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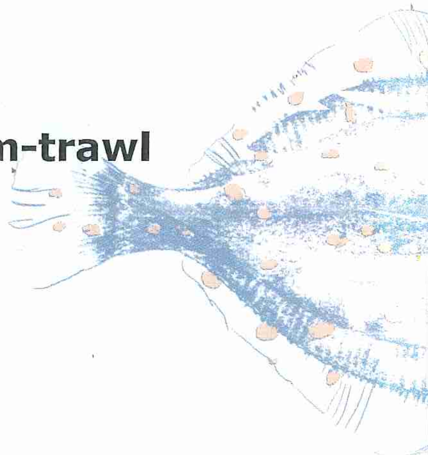

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Harriët van Overzee, Katinka Bleeker, Michiel Dammers

CVO Report 21.002

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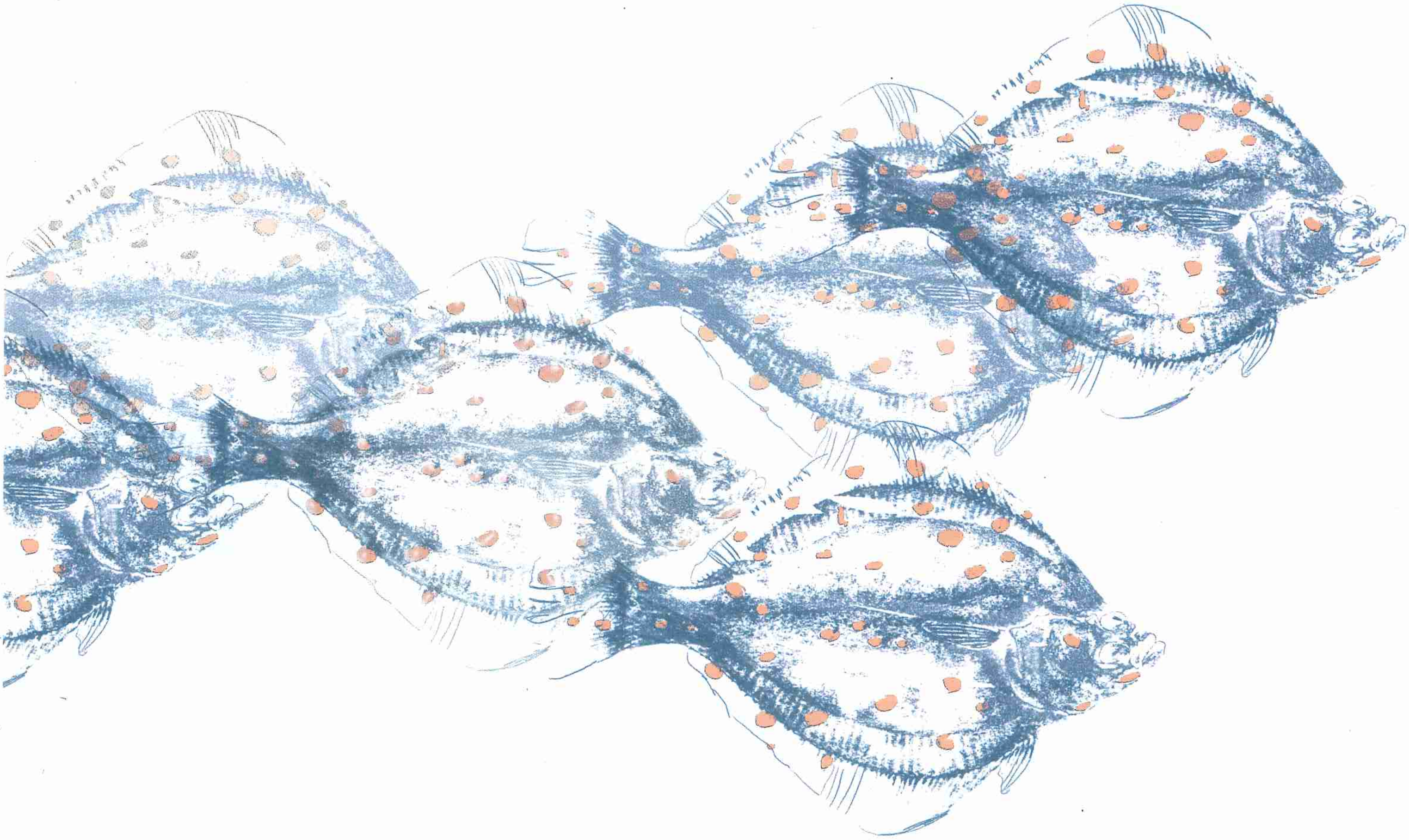

Centrum voor Visserijonderzoek (CVO)

Stichting Wageningen Research Centre for Fisheries Research (CVO)

Discard self-sampling of the Dutch bottom-trawl fisheries in 2019

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Summary

In the European Union the collection and management of fisheries data is regulated through the Data Collection Framework (DCF) of the European Commission (EC). Within this context, Wageningen Marine Research (WMR) coordinates a discards monitoring programme in collaboration with the Dutch demersal fishing industry. A 'reference fleet' of vessels of which the owners are willing to participate in a self-sampling programme, was recruited in 2009 and has been extended and updated regularly. Annually approximately 160 trips need to be sampled by the reference fleet. Fishermen within the reference fleet are requested to collect discard samples of two hauls according to a definite annual sampling plan. In order to avoid any potential bias in trip selection and to work conform the statistical sound principles as defined in the DCF recast, from 2018 onwards the trips are randomly divided over the reference fleet and any refusals are recorded. After the discard samples are brought to shore, WMR collects and analyses these samples. This report summarizes data that has been collected within this self-sampling monitoring programme in 2019.

In 2019 the reference fleet consisted of 21 vessels. In total, 158 trips were sampled in 2019. All sampled trips were assigned to their respective metiers post sampling, based on gear type, mesh size and species composition of the catch. Eight different metiers were assigned: beam trawlers with 80 (engine power > 300 hp and engine power ≤ 300 hp), 100-119 and ≥120 mm mesh size, and otter trawlers with 70-99 mm mesh size (targeting Nephrops, mixed crustaceans and demersal species, or demersal fish) and 100-119 mm mesh size.

Observed discard patterns are quite similar between all metiers; dab and undersized plaice are the most frequently discarded fish species. The majority of the benthic, non-fish, discards consisted of echinoderms and crustaceans. In order to monitor annual discard percentages, it is essential that the sampled trips follow the distribution of the fleet both in space and time; a mismatch between sampling and the distribution of the fleet could indicate a possible bias in the discard estimate. The results shows that sampling effort of the most intensely sampled metiers (i.e. TBB_DEF_70-99) indeed follows the fleet through space and time. However, for the less frequently sampled metiers this does not always appear to be the case.

