0	1	1	6	6	0	0
S294	TBB_DEF_70-99mm_>300hp	Self	1	IVb	194	9	23	1	1	32	0	0	0	1	0	0	5	7	0	0
S297	TBB_DEF_70-99mm_>300hp	Self	1	IVb	94	12	51	95	2	23	0	1	0	1	0	3	4	4	0	0
S305	TBB_DEF_70-99mm_>300hp	Self	1	IVb	65	0	108	2	5	31	0	0	0	1	0	0	2	0	0	0
S306	TBB_DEF_70-99mm_>300hp	Self	1	IVb	45	0	65	4	54	17	0	0	0	6	0	0	2	0	0	0
S314	TBB_DEF_70-99mm_>300hp	Self	1	IVb	22	12	115	123	2	43	0	0	0	4	0	4	0	0	0	0
S315	TBB_DEF_70-99mm_>300hp	Self	1	IVb	69	42	35	117	2	26	0	0	0	4	0	4	1	0	0	0
S213	TBB_DEF_70-99mm_>300hp	Self	1	IVc	29	20	86	46	1	28	0	1	0	0	0	4	1	4	0	0
S221	TBB_DEF_70-99mm_>300hp	Self	1	IVc	11	1	276	100	2	33	1	5	0	4	0	30	0	3	0	0

S222	TBB_DEF_70-99mm_>300hp	Self	1	IVc	92	8	104	79	5	24	0	5	0	3	0	8	6	0	0	0
S223	TBB_DEF_70-99mm_>300hp	Self	1	IVc	182	6	113	61	5	38	2	3	0	3	0	1	4	0	0	0
S230	TBB_DEF_70-99mm_>300hp	Self	1	IVc	15	4	47	58	2	29	0	6	0	3	15	8	9	2	0	0
S231	TBB_DEF_70-99mm_>300hp	Self	1	IVc	119	3	52	41	7	26	0	3	0	1	13	6	10	1	0	0
S245	TBB_DEF_70-99mm_>300hp	Self	1	IVc	59	10	160	29	1	31	3	3	0	2	0	3	5	6	0	0
S298	TBB_DEF_70-99mm_>300hp	Self	1	IVc	173	10	190	25	2	18	0	1	0	0	0	3	0	1	0	0
S205	TBB_DEF_70-99mm_>300hp	Self	2	IVb	0	10	0	223	0	0	0	0	0	1	0	0	0	0	0	0
S307	TBB_DEF_70-99mm_>300hp	Self	2	IVb	134	0	69	1	4	16	0	0	0	11	3	0	4	0	0	0
S308	TBB_DEF_70-99mm_>300hp	Self	2	IVb	202	12	66	17	0	15	0	2	0	6	0	0	1	0	0	0
S316	TBB_DEF_70-99mm_>300hp	Self	2	IVb	54	36	6	66	0	18	0	0	0	7	0	0	1	0	0	0
S317	TBB_DEF_70-99mm_>300hp	Self	2	IVb	49	64	10	30	0	20	0	0	0	8	0	0	1	0	0	0
S214	TBB_DEF_70-99mm_>300hp	Self	2	IVc	35	29	15	24	2	30	1	1	0	1	1	3	32	0	0	0
S215	TBB_DEF_70-99mm_>300hp	Self	2	IVc	12	15	25	55	1	19	0	2	0	2	2	0	1	4	0	0
S216	TBB_DEF_70-99mm_>300hp	Self	2	IVc	12	12	48	139	3	24	0	6	0	4	12	10	4	1	0	0
S232	TBB_DEF_70-99mm_>300hp	Self	2	IVc	24	3	13	20	2	18	0	4	0	2	1	3	14	3	0	0
S233	TBB_DEF_70-99mm_>300hp	Self	2	IVc	16	2	12	41	1	16	0	2	0	2	4	3	5	1	0	0
S234	TBB_DEF_70-99mm_>300hp	Self	2	IVc	32	2	16	46	4	16	0	5	0	2	0	0	5	0	0	0
S246	TBB_DEF_70-99mm_>300hp	Self	2	IVc	65	2	69	34	2	17	0	0	0	3	0	0	5	2	0	0
S247	TBB_DEF_70-99mm_>300hp	Self	2	IVc	9	3	14	61	0	18	0	3	0	5	0	4	1	3	0	0
S295	TBB_DEF_70-99mm_>300hp	Self	2	IVc	26	3	25	2	1	12	0	2	0	6	0	4	2	0	0	0
S299	TBB_DEF_70-99mm_>300hp	Self	2	IVc	49	6	43	28	5	20	1	2	0	2	2	1	8	5	0	0
S284	TBB_DEF_70-99mm_>300hp	Self	3	IVb	49	0	13	236	0	4	0	0	0	11	1	0	7	0	0	0
S296	TBB_DEF_70-99mm_>300hp	Self	3	IVb	69	5	24	5	0	20	0	1	0	2	0	0	0	0	0	0
S309	TBB_DEF_70-99mm_>300hp	Self	3	IVb	164	0	67	0	5	22	0	0	0	15	0	0	0	0	0	0
S318	TBB_DEF_70-99mm_>300hp	Self	3	IVb	116	24	31	22	7	29	0	0	0	11	0	0	0	0	0	0
S319	TBB_DEF_70-99mm_>300hp	Self	3	IVb	37	3	15	256	0	28	0	0	0	5	0	2	0	0	0	3
S226	TBB_DEF_70-99mm_>300hp	Self	3	IVc	42	15	109	131	1	24	0	5	0	3	0	2	0	0	0	0

S235	TBB_DEF_70-99mm_>300hp	Self	3	IVc	97	19	40	63	0	17	0	4	0	2	0	1	11	0	0	0
S236	TBB_DEF_70-99mm_>300hp	Self	3	IVc	42	8	27	72	2	22	0	5	0	3	0	5	0	0	0	0
S248	TBB_DEF_70-99mm_>300hp	Self	3	IVc	44	5	123	15	3	24	0	2	0	5	0	0	0	0	0	0
S300	TBB_DEF_70-99mm_>300hp	Self	3	IVc	96	6	101	40	1	17	0	2	0	3	0	0	0	0	0	0
S301	TBB_DEF_70-99mm_>300hp	Self	3	IVc	103	12	90	92	1	23	0	2	0	4	0	0	1	0	0	0
S210	TBB_DEF_70-99mm_>300hp	Self	4	IVb	7	3	6	126	0	9	0	1	0	18	0	0	0	0	0	0
S211	TBB_DEF_70-99mm_>300hp	Self	4	IVb	5	9	7	137	2	13	0	0	0	13	1	0	1	0	0	0
S249	TBB_DEF_70-99mm_>300hp	Self	4	IVb	7	0	12	91	1	25	0	2	0	3	0	0	1	0	0	0
S302	TBB_DEF_70-99mm_>300hp	Self	4	IVb	118	3	80	106	1	13	0	2	0	4	0	2	1	0	0	0
S304	TBB_DEF_70-99mm_>300hp	Self	4	IVb	67	5	84	102	2	21	0	3	0	5	0	1	2	0	0	0
S311	TBB_DEF_70-99mm_>300hp	Self	4	IVb	177	1	5	8	0	0	0	0	0	16	4	0	0	0	0	0
S312	TBB_DEF_70-99mm_>300hp	Self	4	IVb	65	0	109	4	2	13	0	0	0	16	0	0	8	0	0	0
S313	TBB_DEF_70-99mm_>300hp	Self	4	IVb	44	0	296	5	2	14	0	0	0	15	0	0	0	0	0	0
S320	TBB_DEF_70-99mm_>300hp	Self	4	IVb	157	104	1	217	0	16	0	0	0	4	0	0	1	0	0	0
S321	TBB_DEF_70-99mm_>300hp	Self	4	IVb	22	17	48	135	4	25	0	0	0	11	0	0	0	0	0	1
S322	TBB_DEF_70-99mm_>300hp	Self	4	IVb	34	23	46	75	4	34	0	0	0	5	0	0	0	0	0	0
S329	TBB_DEF_70-99mm_>300hp	Self	4	IVb	41	0	45	283	3	18	0	0	0	5	0	0	2	0	0	0
S218	TBB_DEF_70-99mm_>300hp	Self	4	IVc	11	4	103	121	9	24	0	10	0	6	1	4	9	1	0	0
S219	TBB_DEF_70-99mm_>300hp	Self	4	IVc	14	1	95	115	9	28	0	1	0	2	2	3	24	1	0	0
S227	TBB_DEF_70-99mm_>300hp	Self	4	IVc	87	6	102	118	10	25	0	5	0	3	0	3	5	0	0	0
S228	TBB_DEF_70-99mm_>300hp	Self	4	IVc	55	0	188	129	4	18	0	6	0	3	0	4	4	0	0	0
S229	TBB_DEF_70-99mm_>300hp	Self	4	IVc	48	0	185	253	5	28	0	6	0	3	0	3	5	1	0	0
S237	TBB_DEF_70-99mm_>300hp	Self	4	IVc	46	4	21	60	3	28	0	4	0	2	0	1	5	0	0	0
S238	TBB_DEF_70-99mm_>300hp	Self	4	IVc	2	2	8	49	2	24	0	4	0	3	0	4	4	0	0	0
S303	TBB_DEF_70-99mm_>300hp	Self	4	IVc	33	7	76	71	1	17	0	2	1	2	1	2	2	0	0	0
S328	TBB_DEF_70-99mm_>300hp	Self	4	IVc	16	0	50	187	3	19	0	0	0	7	0	0	4	0	0	0
S253	TBB_DEF_70-99mm_≤300hp	Self	1	IVb	14	1	28	26	1	5	0	0	0	2	0	0	1	0	0	0

S254	TBB_DEF_70-99mm_≤300hp	Self	1	IVb	5	3	8	23	1	7	0	0	0	1	0	3	0	0	0	0
S346	TBB_DEF_70-99mm_≤300hp	Self	1	IVb	78	1	53	14	0	4	0	0	0	0	0	0	0	0	0	0
S265	TBB_DEF_70-99mm_≤300hp	Self	1	IVc	9	4	15	32	1	5	0	1	0	0	0	3	2	0	0	0
S266	TBB_DEF_70-99mm_≤300hp	Self	1	IVc	20	8	8	3	3	10	1	1	0	0	0	2	0	0	0	0
S345	TBB_DEF_70-99mm_≤300hp	Self	1	IVc	13	2	29	8	0	7	0	0	0	0	0	0	0	0	0	0
S220	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	153	11	104	2	8	6	1	1	0	1	0	0	2	1	0	0
S239	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	40	20	48	3	5	9	0	2	0	1	0	1	1	0	0	0
S240	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	34	9	12	7	1	8	1	1	0	0	0	0	0	0	0	0
S250	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	11	1	7	1	1	18	0	0	0	0	0	0	1	0	0	0
S257	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	69	1	65	6	9	10	1	0	0	0	0	0	2	0	0	0
S267	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	22	11	4	1	7	22	0	1	0	1	0	1	1	0	0	0
S268	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	24	10	4	2	7	21	2	1	0	0	0	2	4	1	0	0
S269	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	10	8	21	8	1	6	0	1	0	2	0	0	0	0	0	0
S347	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	6	0	7	11	0	16	0	0	0	0	0	0	0	0	0	0
S242	TBB_DEF_70-99mm_≤300hp	Self	3	IVb	140	4	109	33	0	1	0	0	0	2	1	0	42	2	0	0
S270	TBB_DEF_70-99mm_≤300hp	Self	3	IVc	6	5	21	4	2	10	0	1	0	1	0	0	0	0	0	0
S348	TBB_DEF_70-99mm_≤300hp	Self	3	IVc	27	0	12	3	5	11	0	0	0	0	0	0	0	0	0	0
S271	TBB_DEF_70-99mm_≤300hp	Self	4	IVc	10	5	25	11	8	7	0	2	1	2	0	0	1	0	0	0
S272	TBB_DEF_70-99mm_≤300hp	Self	4	IVc	10	5	17	10	2	8	0	1	0	1	1	1	8	0	0	0
S349	TBB_DEF_70-99mm_≤300hp	Self	4	IVc	20	4	7	3	1	7	0	0	0	12	0	0	0	0	0	0
S285	TBB_DEF_100-119mm	Self	1	IVb	37	13	12	359	0	3	0	1	0	9	0	1	0	0	0	0
S206	TBB_DEF_100-119mm	Self	2	IVb	4	2	0	202	0	0	0	0	0	4	0	0	0	0	0	0
S207	TBB_DEF_100-119mm	Self	2	IVb	10	1	2	264	0	0	0	0	0	3	0	0	0	0	0	0
S281	TBB_DEF_100-119mm	Self	2	IVb	27	4	4	433	0	0	0	0	0	0	0	0	1	0	0	0
S282	TBB_DEF_100-119mm	Self	2	IVb	43	4	2	365	0	0	0	0	0	0	0	0	0	0	0	0
S283	TBB_DEF_100-119mm	Self	2	IVb	219	0	23	10	0	0	0	0	0	0	3	0	1	0	0	0
S286	TBB_DEF_100-119mm	Self	2	IVb	49	10	7	533	0	1	0	1	0	2	0	0	2	5	0	0