An important element in the reform of the Common Fisheries Policy (CFP) is the obligation to land all catches, i.e. a discard ban. Under this landing obligation all discards of quota regulated species have to be landed. For the demersal fisheries the landing obligation has been phased in over a number years. It is clear that as discarding will continue under various forms of exemptions (high survivability, *de minimis*, prohibited species), a discards monitoring programme remains necessary under the landing obligation. From 2016 onwards, monitoring of the catch fraction *Below Minimum Size* (BMS) has been included in the sampling protocol of the discards monitoring programme. So far, BMS has observed and registered sporadically in the self-sampling trips.

Samenvatting

In de Europese Unie wordt het verzamelen en beheren van visserijgegevens gereguleerd door middel van de Data Collectie Verordening (DCF) van de Europese Commissie (EC). Binnen deze regulatie, coördineert Wageningen Marine Research (WMR) een discards zelfbemonsteringsprogramma in samenwerking met de Nederlandse demersale visserij. In dit project wordt gebruik gemaakt van een 'referentie vloot', bestaande uit een groep Nederlandse commerciële vissers die zich willen inzetten voor het onderzoek. Deze referentievloot is in 2009 opgezet en is sindsdien uitgebreid en regelmatig gedeeltelijk vernieuwd. Jaarlijks moeten in totaal ongeveer 160 trips door de referentievloot bemonsterd worden. De vissers van de referentievloot wordt gevraagd om voor specifieke visreizen, die aan het begin van het jaar zijn vastgesteld, een deel van de discards (d.w.z. de vangst die anders overboord zou zijn gegaan) van twee vistrekken aan boord te houden. Om een mogelijk vertekend beeld in de verzamelde gegevens te voorkomen, worden vanaf 2018 de bemonsterde reizen willekeurig over de referentievloot verdeeld, zoals verzocht in de herziene versie van de DCF. De monsters met bijbehorende gegevens over de totale vangst per trek, visserij-inspanning en vispositie worden aangeland en aan WMR overgedragen. WMR zorgt voor de verdere verwerking van de monsters. Voorliggend rapport presenteert de resultaten van het zelfbemonsteringsproject van de Nederlandse demersale vloot opererend in de Noordzee (ICES deelgebied IV) in 2019.

In 2019 bestond de referentievloot uit 21 schepen. In totaal zijn 158 visreizen bemonsterd in 2019. Op basis van vistuig, maaswijdte en soortensamenstelling van de vangst zijn alle bemonsterde visreizen naderhand aan een metier toegekend. In 2019 zijn acht verschillende metiers bemonsterd: boomkorschepen vissend met 70-99 (waarbij onderscheid gemaakt wordt tussen Eurokotters (d.w.z. vissend met een motorvermogen ≤ 300 pk) en grote kotters (d.w.z. vissend met een motorvermogen > 300 pk)), 100-119 en ≥120 mm maaswijdte, en otter trawlers vissend met 70-99 (waarbij onderscheid gemaakt wordt tussen schepen die voornamelijk Noorse kreeft vangen, schepen die voornamelijk demersale vis vangen en daarnaast Noorse kreeft, en schepen die demersale vis vangen en geen Noorse kreeft) en 100-119 mm maaswijdte.

De waargenomen patronen in de discards zijn vergelijkbaar tussen de verschillende metiers; schar en ondermaatse schol zijn de meest voorkomende soorten in de visdiscards. De meerderheid van de benthos discards bestonden uit stekelhuidigen (verschillende zeestersoorten) en kreeftachtigen (zoals zwemkrabben en Noorse kreeft). Om jaarlijkse discardsschattingen van de Nederlandse demersale vloot te bepalen, is het essentieel dat de bemonstering de vloot representeert in ruimte en tijd; een mismatch tussen de verspreiding van de bemonstering en de vloot kan tot een vertekend beeld van de discardsschattingen leiden. De resultaten laten zien dat de bemonsteringsinspanning van de meest bemonsterde metier (d.w.z. boomkor metier gericht op tong) de vloot volgt in de ruimte en tijd. Voor de minder intensief bemonsterde metiers is dit echter niet altijd het geval.

Een belangrijk element in de herziening van het Gemeenschappelijk visserijbeleid (GVB) is de verplichting om alle vangsten aan land te brengen. Onder deze aanlandplicht moeten alle discards van commerciële soorten die gereguleerd worden door quota aangeland worden. Binnen de demersale visserij is de aanlandplicht tussen 1 januari 2016 en 1 januari 2019 ingevoerd. Het is duidelijk dat onder de aanlandplicht waarbinnen discarden, vanwege verschillende uitzonderingen (hoge overleving, de minimis), tot op zeker hoogte zal blijven bestaan, een discards monitoringsprogramma nodig blijft. Sinds 2016 is de monitoring van de vangstfractie *Below Minimum Size* (BMS) opgenomen in het bemonsteringsprotocol van de zelfbemonstering. Tot op heden, is BMS alleen sporadisch waargenomen in de zelfbemonsteringsreizen.

1 Introduction and quality assurance

1.1 Background

Discarding unwanted organisms in European fisheries is unavoidable in mixed fisheries (Feekings et al., 2012). Reasons for discarding could be economic (if there is no commercial value for the species caught) or because of regulatory measures (such as minimum landing size or catch limits (quota)) (Catchpole et al., 2005; Rochet and Trenkel, 2005; Poos et al. 2010; Suuronen & Gilman, 2020). Keeping record of quantities being discarded improves scientific stock assessments and advice on quota, enabling more accurate estimates of total fishing mortality.

Box 1: Data Collection Framework (DCF)
In the European Union (EU) the collection and management of fisheries data is enforced through the Data Collection Framework (DCF) of the European Commission (EC) (EU 2016/1701, EU 2016/1251 and EU 2017/1004). The DCF states which information should be collected, managed and made available by the Member States (MS) for scientific advice regarding the Common Fisheries Policy (CFP). For this purpose all MS are obliged to submit a work plan for data collection in the fisheries and aquaculture sectors on a multiannual basis.

The collection of discard data is enforced through the EC DCF (Box 1). The DCF requires the implementation of at-sea monitoring programmes, which should deliver valid estimates of discards for each type of fisheries, temporal periods and areas. To comply with this ruling an observer programme with scientifically-trained observers have been in place since 2000 for which annually 6-18 active demersal fishing trips have been monitored. In 2009, revisions to the DCF required member states to increase sampling intensity to i) improve precision of their estimates and (ii) the number of sampled fishing fleets (metiers). In foresight of the expenses involved, an affordable self-sampling programme commenced in the Netherlands for the Dutch demersal active fisheries in the North Sea in 2009. Within this programme discard data are collected for Dutch bottom-trawl fisheries for a number of metiers, which are defined in the DCF based on gear type, target species assemblage, and mesh characteristics. To verify the accuracy and objectivity of self-sampling, every year, 10 observer trips are carried out on board of fishing vessels that participate in the programme. The relationship between the catches of both observers and the self-sampling programme are explored for correlation and systematic differences (Paper in prep). In addition, the observer trips have proven to be of importance for training crew members in sampling of discards. Also, the observer trips are appreciated by members of the reference fleet, as it bridges the gap between scientists and crew. The data from these observer trips are solely used for verification and, therefore, excluded from this report.

The aim of this report is to present an overview of the data that has been collected within the Dutch self-sampling programme of bottom-trawl fisheries in 2019. The data is used for further analyses within different projects, including stock assessment working groups (ICES, 2020).

1.2 Quality assurance

CVO is certified to ISO 9001:2015 (certificate number: 268632-2018-AQ-NLD-RvA). This certificate is valid until December 15th, 2021. The certification was issued by DNV GL Business Assurance B.V

2 Methods

2.1 Discard self-sampling programme

2.1.1 Reference fleet

A 'reference fleet', consisting of 21 vessels in 2019, with protocol-instructed fishers collected discard samples according to a predefined schedule during their regular commercial operations. The participants in the reference fleet are recruited by actively approaching vessels and though the fishers organisation while taking the composition of the entire Dutch demersal active fleet into account. Prior to sampling, fishers were provided with all necessary equipment (labels, plastic sampling bags, sealing cable ties, markers, and sampling sheets) and written instructions. Additionally, WMR staff visited the crew in port regularly to evaluate and, when necessary, to reinstruct the sampling protocol. The fishermen receive a fixed compensation for each trip they have sampled.

2.1.2 Sampling and data collection procedures

Annually approximately 160 trips need to be sampled. These trips were randomly divided over the reference fleet and any refusals of randomly assigned trips were recorded.

Operational- and catch data are collected each time the fishing gear is deployed (each 'haul') during a fishing trip. With each haul the following information was registered: vessel position (at start and end); haul duration; depth; weather conditions; and the volumes of catches and landings. The total volume of discards of each haul was calculated by subtracting the retained amount of catch, which was recorded by the fisherman, from the total catch which was estimated by the skipper/crew.

Within a trip, the crew was instructed to retain a sample, consisting of two boxes of discards (one box equals approx. 40 kg), from two separate hauls, thus collecting a total of approx. 160 kg of discards per trip. These boxes were filled by scooping discards at regular intervals from the end of the processing conveyer belt. Crew members sample the discards while other crew members sort and select the commercial catch. The samples were collected in large plastic bags, which were sealed off using a cable tie, labelled and cool-stored until the vessel returns to the port. Back at port, the discard samples were collected by WMR staff and taken to the laboratory for analysis.

Numbers at length were recorded for all fish species, Norway lobster *(Nephrops norvegicus,* hereafter termed *Nephrops*) and edible crab (*Cancer pagurus)*. Numbers without length measurements were recorded for all remaining (benthos) species. Standard data management software was used to enter and subsequently audit all data before the data were stored in the centralised WMR Frisbe database.

2.1.3 Metier classification

All sampled trips were assigned to their respective metiers based on level 6 for the metier classification as defined by the European Union (EU) decision (2016/1251, Table 2) after the trip was executed (Table 1).

Within the Dutch beam trawl metier (TBB_DEF 70-99 mm), a distinction is made based on the vessel's engine power. Due to national regulations, only vessels with an engine power of ≤300 hp (so called "Eurocutters") are allowed to fish in a marine protected area ("plaice box") and the Dutch 12-mile zone.
To reflect this spatial difference of the fleet -which also has implications on their discarding pattern- in the following analysis, summaries of the discard data are presented separately for Eurocutters (termed TBB_DEF_70-99mm_S300hp) and the remaining part of the beam trawl fleet (termed TBB_DEF_70-99mm_G300hp; Table 1). The total number of samples per metier depends on the fleet composition of the reference fleet.

2.2 Raising procedures

See figure 1 for a flow-chart of the raising procedure. Numbers (at length) were registered for all (fish) species for each sample. The numbers (at length) in the samples were multiplied with the volume ratio between discard sample and total discards to estimate total numbers (at length) within each haul.
Whenever a species was very abundant within the sample, a sub-sample of this species was counted. When subsampling was conducted, the numbers (at length) were multiplied with the sub-sample fraction to estimate total numbers (at length) within the sample.

Next, length/weight-relationships[1] were applied to convert numbers at length to weight for all fish species. Both numbers (fish and benthos) and weights (fish) for the two sampled hauls in each trip were summed. These numbers and weights were then standardized into discards per unit effort rates (expressed in number/hour and kg/hour) by dividing them by the deployment duration (i.e. fishing time). Total numbers and weights per fishing trip were calculated by multiplying the standardized rates with the total duration of all hauls together. It is assumed that the sampled hauls per trip are representative in species composition and variance for all the other hauls within the sampled trip.

2.3 Fleet effort

The fleet effort was calculated using the WMR VISSTAT database containing the official Dutch logbook information. In this database, the date and time of port departure and arrival, and other vessel characteristics (such as gear type, engine power, mesh size) are registered for all Dutch fishing vessels over 12 metres. Time between departure and arrival was multiplied by the engine power of each vessel, resulting in a measure of fishing effort expressed as kWdays. The ratio between fleet effort and sampling effort (i.e. the fishing effort of the sampled trips expressed as kWdays) has been used as an auxiliary variable to estimate total discards by species for the Dutch demersal fleet by metier. Since 2011, total discard data from the reference fleet have been used in several ICES Working Groups for the assessment of stocks in the North Sea, such as plaice, cod, sole, whiting, turbot, brill and *Nephrops* (ICES, 2020). Furthermore, the data is also sent to the STECF Expert Working Group on Fisheries Dependent Information (STECF, 2020).

The fleet effort by ICES rectangle, metier and quarter has been extracted from the WMR VISSTAT database and plotted together with the sampled trawls in order to visually inspect the overlap between the sampled trips and the fleet in time and space.

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[1] The L/W relationships for plaice (*Pleuronectus platessa)*, sole (*Solea solea*), turbot (*Scophthalmus maxima*), brill (*Scophthalmus rhombus*) and thickbacksole (*Microchirus variegatus*) are based on WMR data. For all other species these relations are based on literature.

3 Results

3.1 Data selection

In total, 167 trips were sampled in 2019. Trips that were not sampled according to the sampling protocol and/or trips for which essential information was missing were considered invalid and excluded from the analysis. This resulted in 158 valid trips. All sampled trips (Table 2b) were assigned to their respective metiers post-sampling, based on gear type, mesh size and species composition. Sampling was conducted on board of vessels from eight different metiers; beam trawlers with 80 (engine power > 300 hp and engine power ≤ 300 hp), 100-119 and ≥120 mm mesh size, and otter trawlers with 70-99 mm mesh size (targeting Nephrops, mixed crustaceans and demersal species, or demersal fish) and 100-119 mesh size. It should be noted that for some metiers the results are based on a small number of trips (Table 2b). These results can therefore only be used as an indication for discard patterns, and not as exact estimates.