S287	TBB_DEF_100-119mm	Self	2	IVb	156	9	21	501	0	1	0	0	0	5	0	0	2	0	0	0
S323	TBB_DEF_100-119mm	Self	2	IVb	6	13	2	466	0	0	0	0	0	0	0	0	0	0	0	0
S208	TBB_DEF_100-119mm	Self	3	IVb	18	2	2	43	0	6	0	1	0	7	0	1	2	0	0	0
S289	TBB_DEF_100-119mm	Self	3	IVb	228	48	14	428	0	0	0	0	0	4	0	0	0	0	0	0
S327	TBB_DEF_100-119mm	Self	4	IVb	163	22	5	7	0	3	0	0	0	5	2	0	0	0	0	0

Table 11d. Weights (kg) per hour of discarded (Dis) and landed (Lan) dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) for each sampled trip in the demersal otter-trawl métiers (OTB/OTT), by programme (observer – obs; and self-sampling - self), and ICES Subdivision (IVb and IVc) in 2010. Blank cells, no landings were measured.

TripID	Métier	Prog	Q	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
S332	OTB/OTT_MCD_70-99mm	Self	2	IVb	23	0	7	7	0	0	0	0	0	3	4	6	36	1	9	20
S259	OTB/OTT_MCD_70-99mm	Self	3	IVb	61	2	10	18	0	0	0	0	0	2	1	0	1	0	0	11
S260	OTB/OTT_MCD_70-99mm	Self	3	IVb	41	0	61	17	0	1	0	0	0	3	1	0	2	0	10	25
S261	OTB/OTT_MCD_70-99mm	Self	3	IVb	94	3	65	16	0	0	0	1	0	3	1	0	1	0	50	42
S333	OTB/OTT_MCD_70-99mm	Self	4	IVb	13	0	31	21	0	1	0	1	0	2	0	2	7	0	12	12
S334	OTB/OTT_MCD_70-99mm	Self	4	IVb	39	0	10	32	0	0	0	0	0	1	2	1	1	0	57	28
R200	OTB/OTT_DEF_70-99mm	Obs	4	IVb	10	1	4	38	0	0	0	1	0	1	0	2	8	1	9	15
R201	OTB/OTT_DEF_70-99mm	Obs	4	IVb	48	3	21	58	0	0	0	0	0	1	3	1	1	0	5	28
S330	OTB/OTT_DEF_70-99mm	Self	1	IVb	11	1	14	47	11	2	0	0	0	1	0	6	3	0	1	8
S331	OTB/OTT_DEF_70-99mm	Self	1	IVb	10	0	5	14	0	1	0	0	0	0	0	5	11	0	1	6
S335	OTB/OTT_DEF_70-99mm	Self	1	IVb	41	0	58	48	0	2	0	0	0	1	1	5	17	9	7	7
S336	OTB/OTT_DEF_70-99mm	Self	1	IVb	41	1	20	15	0	2	0	0	0	0	0	6	15	3	5	6
S273	OTB/OTT_DEF_70-99mm	Self	1	IVc	55	12	36	89	1	17	1	2	0	1	0	15	1	0	0	0

S274	OTB/OTT_DEF_70-99mm	Self	1	IVc	60	14	55	25	3	26	2	3	1	2	0	2	1	0	0	0
S337	OTB/OTT_DEF_70-99mm	Self	2	IVb	60	1	18	9	0	0	0	1	0	2	3	10	36	21	17	8
S341	OTB/OTT_DEF_70-99mm	Self	2	IVb	34	1	21	16	0	0	0	0	0	2	0	8	7	10	23	16
S338	OTB/OTT_DEF_70-99mm	Self	3	IVb	67	1	77	25	0	0	0	0	1	2	2	4	8	0	2	13
S342	OTB/OTT_DEF_70-99mm	Self	3	IVb	38	1	31	48	0	0	0	0	0	1	1	2	1	1	12	17
S262	OTB/OTT_DEF_70-99mm	Self	4	IVb	90	4	57	34	0	0	0	1	0	4	0	0	0	0	1	14
S263	OTB/OTT_DEF_70-99mm	Self	4	IVb	53	1	26	152	0	0	0	0	0	0	5	0	1	0	1	1
S339	OTB/OTT_DEF_70-99mm	Self	4	IVb	23	0	24	47	0	2	0	1	0	4	1	3	8	0	70	10
S340	OTB/OTT_DEF_70-99mm	Self	4	IVb	128	0	38	27	0	0	0	0	0	1	12	0	4	0	0	9
S343	OTB/OTT_DEF_70-99mm	Self	4	IVb	3	0	3	81	0	1	0	1	0	2	1	5	5	0	35	16
S344	OTB/OTT_DEF_70-99mm	Self	4	IVb	38	2	16	43	0	1	0	0	0	1	0	1	1	0	0	9
S279	OTB/OTT_DEF_70-99mm	Self	4	IVc	28	8	233	98	6	20	0	3	0	2	1	2	4	0	0	0
S280	OTB/OTT_DEF_70-99mm	Self	4	IVc	30	11	128	92	8	17	1	2	0	4	0	3	6	2	0	0
S255	OTB/OTT_DEF_100-119mm	Self	1	IVb	58	23	166	71	0	0	0	1	0	2	1	1	0	0	0	0
S256	OTB/OTT_DEF_100-119mm	Self	2	IVb	49	18	121	89	0	1	0	1	1	3	2	0	1	0	0	0
S258	OTB/OTT_DEF_100-119mm	Self	2	IVb	242	6	21	77	0	0	0	0	0	4	0	0	0	0	0	0
S275	OTB/OTT_DEF_100-119mm	Self	2	IVb	6	21	6	161	0	0	0	0	1	2	0	1	0	0	0	0
S276	OTB/OTT_DEF_100-119mm	Self	2	IVb	38	0	40	279	0	0	0	0	0	0	0	0	2	0	0	0
S277	OTB/OTT_DEF_100-119mm	Self	2	IVb	39	18	34	327	0	0	0	0	0	7	0	1	0	0	0	0
S278	OTB/OTT_DEF_100-119mm	Self	3	IVb	165	23	63	428	0	0	0	0	0	5	1	2	0	0	0	0
S291	OTB/OTT_DEF_100-119mm	Self	3	IVb	60	0	72	144	0	0	0	0	0	4	0	9	1	0	0	0
S292	OTB/OTT_DEF_100-119mm	Self	3	IVb	40	0	77	123	0	0	0	0	0	1	0	3	2	0	0	0

Table 12a. Numbers per hour of discarded (Dis) and landed (Lan) dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) for each sampled trip in the demersal beam-trawl métiers (TBB_DEF), by programme (observer – obs; and self-sampling - self), and ICES Subdivision (IVb and IVc) in 2009.

TripID	Métier	Prog	Q	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis WHG	Lan WHG	Dis COD	Lan COD	Dis NEP	Lan NEP
R108	TBB_DEF_70-99mm_>300hp	Obs	1	IVb	1443		192	164	8	110	0		0		25		0		66	
R107	TBB_DEF_70-99mm_>300hp	Obs	1	IVc	2235	15	1459	102	57	139	0		0		148		1			
R110	TBB_DEF_70-99mm_>300hp	Obs	2	IVb	376	68	279	190	0	56	0		0		13		0		3	
R109	TBB_DEF_70-99mm_>300hp	Obs	2	IVc	1128	17	1102	74	12	79	2		1		29		0			
R111	TBB_DEF_70-99mm_>300hp	Obs	3	IVb	4084	24	3162	268	96	190	1		0		44		0		8	
R112	TBB_DEF_70-99mm_>300hp	Obs	3	IVc	327		496	201	32	92	0		0		8		1			
R113	TBB_DEF_70-99mm_>300hp	Obs	4	IVc	171		320	257	20	155	0		0		126		3			
R114	TBB_DEF_70-99mm_>300hp	Obs	4	IVc	425		1685	253	108	85	0		0		179		0			
S147	TBB_DEF_70-99mm_>300hp	Self	2	IVb	1143		1007		18		0		0		5		0			
S155	TBB_DEF_70-99mm_>300hp	Self	2	IVb	2415		1294		140		0		0		32		0			
S164	TBB_DEF_70-99mm_>300hp	Self	2	IVb	251		229		0		0		0		0		0			
S165	TBB_DEF_70-99mm_>300hp	Self	2	IVb	340		151		2		0		0		21		1			
S166	TBB_DEF_70-99mm_>300hp	Self	2	IVb	454		89		1		0		0		8		0			
S173	TBB_DEF_70-99mm_>300hp	Self	2	IVb	675		299		27		0		0		14		0			
S174	TBB_DEF_70-99mm_>300hp	Self	2	IVb	864		573		57		0		0		57		0			
S175	TBB_DEF_70-99mm_>300hp	Self	2	IVb	0		0		2		0		0		1		0			
S124	TBB_DEF_70-99mm_>300hp	Self	2	IVc	1905		992		76		5		0		766		5			
S125	TBB_DEF_70-99mm_>300hp	Self	2	IVc	784		826		24		3		0		204		3			
S126	TBB_DEF_70-99mm_>300hp	Self	2	IVc	715		1675		47		12		0		18		0			
S146	TBB_DEF_70-99mm_>300hp	Self	2	IVc	327		66		15		0		0		5		0			
S148	TBB_DEF_70-99mm_>300hp	Self	2	IVc	216		40		4		0		0		0		0			