A visual inspection on whether the collected sampled trips follow the distribution of the fleet through space and time give a first indication on representativeness of the sampled data for the entire fleet. The results shows that sampling effort of the most-intensely sampled metiers (i.e. TBB_DEF_70-99) indeed follows the fleet through space and time. However, for the less frequently sampled metiers this not always appears to be the case; for example for TBB_DEF_100-119 in Quarter 3 (Figure 3).

3.2 TBB_DEF_70-99_G300hp

Within this beam trawl metier, different types of innovative gears are deployed. Since 2009, fishermen have been switching from traditional beam to pulse trawling. The pulse fishery uses electric stimulation instead of tickler chains to stun fish from the seabed and move them into the net. Pulse gear increases sole catches and decreases fuel use in comparison with the traditional beam trawl gear (Rijnsdorp et al., 2020; van Marlen et al., 2014). Another innovate gear within this metier is the sumwing. This device is designed to “fly” over the bottom, whereas traditional beam trawls have “shoes”, steel beam heads that keep space between the beam and the sea floor (van Marlen et al., 2009).

The large (>300hp, often >35m LOA) beam trawlers make up the majority of the Dutch demersal fishing fleet, with a fleet effort of 23709878 kWdays in 2019 (Table 2a, Figure 2). 91 trips were sampled for this metier, which coincides with a sampling coverage of 3.4% (Tables 2b,3). Sampling was highest in quarter 4 (Table 2b). Figure 3 shows the distribution of total fleet effort by year and corresponding positions of sampled trawls.

Plaice is the most abundant species in the landings, followed by sole. Turbot, brill and dab, and various other species make up the rest of the landings (Table 4).

Plaice and dab are the most frequently discarded fish species within this fleet (Tables 4,5,8). Plaice is discarded because it is undersized and therefore not allowed to be landed (Figure 4). Dab is discarded because of its low commercial value. Most other fish species that are discarded include smaller flatfishes (e.g. scaldfish (*Arnoglossus laterna*), solenette (*Buglossidium luteum*), undersized sole (*Solea solea*)) or other demersal species (e.g. common dragonet (*Callionymus lyra*), grey gurnard (*Eutrigla gurnardus*)). In addition, the bentho-pelagic oriented species (e.g. whiting (*Merlangius merlangus*)) for which no individual quota is available for the demersal fleet, is encountered frequently in the discards (Table 8). The majority of the benthos discards consisted of echinoderms (sand sea star (*Astropecten irregularis*), common starfish (*Asterias rubens*), serpent star (*Ophiura ophiura*), sea potato (*Echinocarium cordatum*), green sea urchin (*Psammechinus miliaris*)) and crustaceans (swimming crab (*Liocarcinus* sp.), masked crab (*Corystes cassivelaunus*), hermit crab (hermit crab (*Pagurus bernhardus*) and angular crab (*Goneplax rhomboides)*) species (Table 9).

3.3 TBB_DEF_70-99_S300hp

Eurocutters (<300hp) are allowed to fish in the Dutch 12-mile zone and the plaice box (Beare et al., 2013). This is reflected in the distribution of the fleet effort and the sampling locations (Figure 3). During fall and winter the Eurocutters move a little more offshore than in spring and summer (van der Reijden et al., 2014). This might be a response of fishermen to seasonal variation in sole and plaice distribution (Poos & Rijnsdorp, 2007).

18 trips were sampled for this metier, which coincides with a sampling coverage of 2.4% (Tables 2b,3). Sole and plaice are the most frequently landed species within this metier (Table 4). Dab, turbot and brill and various other species make up the rest of the landings. Dab and undersized plaice are the most frequently discarded species within this fleet (Tables 4,5,8, Figure 4). Most other fish species that are discarded include undersized sole, flounder (*Platichthys flesus*), scaldfish and solenette (Table 8). The three most discarded benthic species include serpent star, common starfish and swimming crab (Table 9).

3.4 TBB_DEF_100-119

The large beam trawlers (>300 hp) fishing with a mesh size of 100-119mm target plaice at the Dogger Bbank (Figure 3). The large mesh sized beam trawler metier is a seasonal fishery, with highest effort in quarters 2 and 3 (Table 2a, Figure 2). 10 trips were sampled for this metier, which coincides with a sampling coverage of 7.2% (Tables 2b,3). Sampling took place in Quarters 2, 3 and 4 (Table 2b).

Plaice is the most frequently landed species within this metier (Table 4). Dab and undersized plaice are the most frequently discard fish species (Tables 4,5,8 and Figure 4). However, the observed discard estimate for plaice is lower than the small mesh sized beam trawlers; 36% of plaice catch is discarded in TBB_DEF_100-119 (i.e. 51.8 individuals discarded per hour / 51.8 individuals discarded per hour + 92.08 individuals landed per hour (Table 4)) *vs*. 69% of the plaice catch is discarded in TBB_DEF_70-99_G300hp (i.e. 74.59 individuals discarded per hour / 74.59 individuals discarded per hour + 33.57 individuals landed per hour (Table 4)). The average number per hour discarded starry ray (*Amblyraja radiata*) was highest within this metier in comparison with the other sampled metiers (Table 8). This is most likely due to the fact that the spatial distribution of this fisheries overlaps with the natural distribution of this species (van Overzee et al., 2019a). The discarded benthic species are dominated by the sand seastar followed by the common starfish (Table 9).

3.5 TBB_DEF_>=120

The effort of the large beam trawlers (>300hp) with fishing with a mesh size of 120mm has increased substantially since 2011. In 2019 the total effort was 5.5 times higher than in 2011 (Table 2a *vs.* van der Reijden et al., 2014; Table 2). TBB_DEF_>=120 is a seasonal fishery, with peaking effort in spring and summer (quarters 2 and 3) (table 2a, Figure 2). The majority of the effort is concentrated at the Dogger Bank and northeast of the Dogger Bank (Figure 3). In winter, effort is reduced (Table 2a). This probably reflects a (seasonal) shift towards the deployment of small meshed nets (TBB_DEF_70-99), which target sole (van der Reijden et al., 2014). 11 trips were sampled for this metier, which coincides with a sampling coverage of 2.3% (Tables 2b,3).

Plaice is the most frequently landed species within this metier (Table 4). Undersized plaice and dab were the most frequently discarded fish species (Tables 4,5,8, Figure 4). The two most common discarded benthic species were sand seastar followed by the sea potato (Table 9).

3.6 OTB_CRU_70-99

Even though otter trawlers fishing with small mesh size (OTB_70-99) operate with similar gear, the target species may differ. To discriminate between the different fisheries, the metiers are classified (post sampling) based on landing data per trip. If *Nephrops* from otter-trawl gears (OTB/OTT) composes more than 30% of the landings in a trip, this trip is classified as a crustacean (OTB_CRU) targeting metier. If *Nephrops* composes less than 30% and > 0% of landings in a trip, the trip is classified as a mixed crustacean and demersal fish (OTB_MCD) targeting metier. If no *Nephrops* is landed, the trip is classified as a demersal fish (OTB_DEF) targeting metier. It should be noted that this results in a knowledge deficiency of the initial purpose of the fishing trip (which is probably linked to fishing location), as an unsuccessful trip for *Nephrops* will be classified as OTB_MCD or OTB_DEF and the other way round.

The *Nephrops* fishery is a seasonal fishery, with peaking effort in spring and summer (quarters 2 and 3) (Table 2a, Figure 2). *Nephrops* occur in specific habitats, which to some extent is visualised in the distribution of the total effort of this metier (Figure 3). 11 trips were sampled for this metier, which coincides with a sampling coverage of 1.6% (Tables 2b,3). Sampling effort was, just as the fleet effort, highest in quarters 2 and 3 (Tables 2a,b).

This metier lands most *Nephrops* of the sampled demersal metiers (Table 4). Plaice also comprises a large part of the landings (Table 4). Turbot, brill and various other species make up the rest of the landings (Table 4). Dab, undersized plaice, grey gurnard and whiting are the most frequently discarded fish species (Tables 4,5,8, Figure 4). *Nephrops* was the most frequently discarded benthic species. Figure 4 shows that the majority of the discarded *Nephrops* was of marketable size (i.e. above minimum landing size). Furthermore, the sand sea star, common starfish, and swimming crabs belonged to the most frequently discarded benthic species (Table 9).

3.7 OTB_MCD_70-99

OTB_MCD_70-99 shows a dip in the effort in Q3 (Table 2a, Figure 2). The distribution of the total effort of this metier is similar to that of OTB_CRU_70-99 (Figure 3). 11 trips were self-sampled for this metier, resulting in a sampling coverage of 7.7% (Tables 2b,3). Plaice is the most frequently landed species within this metier, followed by *Nephrops* (Table 4). Turbot, brill and various other species make up the rest of the landings (Table 4). Dab, undersized plaice, whiting and grey gurnard are the most frequently discarded fish species (Tables 4,5,8, Figure 4). Overall, *Nephrops* was the most abundant benthic species in the discards (Table 9). Figure 4 shows that the majority of the discarded *Nephrops* was of marketable size (i.e. above minimum landing size). Thereafter swimming crabs were the most frequently discarded benthic species (Table 9).

3.8 OTB_DEF_70-99

Effort of OTB_DEF_70-99 was highest in autumn and winter (Table 2a, Figure 2). Only 1 trip was sampled for this metier in 2019 (Table 2b). Therefore, information of discards in this metier is only indicative. Plaice was the most landed species in the sampled trip, followed by sole, brill and turbot (Table 4). Undersized plaice, dab and sand sea star were the most frequent discarded species in the sampled trip (Tables 4,5,8,9, Figure 4).

3.9 OTB_DEF_100-119

This metier is a seasonal fishery, with a peak in fleet effort in quarters 2 and 3 (Table 2a, Figure 2). 5 trips were sampled; only quarters 3 and 4 were sampled for this metier (Table 2b).

This metier targets plaice, at the Dogger Bank (Table 4, Figure 3). Dab and undersized plaice are the most frequently discarded fish species, followed by grey gurnard and whiting (Tables 4,5,8 and Figure 4). Benthos discards are dominated by sand sea star (Table 9).

4 Discussion

4.1 Discard patterns

Discard patterns are quite similar between the eight sampled bottom trawling metiers; dab and undersized plaice are the most frequently discarded species. The majority of the benthic, non-fish, discards within the beam trawl and otter trawl metiers consisted of echinoderms and crustaceans. From 2017 onwards the flyshoot fishery has not been part of the reference fleet (Verkempynck et al., 2018). As discarding patterns of the flyshoot fishery differ from the bottom-trawl fishery (Verkempynck et al., 2018), and the flyshoot fishery represents ~3-4% of the total Dutch demersal fleet effort (van Overzee et al., 2019b), efforts have been and will continue being made to reintroduce this fishery in the monitoring programme.

4.2 Data Collection Framework

The reform of the DCF in 2009 required member states to increase sampling intensity. In order to meet this requirement within an affordable budget, WMR commenced, next to its since 2000 existing observer programme, a self-sampling programme in 2009. Within this self-sampling programme vessels were recruited where fishers were willing to retain fractions of their discards during some of their fishing trips. The sampled fishing trips were selected, at the beginning of each monitoring year, in cooperation with the participating vessels. The self-sampling programme has resulted in increased spatial and temporal coverage of the discard sampling of the Dutch demersal fishery in comparison with the observer programme. Although an increase of sampling intensity will most likely improve precision levels of discard estimates, it does not necessarily improve their accuracy (Uhlmann et al., 2013).

The DCF recast, which came into force in 2017, and its accompanying Commission Decisions tackle this (potential) issue by obliging Member States to implement a sampling design that is established according to statistical sound principles. The correct implementation of a statistically sound sampling scheme should reduce any potential bias in the discard data and therefore increase the representativeness of the data for the entire fleet.

Ideally, this would mean that all sampled trips are randomly selected from the Dutch demersal active fleet when sampling its discards, and refusal rates are recorded. In practice, such a random approach will increase the time and effort to collate the discard data enormously. Therefore, working with a reference fleet is a practically desirable alternative option. However, it is important that the reference fleet mirrors the Dutch demersal active fleet with respect to their overall discarding patterns. As a result, since 2018 the sampled trips have randomly been divided over the reference fleet and any refusals are recorded. Figure 3 shows that for the less frequently sampled metiers that sampling effort does not always follow fleet effort in time and space. In order to solve this issue, an increase in sampling intensity is needed, and, consequently, an extension of the reference fleet for these metiers would be necessary. As the data collection under the DCF is based on end-user needs (both in quantitative as qualitative aspects), the end-user should, ideally in consultation with the data provider, flag and argue when sampling intensity should be increased in time and space.

4.3 Reform of the Common Fisheries Policy

An important element in the reform of the CFP is the obligation to land all catches, i.e. a discard ban. Under this landing obligation all discards of commercial species that are regulated by quota have to be landed and are categorised as Below Minimum Size (BMS). The landing obligation has a particular strong impact on the Dutch demersal fishing industry. For the demersal fisheries the landing obligation has been phased in over a number of years, starting in 2016 and full implementation in January 2019. It is clear that as discarding will continue under various forms of exemptions (high survivability, *de minimis*, prohibited species), a discards monitoring programme remains necessary under the landing obligation. Furthermore, additional monitoring of BMS needs to be captured in the sampling programme. From 2016 onwards, BMS sampling has been included as a separate catch fraction in the sampling protocol of the discards monitoring programme. BMS has been collected and registered only sporadically in the self-sampling trips since the phasing in of the landing obligation. The collected information of the BMS catch fraction is not reported here, as it is considered incomplete and therefore may be interpreted wrongly.