S156	TBB_DEF_70-99mm_>300hp	Self	2	IVc	1576		2489		16		0		0		6		0			
S152	TBB_DEF_70-99mm_>300hp	Self	3	IVb	1686		749		24		0		0		39		0			
S158	TBB_DEF_70-99mm_>300hp	Self	3	IVb	4204		648		10		0		0		7		0		130	
S160	TBB_DEF_70-99mm_>300hp	Self	3	IVb	3257		1724		10		0		0		10		15		120	
S176	TBB_DEF_70-99mm_>300hp	Self	3	IVb	293		125		3		0		0		0		0			
S177	TBB_DEF_70-99mm_>300hp	Self	3	IVb	431		182		5		0		0		11		0			
S178	TBB_DEF_70-99mm_>300hp	Self	3	IVb	1993		1123		24		0		0		0		0			
S127	TBB_DEF_70-99mm_>300hp	Self	3	IVc	2064		1998		16		3		0		0		10			
S128	TBB_DEF_70-99mm_>300hp	Self	3	IVc	2027		1581		131		0		0		4		0			
S129	TBB_DEF_70-99mm_>300hp	Self	3	IVc	461		600		44		0		0		29		0			
S149	TBB_DEF_70-99mm_>300hp	Self	3	IVc	1044		543		11		0		0		0		0			
S150	TBB_DEF_70-99mm_>300hp	Self	3	IVc	1118		314		18		0		0		2		0			
S151	TBB_DEF_70-99mm_>300hp	Self	3	IVc	2401		98		20		0		0		9		0			
S157	TBB_DEF_70-99mm_>300hp	Self	3	IVc	4218		3276		43		0		0		0		0			
S159	TBB_DEF_70-99mm_>300hp	Self	3	IVc	5646		2126		17		0		0		11		0			
S122	TBB_DEF_70-99mm_>300hp	Self	4	IVb	244		349		1		0		0		100		0		6	
S163	TBB_DEF_70-99mm_>300hp	Self	4	IVb	1668		1338		55		0		0		39		0		3	
S170	TBB_DEF_70-99mm_>300hp	Self	4	IVb	324		207		0		0		0		31		0			
S171	TBB_DEF_70-99mm_>300hp	Self	4	IVb	230		354		4		0		0		55		0		13	
S179	TBB_DEF_70-99mm_>300hp	Self	4	IVb	858		19		0		0		0		32		0		1169	
S180	TBB_DEF_70-99mm_>300hp	Self	4	IVb	542		886		19		0		0		212		0		372	
S130	TBB_DEF_70-99mm_>300hp	Self	4	IVc	156		1096		119		0		0		84		0			
S131	TBB_DEF_70-99mm_>300hp	Self	4	IVc	309		1421		84		0		0		65		3			
S132	TBB_DEF_70-99mm_>300hp	Self	4	IVc	161		2172		26		0		0		42		2			
S153	TBB_DEF_70-99mm_>300hp	Self	4	IVc	497		467		26		0		0		64		0			
S161	TBB_DEF_70-99mm_>300hp	Self	4	IVc	556		1119		6		0		0		41		0			
S162	TBB_DEF_70-99mm_>300hp	Self	4	IVc	345		1075		130		0		0		177		0			

S138	TBB_DEF_70-99mm_≤300hp	Self	2	IVb	603		613		35		4		0		36		0			
S139	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	1752		1641		198		3		0		3		0			
S117	TBB_DEF_100-119mm	Self	2	IVb	302		72		0		0		0		0		0			
S182	TBB_DEF_100-119mm	Self	2	IVb	32		41		0		0		0		0		0			
S183	TBB_DEF_100-119mm	Self	2	IVb	387		72		0		0		0		5		0			
S118	TBB_DEF_100-119mm	Self	3	IVb	47		46		0		0		0		1		0			
S119	TBB_DEF_100-119mm	Self	3	IVb	31		2		0		0		0		0		0			
S167	TBB_DEF_100-119mm	Self	3	IVb	233		60		1		0		1		0		0			
S168	TBB_DEF_100-119mm	Self	3	IVb	112		41		0		0		0		0		0			
S169	TBB_DEF_100-119mm	Self	3	IVb	138		126		2		0		0		5		0		13	
S184	TBB_DEF_100-119mm	Self	3	IVb	510		237		0		0		0		1		0			
S185	TBB_DEF_100-119mm	Self	3	IVb	274		172		1		0		0		0		0			

Table 12b. Numbers per hour of discarded (Dis) and landed (Lan) dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) for each sampled trip in the demersal otter-trawl métiers (OTB/OTT), by programme (observer – obs; and self-sampling - self), and ICES Subdivision (IVb and IVc) in 2009. Blank cells, no landings were measured.

TripID	Métier	Prog	Q	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
S187	OTB/OTT_MCD_70-99mm	Self	2	IVb	1114		808		0		0		0		609		0		3648	
S141	OTB/OTT_MCD_70-99mm	Self	3	IVb	1269		256		1		0		0		32		1		121	
S189	OTB/OTT_MCD_70-99mm	Self	3	IVb	1992		768		0		0		0		40		5		2615	
S191	OTB/OTT_MCD_70-99mm	Self	4	IVb	918		124		0		0		0		32		4		1845	
R116	OTB/OTT_DEF_70-99mm	Obs	3	IVb	1029	8	227	72	0		0		0		217	18	2		2537	778
S186	OTB/OTT_DEF_70-99mm	Self	2	IVb	644		144		0		0		0		863		0		1909	
S140	OTB/OTT_DEF_70-99mm	Self	3	IVb	244		713		0		0		0		15		10		29	
S188	OTB/OTT_DEF_70-99mm	Self	3	IVb	582		224		0		0		0		38		0		433	
S190	OTB/OTT_DEF_70-99mm	Self	4	IVb	137		98		0		0		0		237		0		1108	
S133	OTB/OTT_DEF_100-119mm	Self	2	IVb	36		114		0		0		0		0		1		1	
S137	OTB/OTT_DEF_100-119mm	Self	2	IVb	98		92		0		1		0		0		0			
S142	OTB/OTT_DEF_100-119mm	Self	4	IVb	487		572		0		0		0		7		33			

Table 12c. Numbers per hour of discarded (Dis) and landed (Lan) dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) for each sampled trip in the demersal beam-trawl métiers (TBB_DEF), by programme (observer – obs; and self-sampling - self), and ICES Subdivision (IVb and IVc) in 2010. Blank cells, no landings were measured.

TripID	Métier	Prog	Q	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis WHG	Lan WHG	Dis COD	Lan COD	Dis NEP
R192	TBB_DEF_70-99mm_>300hp	Obs	1	IVb	1174	97	1457	147	98	96	0		0		25		5		40
R193	TBB_DEF_70-99mm_>300hp	Obs	1	IVc	1253		2103	114	27	130	1		0		11		2		0
R194	TBB_DEF_70-99mm_>300hp	Obs	2	IVc	4756		2212	106	68	146	11		0		199		15		0
R195	TBB_DEF_70-99mm_>300hp	Obs	2	IVc	1388		689	152	54	108	3		0		85		12		0
R197	TBB_DEF_70-99mm_>300hp	Obs	3	IVb	2920		1425	302	13	71	0		0		319		3		26
R196	TBB_DEF_70-99mm_>300hp	Obs	3	IVc	1155		103	53	184	198	0		0		873		0		0
R198	TBB_DEF_70-99mm_>300hp	Obs	4	IVc	630	23	321	213	28	105	0		0		119		0		0
R199	TBB_DEF_70-99mm_>300hp	Obs	4	IVc	1394	23	2525	523	180	200	0		0		440		14		0
S202	TBB_DEF_70-99mm_>300hp	Self	1	IVb	147		147		14		0		0		8		4		3
S203	TBB_DEF_70-99mm_>300hp	Self	1	IVb	205		88		0		0		0		11		0		61
S204	TBB_DEF_70-99mm_>300hp	Self	1	IVb	434		100		24		0		0		10		0		17
S244	TBB_DEF_70-99mm_>300hp	Self	1	IVb	756		631		47		0		0		15		0		0
S293	TBB_DEF_70-99mm_>300hp	Self	1	IVb	2569		275		58		0		0		71		6		0
S294	TBB_DEF_70-99mm_>300hp	Self	1	IVb	2379		304		9		0		0		25		0		0
S297	TBB_DEF_70-99mm_>300hp	Self	1	IVb	1439		469		10		0		0		39		0		0
S305	TBB_DEF_70-99mm_>300hp	Self	1	IVb	1605		2432		86		0		0		59		0		0
S306	TBB_DEF_70-99mm_>300hp	Self	1	IVb	841		748		650		0		0		56		0		850
S314	TBB_DEF_70-99mm_>300hp	Self	1	IVb	456		1317		30		0		0		1		4		0
S315	TBB_DEF_70-99mm_>300hp	Self	1	IVb	1143		627		27		0		0		9		0		0

S213	TBB_DEF_70-99mm_>300hp	Self	1	IVc	539		1264		8		0		3		6		2		0
S221	TBB_DEF_70-99mm_>300hp	Self	1	IVc	163		2314		13		3		0		6		0		0
S222	TBB_DEF_70-99mm_>300hp	Self	1	IVc	1535		1128		37		0		0		44		0		0
S223	TBB_DEF_70-99mm_>300hp	Self	1	IVc	2219		1907		63		13		0		30		0		0
S230	TBB_DEF_70-99mm_>300hp	Self	1	IVc	209		416		22		1		0		57		12		0
S231	TBB_DEF_70-99mm_>300hp	Self	1	IVc	1790		418		62		0		0		72		12		0
S245	TBB_DEF_70-99mm_>300hp	Self	1	IVc	1002		2595		14		20		0		31		0		0
S298	TBB_DEF_70-99mm_>300hp	Self	1	IVc	2554		2761		26		0		0		0		0		0
S205	TBB_DEF_70-99mm_>300hp	Self	2	IVb	1		0		0		0		0		0		0		0
S307	TBB_DEF_70-99mm_>300hp	Self	2	IVb	2092		1076		41		0		0		58		35		71
S308	TBB_DEF_70-99mm_>300hp	Self	2	IVb	3596		1110		0		0		0		23		0		0
S316	TBB_DEF_70-99mm_>300hp	Self	2	IVb	1016		84		0		0		0		5		0		9
S317	TBB_DEF_70-99mm_>300hp	Self	2	IVb	1227		158		5		0		0		15		0		0
S214	TBB_DEF_70-99mm_>300hp	Self	2	IVc	505		191		26		9		0		218		10		0
S215	TBB_DEF_70-99mm_>300hp	Self	2	IVc	210		234		4		0		0		5		5		0
S216	TBB_DEF_70-99mm_>300hp	Self	2	IVc	141		406		29		0		0		21		14		0
S232	TBB_DEF_70-99mm_>300hp	Self	2	IVc	370		179		23		0		0		171		6		0
S233	TBB_DEF_70-99mm_>300hp	Self	2	IVc	252		166		14		0		0		50		13		0
S234	TBB_DEF_70-99mm_>300hp	Self	2	IVc	574		171		47		0		0		60		0		0
S246	TBB_DEF_70-99mm_>300hp	Self	2	IVc	1451		1165		26		3		0		67		0		0
S247	TBB_DEF_70-99mm_>300hp	Self	2	IVc	194		212		3		0		0		12		0		0
S295	TBB_DEF_70-99mm_>300hp	Self	2	IVc	445		405		5		0		0		35		0		0
S299	TBB_DEF_70-99mm_>300hp	Self	2	IVc	1023		868		57		9		0		127		13		0
S284	TBB_DEF_70-99mm_>300hp	Self	3	IVb	868		109		0		0		0		78		3		0
S296	TBB_DEF_70-99mm_>300hp	Self	3	IVb	1539		195		0		0		0		0		0		0
S309	TBB_DEF_70-99mm_>300hp	Self	3	IVb	5313		1617		60		0		0		0		0		0
S318	TBB_DEF_70-99mm_>300hp	Self	3	IVb	3766		787		78		0		0		0		0		0