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5 Tables and Figures

Table 1: List of Dutch bottom-trawl metiers sampled in 2019. Note that not all metiers are sampled for discards each year. These have been classified according to European Union (EU) definitions (2016/1251 Table 2) requiring information about gear type (i.e. demersal beam – TBB; otter trawl - OTB/OTT), 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**
TBB (> 300 hp)*	DEF	70-99 **
TBB (≤ 300 hp)*	DEF	70-99 **
TBB	DEF	100-119
OTB***	CRU	70-99
OTB***	MCD	70-99
OTB***	DEF	70-99
OTB***	DEF	100-119
OTB***	DEF	≥120

* Note that the TBB metier 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".

** Note, that due to regulation vessels within this metier do not fish with a mesh size < 80 mm.

*** In this report, all OTB should be read as OTB/OTT/QUA, as in logbook in the Netherlands data otter (OTB), pair trawl (OTT), and quadrig gear can be used interchangeably.

Table 2a. Summary of the effort (in kWdays) for the sampled fleet in **2019** by quarter.

	2019				
Metier	Q1	Q2	Q3	Q4	**Total**
OTB_DEF_100-119_0_0	17968	292514	426032	94585	**831099**
OTB_CRU_70-99_0_0	124861	379132	329729	136024	**969746**
OTB_MCD_70-99_0_0	74628	75383	44199	95831	**290041**
OTB_DEF_70-99_0_0	929	9426	21076	17695	**49126**
TBB_DEF_>=120_0_0	453547	1486823	1710302	846780	**4497452**
TBB_DEF_100-119_0_0	85594	495002	331653	27381	**939630**
TBB_DEF_70-99_0_0_G300hp	7097816	4942540	5103362	6703288	**23847006**
TBB_DEF_70-99_0_0_S300hp	213208	380513	196731	135908	**926360**
Total	**8068551**	**8061333**	**8163084**	**8057492**	**32350460**

Table 2b. Summary of the number of valid self-sampled trips per metier for **2019** by quarter.

	2019				
Metier	Q1	Q2	Q3	Q4	**Total**
OTB_DEF_100-119	NA	NA	2	3	**5**
OTB_CRU_70-99	1	4	5	1	**11**
OTB_MCD_70-99	2	NA	1	8	**11**
OTB_DEF_70-99	NA	NA	NA	1	**1**
TBB_DEF_>=120	2	6	1	2	**11**
TBB_DEF_100-119	NA	4	4	2	**10**
TBB_DEF_70-99_G300hp	16	16	15	44	**91**
TBB_DEF_70-99_S300hp	9	3	4	2	**18**
Total	**31**	**35**	**32**	**60**	**158**

Table 3. Sampling and fleet effort (in kWdays) of sampled metiers, and sampling coverage (% of kWdays) per self-sampled metier for **2019**.

Metier	**Sampling effort (kWdays)**	**Fleet effort (kWdays)**	**Sampling coverage kWdays (%)**
OTB_DEF_100-119	14180.3	831099	1.7
OTB_CRU_70-99	15905	969746	1.6
OTB_MCD_70-99	22339	290041	7.7
OTB_DEF_70-99	4526.25	49126	9.2
TBB_DEF_>=120	104510.2	4497452	2.3
TBB_DEF_100-119	67649.31	939630	7.2
TBB_DEF_70-99_G300hp	808078.8	23847006	3.4
TBB_DEF_70-99_S300hp	22205	926360	2.4

Table 4. Average weights (in kg) per hour of discarded (Dis) and landed (Lan) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod (COD), whiting (WHG) and *Nephrops* (NEP) by metier for **2019**. N= number of sampled trips.

Year	Metier	N	Dis BLL	Lan BLL	Dis COD	Lan COD	Dis DAB	Lan DAB	Dis NEP	Lan NEP	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis TUR	Lan TUR	Dis WHG	Lan WHG
2019	OTB_DEF_100-119_0_0	5	0	1.33	0	0.02	26.32	4.19	1.65	3.25	43.49	66.22	0	0.04	0.18	4.11	1.46	0
	OTB_CRU_70-99_0_0	11	0	1.22	0.32	0.04	69.15	0.77	15.68	21.9	37.47	13.86	0.09	0.3	0.14	2.79	2.97	0.05
	OTB_MCD_70-99_0_0	11	0	2.95	0.24	0.2	32.24	0.36	22.25	10.44	39.2	22.96	0.04	0.49	0	2.97	11.95	0.06
	OTB_DEF_70-99_0_0	1	0	4.79	0	0	6.08	0	0	0	27.71	28.69	0.06	13.52	0	3.61	0.03	0
	TBB_DEF_>=120_0_0	11	0.05	1.87	0.24	0.11	19.29	9.55	0.19	0.12	50.83	162.19	0.02	1.93	0	4.15	0.29	0
	TBB_DEF_100-119_0_0	10	0.06	1.77	0	0.04	57.82	4.5	0.25	3.55	51.8	92.08	1.05	3.51	1.07	6.14	0.78	0.2
	TBB_DEF_70-99_0_0_G300hp	91	0.25	2.41	0.07	0.05	39.9	1.82	0.09	0.04	74.59	33.57	5.12	23.83	0.43	5.43	8.13	0
	TBB_DEF_70-99_0_0_S300hp	18	0.77	0.3	0	0.01	40.64	0.97	0	0	51.59	8.97	8.88	11.06	1.06	0.86	1.23	0.09

Table 5. Average numbers per hour of discarded (commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod (COD), whiting (WHG) and *Nephrops* (NEP) by metier for **2019**. N= number of sampled trips. *) Metier not sampled.

Year	Metier	N	BLL	COD	DAB	NEP	PLE	SOL	TUR	WHG
2019	OTB_DEF_100-119_0_0	5	0	0.05	388.59	73.67	345.32	0	0.55	24.57
	OTB_CRU_70-99_0_0	11	0	1.73	1106.28	684.63	391.25	0.9	0.73	71.4
	OTB_MCD_70-99_0_0	11	0	1.19	531.8	1107.3	362.65	0.32	0	186.15
	OTB_DEF_70-99_0_0	1	0	0	143.12	0	310.75	1.23	0	0.95
	TBB_DEF_>=120_0_0	11	0.26	1.23	266.37	6.87	497.05	0.83	0	4.74
	TBB_DEF_100-119_0_0	10	0.39	0	802.57	11.34	466.55	14.37	5.63	10.59
	TBB_DEF_70-99_0_0_G300hp	91	1.36	0.48	733.09	3.43	953.16	73.36	2.06	132.53
	TBB_DEF_70-99_0_0_S300hp	18	6.35	0	625.91	0	660.84	179.41	9.14	18.01

Table 6. 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 (COD), whiting (WHG) and *Nephrops* (NEP) by metier and quarter (Q) in **2019.**

Metier	Q	N	Dis BLL	Lan BLL	Dis COD	Lan COD	Dis DAB	Lan DAB	Dis NEP	Lan NEP	Dis PLE	Lan PLE	Dis SOL	Lan SOL	Dis TUR	Lan TUR	Dis WHG	Lan WHG
OTB_DEF_100-119_0_0	1	1	0	0	0	0	26.74	13.92	0	0	56.92	189.48	0	0	0	2.05	0	0
OTB_CRU_70-99_0_0	1	1	0	0	0	0	12.88	1.22	2.13	36.81	8.96	44.26	0	0.01	0	0.7	0.88	0
OTB_MCD_70-99_0_0	1	2	0	0.72	0.05	0.11	28.15	0.74	2.77	15.15	33.67	33.81	0	0.03	0	0.81	25.3	0
TBB_DEF_>=120_0_0	1	2	0	0.75	0.06	0	72.7	3.7	1.03	0.68	95.04	100.66	0.13	8.03	0	6.86	0.63	0
TBB_DEF_70-99_0_0_G300hp	1	16	0.14	2.03	0.02	0.15	47.5	2.05	0.21	0.13	50.49	24.08	5.15	26.59	0.15	3.62	5.57	0
TBB_DEF_70-99_0_0_S300hp	1	9	0.73	0.31	0	0.03	53.1	1.28	0	0	48.3	7.89	10.64	12.84	0.2	0.34	1.48	0.15
OTB_CRU_70-99_0_0	2	4	0	0.28	0.52	0.09	92	0.36	9.67	21.54	36.91	12.55	0	0.08	0.14	1.82	2.58	0.07
TBB_DEF_>=120_0_0	2	6	0.09	0.44	0.32	0.2	9	9.65	0	0	42.2	177.92	0	0.65	0	2.19	0.18	0
TBB_DEF_100-119_0_0	2	4	0.05	0.62	0	0.09	25.45	5.22	0	0	70.61	141.42	0	0	0.04	4.16	0	0
TBB_DEF_70-99_0_0_G300hp	2	18	0.6	1.09	0.14	0.02	25.86	1.17	0	0	67.62	33.86	5.39	20.59	0.18	2.5	14.2	0
TBB_DEF_70-99_0_0_S300hp	2	3	1.77	0.73	0	0	72.64	2	0	0	59.73	13.57	8.51	9.72	0.12	1.39	0.86	0.11
OTB_DEF_100-119_0_0	3	1	0	1.53	0	0	79.74	0.64	6.16	2.51	146.76	12.77	0	0.17	0.75	5.32	5.93	0
OTB_CRU_70-99_0_0	3	5	0	2.02	0.2	0.02	75.8	1.16	26.14	22.53	47.43	10.49	0.21	0.5	0.19	4.26	3.84	0.05
OTB_MCD_70-99_0_0	3	1	0	3.85	0.53	0	68.29	0.6	43.96	11.53	53.09	16.64	0	0.48	0	4.53	8.75	0
TBB_DEF_>=120_0_0	3	1	0	0	0	0	7.62	39.73	0	0	38.68	171.43	0	1.2	0	1.44	0.11	0
TBB_DEF_100-119_0_0	3	4	0	3.6	0	0	115.8	6.03	0.61	8.87	50.8	85.61	0	0.24	0.13	7.16	1.88	0
TBB_DEF_70-99_0_0_G300hp	3	16	0.4	3.28	0.07	0.06	54.42	4.24	0.1	0	85.73	45.09	2.44	24.69	1.08	7.71	3.4	0
TBB_DEF_70-99_0_0_S300hp	3	4	0.42	0	0	0	6.09	0	0	0	23.19	3.94	8.4	8.88	4	1.81	0.21	0
OTB_DEF_100-119_0_0	4	3	0	1.71	0.01	0.03	8.38	2.14	0.7	4.59	4.59	42.94	0	0.01	0.05	4.4	0.46	0
OTB_CRU_70-99_0_0	4	1	0	2.2	0.49	0	0.81	0	0.94	5.2	18.42	5.51	0	0.43	0	1.38	2.3	0
OTB_MCD_70-99_0_0	4	8	0	3.4	0.25	0.25	28.76	0.24	24.4	9.12	38.85	21.03	0.05	0.61	0	3.32	9.02	0.09
OTB_DEF_70-99_0_0	4	1	0	4.79	0	0	6.08	0	0	0	27.71	28.69	0.06	13.52	0	3.61	0.03	0
TBB_DEF_>=120_0_0	4	2	0	8.22	0.3	0	2.61	0	0	0	38.58	171.92	0	0	0	8.68	0.36	0
TBB_DEF_100-119_0_0	4	2	0.2	0.42	0	0	6.6	0	0	0	16.18	6.35	5.23	17.06	4.99	8.07	0.12	1.02
TBB_DEF_70-99_0_0_G300hp	4	41	0.07	2.8	0.06	0.01	37.43	1.08	0.08	0.04	82.71	32.64	6.04	23.84	0.39	6.52	8.31	0.01
TBB_DEF_70-99_0_0_S300hp	4	2	0.1	0.2	0	0	5.68	0	0	0	110.96	17	2.48	9.41	0.44	0.5	2.7	0

Table 7. Average numbers per hour of discarded (Dis) commercially-important target species: dab (DAB), plaice (PLE), sole, (SOL), brill (BLL), turbot (TUR), cod (COD), whiting (WHG) and *Nephrops* (NEP) by metier and quarter (Q) in **2019**.