S319	TBB_DEF_70-99mm_>300hp	Self	3	IVb	814		173		4		0		0		2		0		0
S226	TBB_DEF_70-99mm_>300hp	Self	3	IVc	602		1044		12		0		0		0		0		0
S235	TBB_DEF_70-99mm_>300hp	Self	3	IVc	1365		344		2		0		0		111		0		0
S236	TBB_DEF_70-99mm_>300hp	Self	3	IVc	554		249		21		0		0		0		0		0
S248	TBB_DEF_70-99mm_>300hp	Self	3	IVc	954		1396		36		0		3		0		0		0
S300	TBB_DEF_70-99mm_>300hp	Self	3	IVc	1658		1439		7		0		0		0		0		0
S301	TBB_DEF_70-99mm_>300hp	Self	3	IVc	1896		1107		8		0		0		18		0		0
S210	TBB_DEF_70-99mm_>300hp	Self	4	IVb	179		100		0		0		0		0		0		33
S211	TBB_DEF_70-99mm_>300hp	Self	4	IVb	124		132		19		0		0		37		5		47
S249	TBB_DEF_70-99mm_>300hp	Self	4	IVb	198		172		11		0		0		35		0		0
S302	TBB_DEF_70-99mm_>300hp	Self	4	IVb	3037		863		14		0		0		51		0		0
S304	TBB_DEF_70-99mm_>300hp	Self	4	IVb	1233		872		26		0		0		64		0		0
S311	TBB_DEF_70-99mm_>300hp	Self	4	IVb	1973		25		0		0		0		0		13		0
S312	TBB_DEF_70-99mm_>300hp	Self	4	IVb	1306		1501		12		0		0		304		0		1055
S313	TBB_DEF_70-99mm_>300hp	Self	4	IVb	737		4054		27		0		0		0		0		84
S320	TBB_DEF_70-99mm_>300hp	Self	4	IVb	1839		6		0		0		0		6		0		0
S321	TBB_DEF_70-99mm_>300hp	Self	4	IVb	516		1038		53		0		0		12		6		0
S322	TBB_DEF_70-99mm_>300hp	Self	4	IVb	639		916		40		0		0		4		4		0
S329	TBB_DEF_70-99mm_>300hp	Self	4	IVb	1027		727		44		0		0		100		3		0
S218	TBB_DEF_70-99mm_>300hp	Self	4	IVc	132		795		103		0		0		113		1		0
S219	TBB_DEF_70-99mm_>300hp	Self	4	IVc	200		912		109		3		0		258		4		0
S227	TBB_DEF_70-99mm_>300hp	Self	4	IVc	1541		920		74		0		0		49		0		0
S228	TBB_DEF_70-99mm_>300hp	Self	4	IVc	917		1847		38		0		0		37		0		0
S229	TBB_DEF_70-99mm_>300hp	Self	4	IVc	810		1731		44		0		0		51		0		0
S237	TBB_DEF_70-99mm_>300hp	Self	4	IVc	712		195		24		0		0		62		0		0
S238	TBB_DEF_70-99mm_>300hp	Self	4	IVc	29		71		29		0		0		48		0		1
S303	TBB_DEF_70-99mm_>300hp	Self	4	IVc	558		1160		16		0		5		55		4		0

S328	TBB_DEF_70-99mm_>300hp	Self	4	IVc	405		810		44		0		0		182		5		0
S253	TBB_DEF_70-99mm_≤300hp	Self	1	IVb	256		507		9		1		0		9		1		1
S254	TBB_DEF_70-99mm_≤300hp	Self	1	IVb	80		131		9		0		0		4		1		6
S346	TBB_DEF_70-99mm_≤300hp	Self	1	IVb	1626		714		5		0		0		1		2		2
S265	TBB_DEF_70-99mm_≤300hp	Self	1	IVc	121		139		16		1		0		21		0		0
S266	TBB_DEF_70-99mm_≤300hp	Self	1	IVc	265		121		35		5		1		2		1		0
S345	TBB_DEF_70-99mm_≤300hp	Self	1	IVc	320		597		3		1		0		6		1		0
S220	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	2482		1314		111		5		0		12		0		0
S239	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	646		610		72		0		0		8		0		0
S240	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	491		242		10		10		0		0		0		0
S250	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	263		161		30		0		0		8		0		0
S257	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	1917		1148		98		9		0		13		0		0
S267	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	307		53		82		0		3		7		1		0
S268	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	317		51		74		11		0		40		3		0
S269	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	122		236		9		2		0		2		0		0
S347	TBB_DEF_70-99mm_≤300hp	Self	2	IVc	120		116		5		2		0		1		0		0
S242	TBB_DEF_70-99mm_≤300hp	Self	3	IVb	2179		1300		0		0		0		392		5		476
S270	TBB_DEF_70-99mm_≤300hp	Self	3	IVc	94		286		28		0		2		1		0		0
S348	TBB_DEF_70-99mm_≤300hp	Self	3	IVc	1015		330		65		2		0		2		0		0
S271	TBB_DEF_70-99mm_≤300hp	Self	4	IVc	116		318		102		0		4		8		0		0
S272	TBB_DEF_70-99mm_≤300hp	Self	4	IVc	110		250		24		2		3		112		2		0
S349	TBB_DEF_70-99mm_≤300hp	Self	4	IVc	480		294		13		7		2		9		0		0
S285	TBB_DEF_100-119mm	Self	1	IVb	484		95		0		0		0		0		0		0
S206	TBB_DEF_100-119mm	Self	2	IVb	41		2		0		0		0		0		0		0
S207	TBB_DEF_100-119mm	Self	2	IVb	80		5		0		0		0		1		1		0
S281	TBB_DEF_100-119mm	Self	2	IVb	278		27		0		0		0		3		0		0
S282	TBB_DEF_100-119mm	Self	2	IVb	548		14		0		0		0		3		1		0

S283	TBB_DEF_100-119mm	Self	2	IVb	2925		158		0		0		0		17		28		0
S286	TBB_DEF_100-119mm	Self	2	IVb	624		49		0		0		0		10		0		0
S287	TBB_DEF_100-119mm	Self	2	IVb	2050		149		0		0		0		24		7		0
S323	TBB_DEF_100-119mm	Self	2	IVb	76		12		0		0		0		1		0		0
S208	TBB_DEF_100-119mm	Self	3	IVb	403		27		0		0		0		27		2		30
S289	TBB_DEF_100-119mm	Self	3	IVb	2976		105		0		0		0		0		0		0
S327	TBB_DEF_100-119mm	Self	4	IVb	1786		39		0		0		0		0		9		0

Table 12d. Numbers per hour of discarded (Dis) and landed (lan) dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) for each sampled trip in the demersal otter-trawl métiers (OTT/OTB), by programme (observer – obs; and self-sampling - self), and ICES Subdivision (IVb and IVc) in 2010. Blank cells, no landings were measured.

TripID	Métier	Prog	Q	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis WHG	Lan WHG	Dis COD	Lan COD	Dis NEP	Lan NEP
S332	OTB/OTT_MCD_70-99mm	Self	2	IVb	315		66		0		0		0		238		16		538	
S259	OTB/OTT_MCD_70-99mm	Self	3	IVb	710		102		0		0		0		14		6		73	
S260	OTB/OTT_MCD_70-99mm	Self	3	IVb	611		654		0		0		0		25		3		381	
S261	OTB/OTT_MCD_70-99mm	Self	3	IVb	1165		680		0		0		0		17		6		1938	
S333	OTB/OTT_MCD_70-99mm	Self	4	IVb	238		183		0		0		0		93		0		734	
S334	OTB/OTT_MCD_70-99mm	Self	4	IVb	401		50		0		0		0		18		15		2913	
R200	OTB/OTT_DEF_70-99mm	Obs	4	IVb	121		23	68	0	1	0		0		114	7	1		742	369
R201	OTB/OTT_DEF_70-99mm	Obs	4	IVb	650	12	142	143	0		0		0		15		14		305	436
S330	OTB/OTT_DEF_70-99mm	Self	1	IVb	157		83		43		0		0		20		1		38	
S331	OTB/OTT_DEF_70-99mm	Self	1	IVb	116		35		0		0		0		77		2		82	
S335	OTB/OTT_DEF_70-99mm	Self	1	IVb	593		404		0		0		0		147		6		463	
S336	OTB/OTT_DEF_70-99mm	Self	1	IVb	519		147		2		0		0		122		0		415	
S273	OTB/OTT_DEF_70-99mm	Self	1	IVc	723		528		5		3		1		3		0		0	
S274	OTB/OTT_DEF_70-99mm	Self	1	IVc	921		733		37		12		4		8		0		0	
S337	OTB/OTT_DEF_70-99mm	Self	2	IVb	910		161		0		0		0		254		14		1005	
S341	OTB/OTT_DEF_70-99mm	Self	2	IVb	639		208		0		0		0		59		4		1371	
S338	OTB/OTT_DEF_70-99mm	Self	3	IVb	1083		617		0		0		3		62		15		91	
S342	OTB/OTT_DEF_70-99mm	Self	3	IVb	562		248		0		0		0		6		14		575	
S262	OTB/OTT_DEF_70-99mm	Self	4	IVb	1023		543		0		0		0		0		2		23	
S263	OTB/OTT_DEF_70-99mm	Self	4	IVb	850		270		1		0		0		10		22		61	
S339	OTB/OTT_DEF_70-99mm	Self	4	IVb	300		145		0		0		0		97		3		4784	

S340	OTB/OTT_DEF_70-99mm	Self	4	IVb	1952		243		0		0		0		63		38		178	
S343	OTB/OTT_DEF_70-99mm	Self	4	IVb	41		19		0		0		0		69		2		2357	
S344	OTB/OTT_DEF_70-99mm	Self	4	IVb	461		137		1		0		0		11		1		20	
S279	OTB/OTT_DEF_70-99mm	Self	4	IVc	474		2425		46		4		0		37		5		0	
S280	OTB/OTT_DEF_70-99mm	Self	4	IVc	412		1442		96		8		2		59		0		0	
S255	OTB/OTT_DEF_100-119mm	Self	1	IVb	555		1541		0		0		2		3		4		3	
S256	OTB/OTT_DEF_100-119mm	Self	2	IVb	454		1079		0		0		5		5		4		2	
S258	OTB/OTT_DEF_100-119mm	Self	2	IVb	2911		141		0		0		0		0		0		0	
S275	OTB/OTT_DEF_100-119mm	Self	2	IVb	54		49		0		0		1		0		0		0	
S276	OTB/OTT_DEF_100-119mm	Self	2	IVb	490		316		0		0		1		13		2		0	
S277	OTB/OTT_DEF_100-119mm	Self	2	IVb	492		217		0		0		0		0		4		0	
S278	OTB/OTT_DEF_100-119mm	Self	3	IVb	2027		411		0		0		0		4		3		0	
S291	OTB/OTT_DEF_100-119mm	Self	3	IVb	869		639		0		0		0		11		0		0	
S292	OTB/OTT_DEF_100-119mm	Self	3	IVb	603		521		0		0		0		19		0		10	

Appendix E:

Table 13a. Standard deviations of the weights (kg) per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier in 2009 and 2010.

Year	Metier	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	64.8	79.8	72.6	40.4	3.6	7.4	0.3	1.8	0.0	4.2	1.0	2.3	12.8	1.3	0.0	0.2
2009	TBB_DEF_70-99mm_<300hp	34.6	0.1	41.9	3.5	7.9	4.8	0.1	0.2	0.0	0.4	0.0	0.0	2.6	0.0	0.0	0.0
2009	TBB_DEF_100-120	12.6	5.3	8.0	107.8	0.1	9.0	0.0	0.4	0.0	3.9	0.1	0.4	0.2	0.3	0.0	0.2
2009	OTB/OTT_MCD_70-99mm	31.7	1.5	43.0	12.3	0.1	0.3	0.0	0.3	0.0	1.0	0.6	3.2	28.5	1.4	0.0	29.1
2009	OTB/OTT_DEF_70-99mm	18.3	0.9	26.3	26.9	0.0	0.4	0.0	0.3	0.0	0.9	0.7	3.3	40.6	5.1	0.0	11.7
2009	OTB/OTT_DEF_100-119mm	14.9	8.0	40.2	84.9	0.0	0.0	0.0	2.8	0.0	4.8	9.6	7.6	0.5	0.0	0.0	0.0
2010	TBB_DEF_70-99mm_>300hp	56.6	15.3	64.4	70.4	6.7	8.9	0.5	2.1	0.1	4.1	2.7	4.0	7.0	1.9	0.0	0.4
2010	TBB_DEF_70-99mm_<300hp	42.1	4.9	30.7	10.0	3.1	5.5	0.4	0.7	0.2	2.6	0.2	1.0	9.2	0.5	0.0	0.0
2010	TBB_DEF_100-119	85.8	13.3	7.9	170.5	0.0	1.9	0.0	0.4	0.0	3.0	1.1	0.3	0.9	1.5	0.0	0.0
2010	OTB/OTT_MCD_70-99mm	28.9	1.2	26.5	8.3	0.0	0.4	0.0	0.4	0.0	0.8	1.5	2.3	13.7	0.2	24.0	11.3
2010	OTB/OTT_DEF_70-99mm	29.5	4.5	53.3	36.1	3.1	8.1	0.5	1.0	0.2	1.2	2.7	3.7	8.4	5.1	17.0	7.2
2010	OTB/OTT_DEF_100-119mm	75.6	10.3	50.5	126.5	0.0	0.4	0.0	0.4	0.4	2.1	0.7	2.8	0.8	0.0	0.1	0.1

Table 14b. Standard deviations of the numbers per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier in 2009 and 2010. Nm, no landings were measured.

Year	Metier	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	1277	25	817	72	39	45	2	Nm	0	Nm	3	Nm	119	Nm	177	Nm
	TBB_DEF_70-99mm_<300hp	813	Nm	727	Nm	115	Nm	0	Nm	0	Nm	0	Nm	24	Nm	0	Nm
	TBB_DEF_100-119mm	163	Nm	71	Nm	1	Nm	0	Nm	0	Nm	0	Nm	2	Nm	4	Nm
	OTB/OTT_MCD_70-99mm	468	Nm	350	Nm	0	Nm	0	Nm	0	Nm	2	Nm	287	Nm	1487	Nm
	OTB/OTT_DEF_70-99mm	354	Nm	247	Nm	0	Nm	0	Nm	0	Nm	4	Nm	344	Nm	1032	Nm
	OTB/OTT_DEF_100-119mm	245	Nm	271	Nm	0	Nm	0	Nm	0	Nm	19	Nm	4	Nm	0	Nm
2010	TBB_DEF_70-99mm_>300hp	1062	43	816	150	80	47	3	Nm	1	Nm	6	Nm	126	Nm	156	Nm
	TBB_DEF_70-99mm_<300hp	751	Nm	393	Nm	37	Nm	4	Nm	1	Nm	1	Nm	86	Nm	104	Nm
	TBB_DEF_100-119mm	1105	Nm	56	Nm	0	Nm	0	Nm	0	Nm	8	Nm	10	Nm	9	Nm
	OTB/OTT_MCD_70-99mm	340	Nm	296	Nm	0	Nm	0	Nm	0	Nm	7	Nm	89	Nm	1096	Nm
	OTB/OTT_DEF_70-99mm	438	Nm	576	53	25	Nm	3	Nm	1	Nm	10	Nm	63	Nm	1145	48
	OTB/OTT_DEF_100-119mm	919	Nm	484	Nm	0	Nm	0	Nm	2	Nm	2	Nm	7	Nm	3	Nm

Table 15a. Standard deviations of the weights (kg) per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier and quarter (Q) in 2009 and 2010.

Year	Metier	Q	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	1	35.0	0.3	73.8	14.2	3.8	6.8	0.0	1.2	0.0	0.4	0.1	6.0	10.2	2.9	0.0	0.0
2009	TBB_DEF_70-99mm_>300hp	2	30.8	77.5	49.5	30.8	3.5	7.3	0.5	0.8	0.0	6.2	0.7	1.1	21.4	1.7	0.0	0.2
2009	TBB_DEF_70-99mm_>300hp	3	84.7	81.9	92.2	29.6	3.3	5.9	0.1	1.7	0.0	2.8	1.1	0.9	1.5	0.6	0.0	0.4
2009	TBB_DEF_70-99mm_>300hp	4	19.5	89.9	66.3	44.8	4.3	5.6	0.0	2.4	0.0	2.7	1.2	2.5	4.3	0.3	0.0	0.0
2009	TBB_DEF_70-99mm_<300hp	2	24.6	0.2	35.7	2.8	5.6	3.6	0.2	0.2	0.0	1.4	0.0	0.0	1.9	0.0	0.0	0.0
2009	TBB_DEF_100-119mm	2	15.0	0.8	2.2	25.1	0.0	0.6	0.0	0.1	0.0	0.8	0.2	0.6	0.3	0.6	0.0	0.0
2009	TBB_DEF_100-119mm	3	11.4	5.5	9.7	113.7	0.1	9.6	0.0	0.5	0.0	4.0	0.0	0.4	0.0	0.0	0.0	0.2
2009	OTB/OTT_MCD_70-99mm	3	21.7	2.1	56.5	4.5	0.1	0.4	0.0	0.4	0.0	0.5	0.6	0.0	0.1	0.0	0.0	28.3
2009	OTB/OTT_DEF_70-99mm	3	16.7	1.0	31.6	15.0	0.0	0.4	0.0	0.3	0.0	0.7	0.9	2.7	11.2	2.4	0.0	16.2
2009	OTB/OTT_DEF_100-119mm	2	3.8	8.5	4.7	119.2	0.0	0.0	0.1	3.4	0.0	5.7	0.5	0.6	0.0	0.0	0.0	0.0
2010	TBB_DEF_70-99mm_>300hp	1	35.0	0.3	73.8	14.2	3.8	6.8	0.0	1.2	0.0	0.4	0.1	6.0	10.2	2.9	0.0	0.0
2010	TBB_DEF_70-99mm_>300hp	2	30.8	77.5	49.5	30.8	3.5	7.3	0.5	0.8	0.0	6.2	0.7	1.1	21.4	1.7	0.0	0.2
2010	TBB_DEF_70-99mm_>300hp	3	84.7	81.9	92.2	29.6	3.3	5.9	0.1	1.7	0.0	2.8	1.1	0.9	1.5	0.6	0.0	0.4
2010	TBB_DEF_70-99mm_>300hp	4	19.5	89.9	66.3	44.8	4.3	5.6	0.0	2.4	0.0	2.7	1.2	2.5	4.3	0.3	0.0	0.0
2010	TBB_DEF_70-99mm_<300hp	2	34.6	0.1	41.9	3.5	7.9	4.8	0.1	0.2	0.0	0.4	0.0	0.0	2.6	0.0	0.0	0.0
2010	TBB_DEF_100-119mm	2	15.0	0.8	2.2	25.1	0.0	0.6	0.0	0.1	0.0	0.8	0.2	0.6	0.3	0.6	0.0	0.0
2010	TBB_DEF_100-119mm	3	11.4	5.5	9.7	113.7	0.1	9.6	0.0	0.5	0.0	4.0	0.0	0.4	0.0	0.0	0.0	0.2
2010	OTB/OTT_MCD_70-99mm	3	21.7	2.1	56.5	4.5	0.1	0.4	0.0	0.4	0.0	0.5	0.6	0.0	0.1	0.0	0.0	28.3
2010	OTB/OTT_DEF_70-99mm	3	16.7	1.0	31.6	15.0	0.0	0.4	0.0	0.3	0.0	0.7	0.9	2.7	11.2	2.4	0.0	16.2
2010	OTB/OTT_DEF_100-119mm	2	3.8	8.5	4.7	119.2	0.0	0.0	0.1	3.4	0.0	5.7	0.5	0.6	0.0	0.0	0.0	0.0

Table 15b. Standard deviations of the numbers per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier and quarter (Q) in 2009 and 2010. Nm, no landings were measured.

Year	Metier	Q	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	1	560	Nm	896	44	34	21	0	Nm	0	Nm	1	Nm	87	Nm	47	Nm
	TBB_DEF_70-99mm_>300hp	2	668	36	704	82	37	16	3	Nm	0	Nm	1	Nm	191	Nm	1	Nm
	TBB_DEF_70-99mm_>300hp	3	1650	Nm	1035	47	35	69	1	Nm	0	Nm	4	Nm	14	Nm	43	Nm
	TBB_DEF_70-99mm_>300hp	4	398	Nm	632	3	48	50	0	Nm	0	Nm	1	Nm	61	Nm	320	Nm
	TBB_DEF_70-99mm_<300hp	2	575	Nm	535	Nm	82	Nm	3	Nm	0	Nm	0	Nm	17	Nm	0	Nm
	TBB_DEF_100-119mm	2	185	Nm	18	Nm	0	Nm	0	Nm	0	Nm	0	Nm	3	Nm	0	Nm
	TBB_DEF_100-119mm	3	166	Nm	84	Nm	1	Nm	0	Nm	0	Nm	0	Nm	2	Nm	5	Nm
	OTB/OTT_MCD_70-99mm	3	511	Nm	362	Nm	1	Nm	0	Nm	0	Nm	3	Nm	6	Nm	1764	Nm
	OTB/OTT_DEF_70-99mm	3	394	Nm	281	Nm	0	Nm	0	Nm	0	Nm	6	Nm	111	Nm	1346	Nm
	OTB/OTT_DEF_100-119mm	2	44	Nm	15	Nm	0	Nm	0	Nm	0	Nm	1	Nm	0	Nm	1	Nm
2010	TBB_DEF_70-99mm_>300hp	1	560	Nm	896	44	34	21	0	Nm	0	Nm	1	Nm	87	Nm	47	Nm
	TBB_DEF_70-99mm_>300hp	2	668	36	704	82	37	16	3	Nm	0	Nm	1	Nm	191	Nm	1	Nm
	TBB_DEF_70-99mm_>300hp	3	1650	Nm	1035	47	35	69	1	Nm	0	Nm	4	Nm	14	Nm	43	Nm
	TBB_DEF_70-99mm_>300hp	4	398	Nm	632	3	48	50	0	Nm	0	Nm	1	Nm	61	Nm	320	Nm
	TBB_DEF_70-99mm_<300hp	2	813	Nm	727	Nm	115	Nm	0	Nm	0	Nm	0	Nm	24	Nm	0	Nm
	TBB_DEF_100-119mm	2	185	Nm	18	Nm	0	Nm	0	Nm	0	Nm	0	Nm	3	Nm	0	Nm
	TBB_DEF_100-119mm	3	166	Nm	84	Nm	1	Nm	0	Nm	0	Nm	0	Nm	2	Nm	5	Nm
	OTB/OTT_MCD_70-99mm	3	511	Nm	362	Nm	1	Nm	0	Nm	0	Nm	3	Nm	6	Nm	1764	Nm
	OTB/OTT_DEF_70-99mm	3	394	Nm	281	Nm	0	Nm	0	Nm	0	Nm	6	Nm	111	Nm	1346	Nm
	OTB/OTT_DEF_100-119mm	2	44	Nm	15	Nm	0	Nm	0	Nm	0	Nm	1	Nm	0	Nm	1	Nm

Table 16a. Standard deviations of the weights (kg) per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier and ICES subdivison (IVb,c) in 2009 and 2010.

Year	Metier	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	IVb	65.8	107.6	65.9	42.3	2.9	8.6	0.0	0.5	0.0	5.5	0.6	1.7	1.8	1.3	0.0	0.3
	TBB_DEF_70-99mm_>300hp	IVc	65.0	2.7	69.9	38.2	3.9	6.2	0.4	2.0	0.0	1.3	1.2	2.6	17.3	1.3	0.0	0.0
	TBB_DEF_70-99mm_<300hp	IVc	14.5	0.3	45.4	0.0	4.1	0.8	0.2	0.3	0.0	1.5	0.0	0.0	0.6	0.0	0.0	0.0
	TBB_DEF_100-119mm	IVb	12.6	5.3	8.0	107.8	0.1	9.0	0.0	0.4	0.0	3.9	0.1	0.4	0.2	0.3	0.0	0.2
	OTB/OTT_MCD_70-99mm	IVb	31.7	1.5	43.0	12.3	0.1	0.3	0.0	0.3	0.0	1.0	0.6	3.2	28.5	1.4	0.0	29.1
	OTB/OTT_DEF_70-99mm	IVb	18.3	0.9	26.3	26.9	0.0	0.4	0.0	0.3	0.0	0.9	0.7	3.3	40.6	5.1	0.0	11.7
	OTB/OTT_DEF_100-119mm	IVb	14.5	7.0	37.3	115.0	0.0	0.0	0.0	2.5	0.0	4.2	8.3	6.3	0.4	0.0	0.0	0.0
2010	TBB_DEF_70-99mm_>300hp	IVb	65.8	107.6	65.9	42.3	2.9	8.6	0.0	0.5	0.0	5.5	0.6	1.7	1.8	1.3	0.0	0.3
	TBB_DEF_70-99mm_>300hp	IVc	65.0	2.7	69.9	38.2	3.9	6.2	0.4	2.0	0.0	1.3	1.2	2.6	17.3	1.3	0.0	0.0
	TBB_DEF_100-119mm	IVb	12.6	5.3	8.0	107.8	0.1	9.0	0.0	0.4	0.0	3.9	0.1	0.4	0.2	0.3	0.0	0.2
	OTB/OTT_MCD_70-99mm	IVb	31.7	1.5	43.0	12.3	0.1	0.3	0.0	0.3	0.0	1.0	0.6	3.2	28.5	1.4	0.0	29.1
	OTB/OTT_DEF_70-99mm	IVb	18.3	0.9	26.3	26.9	0.0	0.4	0.0	0.3	0.0	0.9	0.7	3.3	40.6	5.1	0.0	11.7
	OTB/OTT_DEF_100-119mm	IVb	14.9	8.0	40.2	84.9	0.0	0.0	0.0	2.8	0.0	4.8	9.6	7.6	0.5	0.0	0.0	0.0

Table 16b. Standard deviations of the numbers per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod, whiting (WHG) and Norway lobster (NEP) by métier and ICES subdivison (IVb,c) in 2009 and 2010.

Year	Metier	ICES	Dis DAB	Lan DAB	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis BLL	Lan BLL	Dis TUR	Lan TUR	Dis COD	Lan COD	Dis WHG	Lan WHG	Dis NEP	Lan NEP
2009	TBB_DEF_70-99mm_>300hp	4B	1234	31	729	54	35	67	0	Nm	0	Nm	3	Nm	46	Nm	251	Nm
2009	TBB_DEF_70-99mm_>300hp	4C	1341	1	830	85	40	35	3	Nm	0	Nm	2	Nm	157	Nm	0	Nm
2009	TBB_DEF_70-99mm_<300hp	4C	380	Nm	548	Nm	71	Nm	4	Nm	0	Nm	0	Nm	7	Nm	0	Nm
2009	OTB/OTT_MCD_70-99mm	4B	468	Nm	350	Nm	0	Nm	0	Nm	0	Nm	2	Nm	287	Nm	1487	Nm
2009	OTB/OTT_DEF_70-99mm	4B	354	Nm	247	Nm	0	Nm	0	Nm	0	Nm	4	Nm	344	Nm	1032	Nm
2009	OTB/OTT_DEF_100-119mm	4B	163	Nm	71	Nm	1	Nm	0	Nm	0	Nm	0	Nm	2	Nm	4	Nm
2009	OTB/OTT_DEF_100-119mm	4B	224	Nm	253	Nm	0	Nm	0	Nm	0	Nm	16	Nm	3	Nm	0	Nm
2010	TBB_DEF_70-99mm_>300hp	4B	1234	31	729	54	35	67	0	Nm	0	Nm	3	Nm	46	Nm	251	Nm
2010	TBB_DEF_70-99mm_>300hp	4C	1341	1	830	85	40	35	3	Nm	0	Nm	2	Nm	157	Nm	0	Nm
2010	OTB/OTT_MCD_70-99mm	4B	468	Nm	350	Nm	0	Nm	0	Nm	0	Nm	2	Nm	287	Nm	1487	Nm
2010	OTB/OTT_DEF_70-99mm	4B	354	Nm	247	Nm	0	Nm	0	Nm	0	Nm	4	Nm	344	Nm	1032	Nm
2010	OTB/OTT_DEF_100-119mm	4B	163	Nm	71	Nm	1	Nm	0	Nm	0	Nm	0	Nm	2	Nm	4	Nm
2010	OTB/OTT_DEF_100-119mm	4B	245	Nm	271	Nm	0	Nm	0	Nm	0	Nm	19	Nm	4	Nm	0	Nm

Appendix F:

Uhlmann, S. S., Bierman, S. M., and Helmond, A. T. M. v. 2011. A method of detecting patterns in mean lengths of samples of discarded fish, applied to the self-sampling programme of the Dutch bottom-trawl fishery. ICES Journal of Marine Science, 68: 1712-1718.

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A method of detecting patterns in mean lengths of samples of discarded fish, applied to the self-sampling programme of the Dutch bottom-trawl fishery

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In 2009, a self-sampling programme was organized in the Netherlands, fishers sampling ca. 80 kg of discards from randomly selected bottom trawls in the North Sea. A statistical procedure is proposed to highlight samples, trips (with multiple samples), or vessels (which may have multiple trips within a year) where extreme mean lengths of discarded fish were observed. Randomization methods were used to test for evidence of non-randomness in patterns of highlighted discard samples, e.g. repeated observations of extreme mean lengths for consecutive discard samples across trips from the same vessel. European plaice (Pleuronectes platessa), common dab (Limanda limanda), grey gurnard (Eutrigla gurnardus), and whiting (Merlangius merlangus) were considered because these were the most abundant species in most of the discard samples. A linear mixed model was used to estimate random-sample effects on the estimated mean lengths by species. These random effects were incorporated into uni- and bivariate procedures to identify extreme samples that were summed for each vessel, and the probability of observing such numbers was estimated. Excluding these samples from the dataset had marginal effects on estimated size distributions of fish.

Keywords: at-sea sampling, data quality, discards, self-reporting.

Introduction

At-sea sampling of commercial fish catches by observers is expensive because the observers typically have to remain on board for the duration of a trip. This tends to return large clusters of samples from a few trips, which may lead to small effective sample sizes (e.g. Pennington and Vølstad, 1994), when the aim is to make inferences for all trips made by the whole fleet. From this perspective, self-sampling by fishers is an attractive alternative because more samples from more trips can be collected with unit costs being lower. Compared with the long-term fishery-observer programme organized under the European Data Collection Framework (EU Regulations 1543/2000 and 10121/2009), the benefit has been demonstrated for a self-sampling programme conceived at the Institute for Marine Resources and Ecosystem Studies (IMARES, Wageningen University; see van Helmond and van Overzee, 2010, for detail). In both programmes, apart from general biological, technical, and environmental information, length frequency data are collected for discards of the Dutch bottom-trawl fishery in the North Sea. Ideally, these data are used for stock assessment.

However, fishery-dependent length frequency data may be biased by systematic sampling errors that can influence stock assessments seriously (Heery and Berkson, 2009). Self-sampling may be particularly prone to such bias, because fishers routinely and subjectively select fish from the catch during their daily commercial operations (sorting ogive), but potentially non-randomly subsample the discards for subsequent biological analysis (sampling ogive). Fishers may find it difficult to conform to the more objective sampling regime required for scientific monitoring. Although sorting ogives may be similar across vessels, especially when targeting species with a minimum landing size (MLS; Appendix XII of EC Council Regulation No 850/98), sampling ogives may differ, especially if fishers consistently and non-randomly pick and/or miss certain size classes of a species.

Lacking any independent *in situ* validation techniques (e.g. video-assisted monitoring; Ames *et al.*, 2007; Stanley *et al.*, 2009), a *post hoc* statistical screening method is developed here to detect patterns in the mean lengths of samples of discarded fish across species, hauls, vessels, and trips which may suggest biased sampling at a haul level. Self-reported data may also be biased at the sorting level as a consequence of fishers misreporting catches and/or discards to circumvent regulations, e.g. on quota and MLS (Bremner *et al.*, 2009; Heery and Berkson, 2009; Bousquet *et al.*, 2010). This can arise with large marketable fish or small fish (below MLS); in either case, the sampled size distribution of the discards will be biased.

Historically, this problem has been observed in comparisons of the discard fractions of European plaice (*Pleuronectes platessa*) and Atlantic cod (*Gadus morhua*) reported from observer and self-sampling operations in the Dutch beam-trawl fishery (Aarts and van Helmond, 2007). The different length frequency distributions for plaice, despite accounting for spatial and temporal effects, suggested that discarded small fish were consistently missing from the samples (this term is used here instead of "underreporting", because the latter implies a deliberate process, which it may not be) in the self-sampling programme (Aarts and van Helmond, 2007). Because of these discrepancies, the data from this self-sampling programme were considered unsuitable for stock assessments.

Since the study of Aarts and van Helmond (2007), the self-sampling programme has shifted from an industry-driven initiative (designed and organized by staff of the Dutch Fish Product Board, from 2004 to 2008) to a scientific sampling scheme (designed, organized, and analysed by IMARES staff, from 2009 on) which has operated in parallel with the long-term observer programme. In the current IMARES self-sampling programme, there is a reference fleet (n ¼ 12 vessels in 2009) with trained observers among the crew who opportunistically and voluntarily collect discard samples during commercial fishing operations throughout the year. In accord with the instructions of IMARES staff, two random and pre-determined hauls are sampled on an agreed trip. One sample comprises two boxes of discards (a box weighs ca. 40 kg), filled by taking subsamples ideally at intervals while the catch is sorted (Heales *et al.*, 2003). For each sampled haul, additional information on the composition and volume of catch and landings, environmental factors (e.g. wind direction and speed, latitude and longitude, and water depth) and operational details (e.g. start and end times of trawling, gear type, and mesh size) are also recorded. All discard samples are returned to the laboratory where the species composition, size, and age structure of the sample is determined. European plaice, common dab (*Limanda limanda*), grey gurnard (*Eutrigla gurnardus*), and whiting (*Merlangius merlangus*) are among the most commonly discarded species (van Helmond and van Overzee, 2010).

Here, we present a statistical tool to highlight samples, trips (with multiple samples), or vessels (with multiple trips) for which (i) the on-board sorting into discards and landings, (ii) the on-board sampling of individual fish from the discard fraction for return to the laboratory, or both have led to mean length in a sample being different from other samples. Process (ii) may indicate sampling bias. However, our statistical tool cannot establish which of processes (i) or (ii) prevails, especially for species without an MLS. It can, however, visualize simultaneous occurrences of extreme values. Notwithstanding this, the tool can be used for rapid assessment of potential biases in the estimated mean fish lengths of discards by species where each sample is taken at a haul level. Because of the geographic spread of sampling, different populations of discarded fish are sampled by the observer and self-sampling programmes (Figure 1). Therefore, the present study focuses on the data from the Dutch self-sampling programme in 2009, as a case study.

Material and methods

The numbers-at-length of discarded European plaice, common dab, grey gurnard, and whiting were extracted from the IMARES database. Samples, i.e. two boxes (ca. 80 kg) of discards per haul, were returned from two fleet segments each with two characteristic mesh sizes (in total, four métiers) operating in ICES Divisions IVc and IVb throughout the year, namely beam and otter trawlers with 80 and 100 mm mesh sizes. Discards were sampled from 133 hauls on a total of 70 trips in each month of 2009. For each haul, the numbers-at-length were raised to the haul level, based on the fraction of the subsample, i.e. two boxes out of the total number of boxes discarded. All data were checked carefully for transcription errors and missing values.

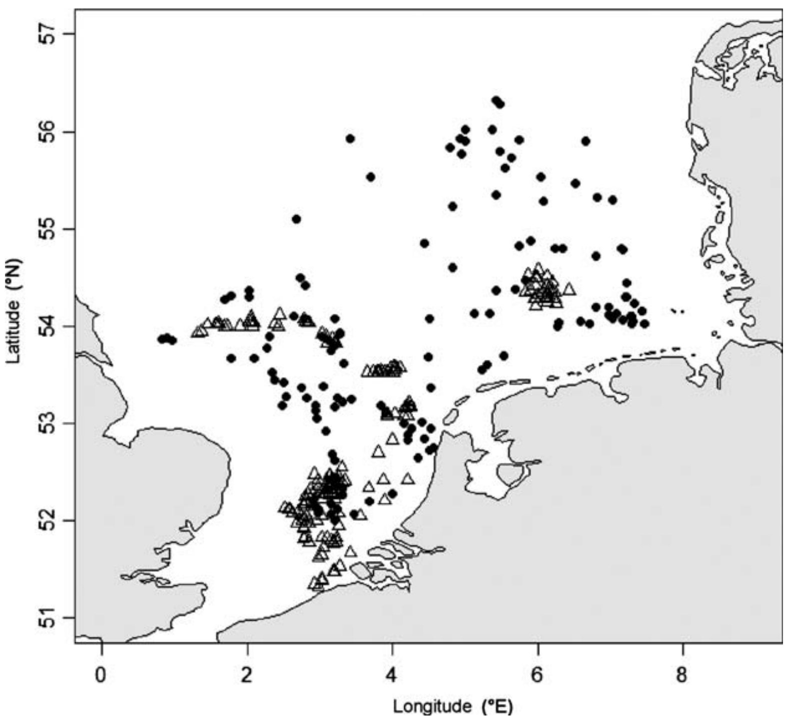

Figure 1. Geographic locations of hauls sampled in 2009 for the Dutch bottom-trawl fishery by the observer (open triangles) and self-sampling (dots) programmes.

Statistical analysis

Mixed model for estimating random-sample effects on mean lengths

The means of the measured discarded fish lengths by species were expected to vary as a result of changes in the underlying population from which the catch was taken, the selectivity of the gear, the on-board sampling method, and sorting and sampling ogives (Benoît and Allard, 2009). Therefore, we modelled the expected mean fish lengths in the absence of on-board sorting and sampling bias as a function of location, season, and gear type. Location was treated as three distinct areas to reflect the distribution of the metiérs, e.g. mesh sizes ‒ 100 mm need to be used north of 558N: ≥51 to ‸ 53.58N; ≥53.58 to 558N; and ≥558N. The number of measured fish per species in a sample (corresponding to a haul) can vary from just 1 to ‒ 100. We chose a mixed-model approach in which sample effects on mean lengths are estimated as random effects, because in that case the estimated sample effects based on a few fish will decrease towards the expected mean length (Gelman et al., 1995).

Let y_{ji} be the measured length of fish i (i ¼ 1,2, . . ., n_j) in sample j, where n_j is the number of measured fish in sample j. For readability, we do not use a subscript for species here; the same model applies to each species. Then, a random-sample effect can be estimated using the following mixed model:

$$y_{j,i} = a + b_1\,\text{gear}_{g(j)} + b_2\,\text{area}_{a(j)} + b_3\,\text{quarter}_{q(j)} + b_4\,\text{area}_{a(j)} \times \text{quarter}_{q(j)} + r_{r(j)} + g_j + 1_{ij}, \quad (1)$$

where $\text{gear}_{g(j)}$, $\text{area}_{a(j)}$, and $\text{quarter}_{q(j)}$ are fixed-effect parameters for gear type g, area a ($a \times \{1,2,3\}$), and quarter q ($q \times \{1,2,3,4\}$), corresponding to sample j, and $\text{area}_{a(j)} \times \text{quarter}_{q(j)}$ is the interaction between these factors. Random effects are $r_{r(j)}$ for the combination of quarter and ICES rectangle r in which sample j was taken, i.e. accounting for the between-rectangle variability within a given area, and g_j are random-sample effects. The residual error term is 1_{ij} for fish i in sample j. Both random effects are assumed to be normally distributed with a mean of zero and variances s^2 and $s^2_{,g}$ respectively. The distribution of length measurements was also modelled by a normal distribution (error term).

Uni- and bivariate approaches

Extreme values (with reference to a normal distribution) of random-sample effects g_j as estimated using the mixed model, Equation (1), may indicate a different sorting ogive or a sampling bias, particularly if large/small values of g_j were estimated simultaneously for multiple species within the same trip (across hauls) or for multiple trips by the same vessel. To investigate this, we counted the number of extreme values in the estimated random-sample effects per trip and vessel, taking both univariate (per species) and bivariate (with combinations of species) approaches. Although the latter approach could extend to many more dimensions, two seemed appropriate here, because including more species would result in too few samples per category to be useful. We chose to couple the two most abundant species groups (European plaice and common dab; and grey gurnard and whiting, respectively) because most samples had at least one measured fish of each of these species. Univariately, results were classified beyond the 2.5 and 97.5 percentiles of the random-sample effects by species as extreme. The choice of percentile is subjective and arbitrary and can be varied by the analyst. For the univariate and bivariate methods, percentiles need to be selected to return numbers of extreme samples that are neither too small nor too large to identify patterns and to compute p-values using the randomization method.

Bivariately, the distance–distance plot methodology proposed by Rousseeuw and van Zomeren (1990) was used to classify extreme samples in bivariate space, based on comparing a robust version of the Mahalanobis distance with the quantiles of the Chi-squared distribution, with 2 degrees of freedom (Garrett, 1989). This classification method circumvents potential problems with biased estimation of the multivariate mean and covariance matrix attributable to the presence of potential extreme values, based on the minimum covariance determinant (MCD) estimator of Rousseeuw and van Driessen (1999). As the random-sample effects are estimated independently for each species, the multivariate mean may not necessarily be at zero.

Finally, using the bivariate extreme samples from the European plaice and common dab group, a randomization test (Manly, 2007) was used to investigate whether the observed numbers of extreme samples per vessel could have occurred by chance. In all, 5000 replicate datasets were simulated by randomly reordering the flags (extreme sample or not) across all samples. For each replicate dataset, the number of flags per vessel was counted, and the number of flags per vessel compared with the observed number of flags per vessel, to estimate the chance of observing the same number or more flags. Bonferroni correction (Gotelli and Ellison, 2004) was applied to account for the multiplicity of tests if more than one vessel had flagged samples.

To illustrate how the estimated length distribution of discarded European plaice and common dab changed by excluding the extreme samples identified in the bivariate approach, relative length frequency distributions (i.e. proportions per size class) for these species were plotted from all self-sampled trips in 2009. The size frequency distributions (at 1-cm intervals) of counts (raised to trip level) of European plaice and common dab, from samples including or excluding extreme samples, were compared using two-sample Kolmogorov–Smirnov tests.

The mixed-model analyses were carried out using the statistical software R (R Development Core Team, 2005), with the aid of the "ellipse" (Murdoch and Chow, 1996) and "mvoutlier" (Filzmoser et al., 2005) packages, which contain routines for drawing ellipse-like confidence regions, and estimation of robust Mahalanobis distances using the MCD method for estimating variance–covariance matrices. The package "nlme" (Pinheiro et al., 2009) was used to fit the random-effects model. All packages can be downloaded from http://cran.r-project.org.

Results

For the univariate method of classifying extreme samples (using the random-sample effects on a per-species basis), 130 samples with measured fish were included (European plaice, n ¼ 127; common dab, n ¼ 130; grey gurnard, n ¼ 109; whiting, n ¼ 89; Table 1, Figure 2).

All but one of the 12 vessels participating in the self-sampling programme in 2009 returned at least one sample with either a positive or a negative sample effect (estimated mean lengths greater or smaller than expected) for at least one of the species measured (Table 1). Within any sample, no more than two extreme mean lengths across the four species were evident (Table 1); more extreme mean lengths were found for European plaice and common dab (Table 1). Within a trip up to three,

Table 1. List of vessel codes, number of sampled trips (n), and sample codes for which at least one random-sample effect for plaice, dab, grey gurnard, and whiting was classified as extreme (univariate method; see Figure 2).

Vessel code	n	Trip code	Sample code	Plaice	Dab	Grey gurnard	Whiting
1	4	119	6000684	0	+	+	n/a
2	9	124	6000602	2	0	0	0
2	9	126	6000629	2	0	0	0
2	9	127	6000679	2	0	0	n/a
2	9	128	6000700	+	0	0	0
2	9	130	6000725	0	0	0	+
2	9	130	6000726	0	0	0	2
3	2	134	6000685	0	+	+	n/a
4	2	135	6000609	0	0	n/a	2
4	2	136	6000643	+	0	n/a	0
5	8	138	6000623	0	2	0	0
5	8	138	6000624	0	0	0	+
5	8	140	6000663	0	0	0	+
7	8	149	6000662	0	2	0	n/a
8	9	155	6000605	0	0	+	0
8	9	156	6000632	0	+	0	n/a
8	9	157	6000659	+	0	0	n/a
9	8	167	6000670	0	0	2	n/a
10	8	173	6000612	2	0	0	0
11	5	182	6000647	+	+	0	n/a
12	6	187	6000636	0	2	0	2
12	6	189	6000707	0	0	2	0
12	6	189	6000708	0	2	2	0
n ¼ 11	69	20	23	4+/42	4+/42	3+/32	3+/32

The extreme cases are shown as 2 or + for, respectively, extreme negative or positive random-sample effects, and 0 for all others. The total number of samples for each category "(n; vessel, trip, sample, and positive/negative random-sample effect per species) are given in the bottom row. n/a, no data available.

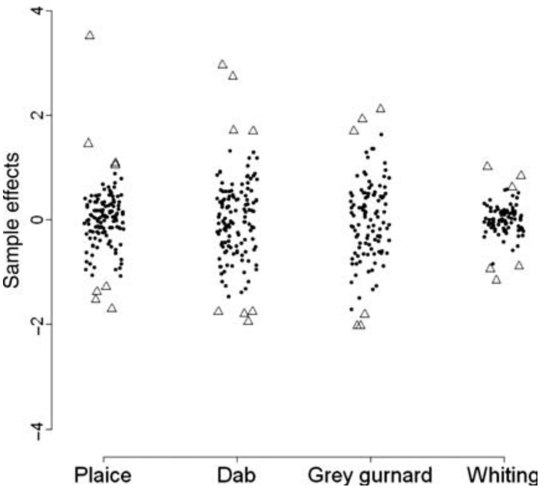

Figure 2. Classification of extreme length measurements using the univariate approach. The smallest (¸ 2.5 percentile) and the largest (ˆ 97.5 percentile) of the random-sample effects estimated using the mixed model [Equation (1)] for plaice, dab, grey gurnard, and whiting are deemed extreme (triangles); other data points are shown as dots.

and within a vessel up to six, extreme mean lengths were recorded. Of these, four extreme negative mean lengths were returned for a particular vessel (code "2"; three and one for MLS-regulated European plaice and whiting, respectively), although overall the numbers of positive or negative sample effects were evenly distributed within and across species (Table 1).

For the bivariate method (excluding extreme values), 126 samples with measurements of both European plaice and common dab could be included, along with 69 with both grey gurnard and whiting (Table 2, Figure 3).

Sample effects (extreme values) were flagged for data collected on 8 of the 12 vessels (Table 2). For the European plaice and common dab group, five and three samples were flagged as falling outside the 95 and 99% prediction intervals of the normal random effect, respectively (Figure 3a). For grey gurnard and whiting, the corresponding numbers were five and one samples, respectively (Figure 3c). Notably, for one vessel (code "2" in Tables 1 and 2), samples of both European plaice and common dab were flagged on nearly every trip, and repeatedly in consecutive samples from the same trip (Table 2). This is the same vessel for which the most sample effects were recorded as extreme in the univariate analysis. The number of trips sampled was similar compared with other participating vessels (Table 1). However, given Bonferroni correction (n ¼ 12 tests; error rate p ¸ 0.005), it appears likely that such a large number of extreme samples could have arisen at least once by chance for a particular vessel if the extreme samples were distributed randomly across all samples (randomization test; Table 3).

There were no significant differences in length frequency distributions of European plaice or common dab whether or not extreme samples identified by the bivariate method were included (Kolmogorov–Smirnov test, p ˆ 0.05; Figure 4).

Discussion

Self-sampling programmes are popular (Catchpole and Gray, 2010) because more samples from more trips can be collected at lower cost than during on-board observer programmes. The results here suggest that the length frequencies of self-sampled discards of European plaice, common dab, grey gurnard, and whiting in 2009 provided no evidence that the sampling may have been biased at a vessel level, assuming that all vessels applied the same sorting ogive for discards, because MLS-regulated species were targeted. However, using our uni- and bivariate approaches, we identified individual discard samples (e.g. samples of European plaice from vessel "2"or the top triangles in Figure 3a) that may be considered in greater detail, e.g. by plotting length frequency distributions. Further, we examined the sensitivity of the estimated length-class proportions with and without the trips that returned large random-sample effects, using the bivariate method for European plaice and common dab (Figure 4). Although the variation is negligible, our results may nevertheless be used to identify the crews that need additional training or experience in the sampling methodology or for which it is necessary to study the discard sorting ogive.

Central to the method here is the use of a mixed model to determine random-sample effects on the estimated mean length of discarded fish. An important advantage of the method is that the effects of samples with few measured fish will decrease towards the overall mean of the fixed effects. This avoids the problem that samples with just a few fish might be flagged as extreme. On the other hand, samples with many measured fish may be classified as extreme because the shrinkage effect of the model is less effective in that case. Most samples with a random-sample effect contained at least ten measured fish (Table 2).

Table 2. List of vessel, trip, and sample codes for which at least one random-sample effect for European plaice, common dab, grey gurnard, and whiting was classified as extreme using the bivariate method, showing the numbers of discarded fish measured, with bivariate 1 (BIV1) and 2 (BIV2) flagging extreme values for discard samples with plaice and dab, and grey gurnard and whiting, respectively (Figure 3).

Vessel code	Trip code	Sample code	BIV1	BIV2	Plaice	Dab	Grey gurnard	Whiting
2	124	6000602	1	0	97	85	4	27
2	126	6000629	1	0	167	106	1	3
2	127	6000679	1	n/a	66	92	1	n/a
2	127	6000680	1	n/a	86	67	n/a	n/a
2	128	6000700	1	0	25	41	5	1
2	130	6000725	0	1	44	14	5	12
2	130	6000726	0	1	104	27	6	7
3	134	6000685	1	n/a	57	13	53	n/a
5	138	6000624	0	1	106	123	3	21
8	160	6000711	1	n/a	50	63	2	n/a
9	170	6000717	1	0	26	56	16	2
10	173	6000612	1	0	17	31	3	5
11	182	6000647	1	n/a	54	50	30	n/a
12	186	6000607	0	1	25	56	39	75
12	187	6000636	1	1	167	77	14	83
n ¼ 8	13	15	11	5	1 091	901	182	236

For BIV1 and BIV2,, the extreme values are shown as "1", and "0" otherwise. The total number of samples for each category (n; vessel, trip, sample, and random-sample effect per species group) and total number of individual fish measured are given in the bottom row. n/a, no data available.

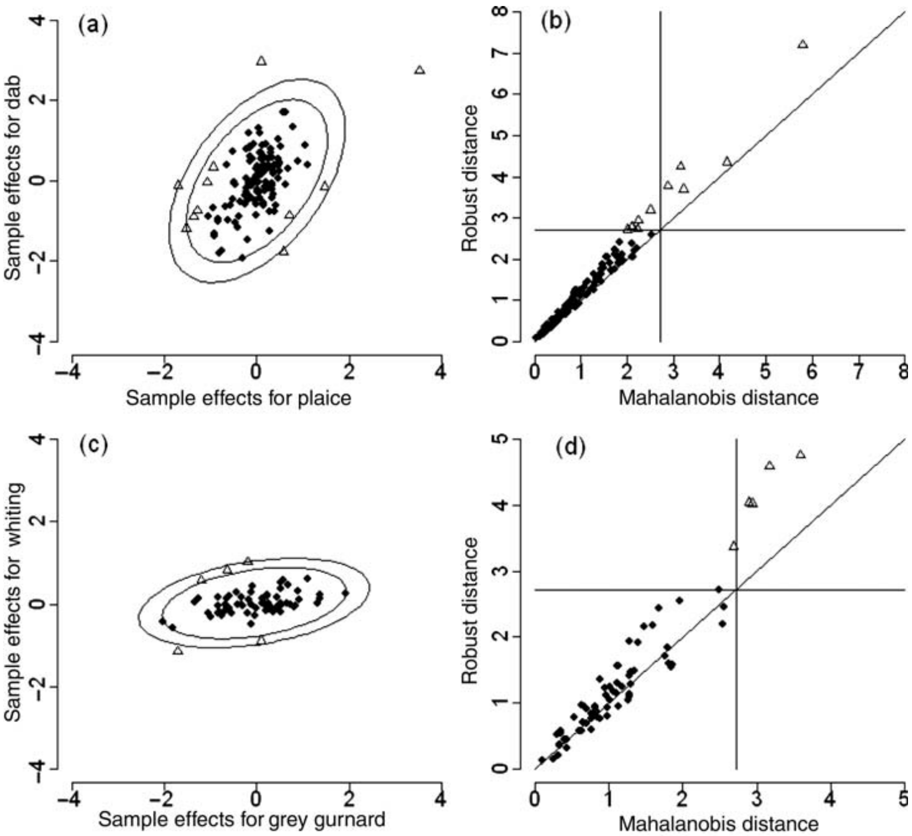

Figure 3. Classification of extreme samples using the bivariate distributions of the random-sample effects estimated using the mixed model [Equation (1)]. The bivariate distribution, with 95 and 99% prediction intervals (inner and outer ellipses, respectively), is shown for (a) plaice vs. dab and (c) grey gurnard vs. whiting. The classification of extreme samples is made using the method of Rousseeuw and van Zomeren (1990) by comparing a robust version of the Mahalanobis distance with the quantiles of the Chi-squared distribution with 2 degrees of freedom. The horizontal and vertical lines in (b) and (d) are drawn at the square roots of the 97.5% quantiles of a Chi-squared distribution with 2 degrees of freedom for (b) plaice and dab, and (d) grey gurnard and whiting. Points above the horizontal line (shown as triangles) are considered extremes.

Table 3. Results of the randomization test for the number of extreme samples per vessel classified using the bivariate distribution of the random-sample effects for plaice and dab (Figure 3a and b).

	k									
Vessel code	0	1	2	3	4	5	6	7	K	p(k ≥ K)
1	0.526	0.358	0.094	0.02	0.002	0	0	0	0	1
2	0.203	0.318	0.293	0.134	0.039	0.013	0	0	5	0.013
3	0.668	0.292	0.039	0.001	0	0	0	0	1	0.232
4	0.627	0.312	0.060	0.001	0	0	0	0	0	1
5	0.33	0.393	0.218	0.050	0.007	0.002	0	0	1	0.670
6	0.839	0.155	0.006	0	0	0	0	0	0	1
7	0.303	0.376	0.230	0.079	0.010	0.002	0	0	0	1
8	0.158	0.343	0.318	0.128	0.044	0.008	0	0.001	1	0.842
9	0.249	0.39	0.254	0.079	0.023	0.003	0.002	0	1	0.751
10	0.263	0.403	0.235	0.076	0.020	0.003	0	0	1	0.737
11	0.460	0.399	0.120	0.020	0.001	0	0	0	1	0.54
12	0.334	0.398	0.208	0.051	0.007	0.002	0	0	2	0.286

The probabilities of observing k extreme samples per vessel were estimated from 5000 replicate datasets, where the extremes were randomly reordered across samples. The probabilities of observing at least K extreme samples per vessel [p(k ≥ K)] are in the column to the right. The error rate (p ¼ 0.05) was divided by the number of hypothesis tests carried out within the randomization analysis (Bonferroni correction, p ≥ 0.005).

There are several limitations of the present methodology. First, compared with the univariate method, the bivariate method currently does not identify the direction of the random-sample effect, i.e. positive or negative. Second, classification of individual random-sample effects into extreme or non-extreme values is necessarily partly subjective, influenced to a large extent by the choice of confidence levels. For example, classification based on the 99% prediction intervals (outer ellipses in Figure 3) resulted in fewest samples classified as extreme, whereas the univariate method based on 2.5 and 97.5 percentiles resulted in most (Table 1). Although the choice of confidence level can be varied, the idea behind the methodology is that patterns in highlighted samples are investigated using randomization methods to test for evidence of possible non-randomness in these patterns. Third, the classification of extreme samples relies heavily upon modelling assumptions, so care should be taken in interpreting random-sample effects. Notably, the validity of the method depends upon having a good model for the dependence of sampled mean lengths on the structure of the fish population and the gear-selectivity characteristics. In the mixed model [Equation (1)], these effects were incorporated by including spatial and temporal factors, and their interactions, as well as technical (gear) factors. Another and potentially more robust way of including such effects in the analysis would be to subdivide the data by grouping trips from the same fishing ground, the same season, and the same gear and mesh-size combination. However, in interpreting patterns (if any), one needs to be aware that certain modelling assumptions could have been violated, e.g. that certain explanatory variables were missing or included in the model in the wrong way (e.g. their effect was non-linear when they were included as linear effects). Such misspecifications of the model can introduce bias in the estimated random effects or induce the random effects to be non-normal.

Here, the focus was on detecting potential sampling biases for mean fish length. However, this is just one of several biases that may arise, and alternative important aspects of the sampling and its variance may be looked at using similar methodologies (Vigneau and Mahévas, 2007). The methodology employed is purely statistical and cannot be used to make any inferences on the processes underlying the potential bias in sampling. For that,

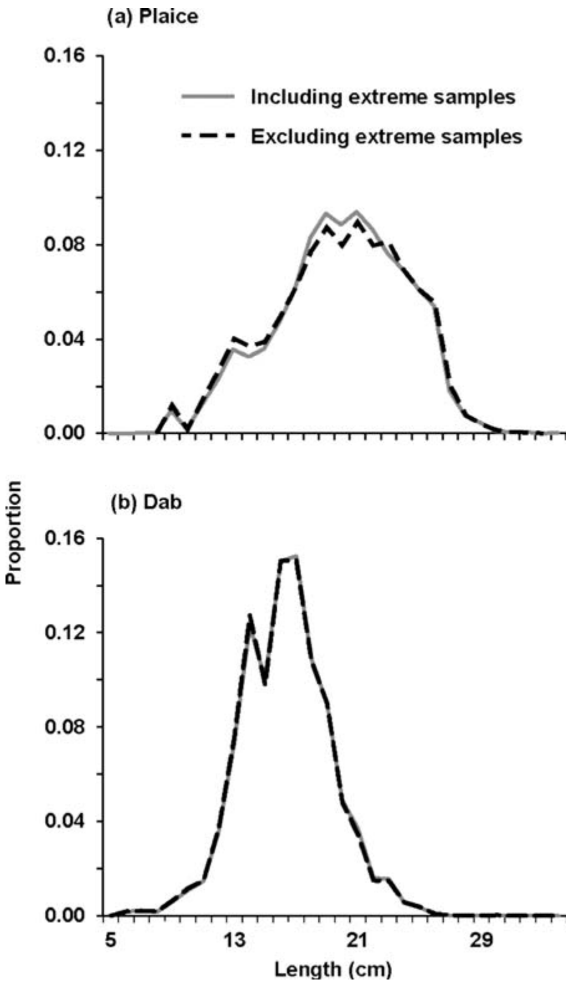

Figure 4. Proportions of the numbers of discarded (a) plaice and (b) dab per trip and size class (cm) from self-sampled discard data for the Dutch bottom-trawl fisheries in 2009. Grey continuous lines, all data included; black dashed lines, length distributions where trips with extreme samples detected by the bivariate method (Table 2 and Figure 3) were excluded.

less-theoretical, more-practical approaches are needed, such as *in situ* video-monitoring systems to validate logbook catch estimates (Stanley et al., 2009), or concurrent sampling by both fishers and on-board observers. Recognizing the importance of having statistical methodology in place to screen data from discard self-sampling programmes, especially considering the incentives for fishers to misreport the occurrence of large marketable and/or small juvenile fish within the discard fraction, so negatively or positively biasing the length frequency distributions, we caution jumping to any foregone conclusion if any extreme samples were to be excluded from a database and/or analysis. Achieving the long- term goal of proving that reliable data can be obtained through self-sampling will eventually promote and maximize the benefits of cooperative research partnerships between fishers, scientists, and managers (Johnson and van Densen, 2007).

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Head WOT, Centre for Fisheries Research

Signature:

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