Metier	**Q**	**N**	**BLL**	**COD**	**DAB**	**NEP**	**PLE**	**SOL**	**TUR**	**WHG**
OTB_DEF_100-119_0_0	1	1	0	0	346.73	0	455.74	0	0	0
OTB_CRU_70-99_0_0	1	1	0	0	194.23	97	92.44	0	0	14.78
OTB_MCD_70-99_0_0	1	2	0	0.54	451.76	150.33	319.01	0	0	256.09
TBB_DEF_>=120_0_0	1	2	0	1.35	1068.94	36.96	1092.12	4.56	0	16.9
TBB_DEF_70-99_0_0_G300hp	1	16	0.87	0.19	837.17	9.71	732.18	69.54	0.6	74.01
TBB_DEF_70-99_0_0_S300hp	1	9	4.81	0	813.58	0	560.55	211.76	0	20.6
OTB_CRU_70-99_0_0	2	4	0	3.15	1420.01	465.3	399.11	0	0.54	40.18
TBB_DEF_>=120_0_0	2	6	0.48	1.54	106.38	0.28	343.16	0	0	1.51
TBB_DEF_100-119_0_0	2	4	0.26	0	311.28	0	575.05	0	0.16	0
TBB_DEF_70-99_0_0_G300hp	2	18	3.34	0.97	431.4	0	834.41	82.24	0.73	155.44
TBB_DEF_70-99_0_0_S300hp	2	3	10.65	0	1113.82	0	809.81	124.51	1.07	14.72
OTB_DEF_100-119_0_0	3	1	0	0	1235.42	282.08	1170.62	0	2.22	78.89
OTB_CRU_70-99_0_0	3	5	0	1.08	1256.78	1102.78	492.15	1.99	1.19	116.95
OTB_MCD_70-99_0_0	3	1	0	1.59	1103.64	1929.78	540.42	0	0	262.47
TBB_DEF_>=120_0_0	3	1	0	0	97.05	0	466.42	0	0	0.43
TBB_DEF_100-119_0_0	3	4	0	0	0	28.36	472.67	0	0.58	24.99
TBB_DEF_70-99_0_0_G300hp	3	16	2.43	0.29	954.57	2.93	1082.87	34.8	5.58	53.83
TBB_DEF_70-99_0_0_S300hp	3	4	9.48	0	115.12	0	420.5	219.8	35.27	8.78
OTB_DEF_100-119_0_0	4	3	0	0.09	120.26	28.76	33.41	0	0.18	14.65
OTB_CRU_70-99_0_0	4	1	0	0.98	10.95	58.83	154.09	0	0	25.15
OTB_MCD_70-99_0_0	4	8	0	1.3	480.34	1243.73	351.34	0.43	0	159.12
OTB_DEF_70-99_0_0	4	1	0	0	143.12	0	310.75	1.23	0	0.95
TBB_DEF_>=120_0_0	4	2	0	0.81	28.45	0	378.95	0	0	4.42
TBB_DEF_100-119_0_0	4	2	1.46	0	90.38	0	237.32	71.86	26.65	2.94
TBB_DEF_70-99_0_0_G300hp	4	41	0	0.46	738.49	2.68	1040.91	0	0	176.01
TBB_DEF_70-99_0_0_S300hp	4	2	0.53	0	71.05	0	1369.38	35.41	1.48	29.79

Table 8. Average numbers per hour of discarded fish species in Dutch demersal fisheries by metier in **2019**.

Scientific name	**OTB_DEF_100-119**	**OTB_CRU_70-99**	**OTB_MCD_70-99**	**OTB_DEF_70-99**	**TBB_DEF_>=120**	**TBB_DEF_100-119**	**TBB_DEF_70-99_G300hp**	**TBB_DEF_70-99_S300hp**
Agonus cataphractus	0	0.14	0	0.41	1.13	0.94	6.6	8.3
Alosa fallax	0	0	0	0	0	0	0.02	0
Amblyraja radiata	1.19	0.42	0	0	2.18	4.84	0.43	0.11
Ammodytes sp.	2.25	0	0	0	2.59	1.89	3.06	2.92
Argentina silus	0	0	0	0	0	0	0	11.4
Arnoglossus laterna	0.99	29.07	15.54	11.78	19.65	4.75	138.47	41
Buglossidium luteum	2.46	8.07	3.48	6.97	36.4	7.97	93.44	35.41
Callionymus lyra	3.73	24.81	9.82	0.82	4.74	3.48	46.31	11.01
Callionymus maculatus	0	0	0	0	0	0	0.03	0.19
Callionymus reticulatus	0	0	0.17	0	0	0	0.25	0.87
Callionymus sp.	0	0	0	0	0	0	0	0.39
Chelidonichthys cuculus	0	0	0	0	0	0	0.62	0.65
Chelidonichthys lucerna	0.05	1.46	0.42	0	0.02	1.12	5.01	7.91
Ciliata mustela	0	0	0	0	0	0	0.11	0.13
Clupea harengus	0	0.33	1.04	0	1.71	0.07	2.05	0.44
Coryphoblennius galerita	0	0	0	0	0	0	0.09	0
Dicentrarchus labrax	0	0	0	0	0	0	0.02	0.05
Echiichthys vipera	0	0	0	0	0	0	20	12.08
Enchelyopus cimbrius	0.2	4.41	2.79	0	1.42	0.38	4.13	0.3
Eutrigla gurnardus	45.44	160.8	97.2	10.9	55.61	23.69	36.71	22.39
Gadus morhua	0.05	1.73	1.19	0	1.23	0	0.48	0
Glyptocephalus cynoglossus	0.17	0.68	3.34	0	0	0.13	0	0
Gnathostomata	0	0	0	0	0	0	0	0
Gobius niger	0	0	0	0	0	0	0.04	0
Helicolenus dactylopterus	0	0.12	0	0	0	0	0.01	0
Hippoglossoides platessoides	2.43	15.54	7.41	0	1.31	0.63	0.26	0
Holtbyrnia anomala	0	0	0	0	0	0	0	1.85
Hyperoplus lanceolatus	0	0	0	0	1.37	0.21	0.96	0.97
Kogia breviceps	0	0	0	0	0	0	0.02	0
Leucoraja naevus	0.55	0.04	0.34	0	0	0	0.04	0
Limanda limanda	388.59	1106.28	531.8	143.12	266.37	802.57	733.09	625.91
Liparis liparis liparis	0	0	0	0	0	0	0	0.07
Lophius piscatorius	0.49	0.02	0.83	0	0.19	0	0.11	0

Table 8. Continued.

Metier	OTB_DEF_100-119	OTB_CRU_70-99	OTB_MCD_70-99	OTB_DEF_70-99	TBB_DEF_>=120	TBB_DEF_100-119	TBB_DEF_70-99_G300hp	TBB_DEF_70-99_S300hp
Melanogrammus aeglefinus	0	0.08	9.44	0.41	1.29	0.05	0.34	0
Merlangius merlangus	24.57	71.4	186.15	0.95	4.74	10.59	132.53	18.01
Microchirus variegatus	0	0	0	0	0	0	0.23	0
Micropogonias undulatus	0	0	0.06	0	0	0	0	0
Microstomus kitt	4.26	3.42	10.46	9.7	4.51	8.7	12.21	0.69
Mullus surmuletus	0.55	1.63	2.01	0.41	0	0.45	3.53	1.56
Mustelus sp.	0	0.06	0.37	0	0	0.05	0.47	0
Myoxocephalus scorpius	0	0.1	0.68	0	0.28	0.21	1.84	6.33
Parablennius gattorugine	0	0	0	0	0	0	0.05	0
Pegusa lascaris	0	0	0	0	0	0	0.25	0
Phrynorhombus norvegicus	0.09	0.78	0.49	0	0	0	0.45	0
Platichthys flesus	0	0	0	0	0.53	0.11	0.94	42.81
Pleuronectes platessa	345.32	391.25	362.65	310.75	497.05	466.55	953.16	660.84
Pollachius virens	0	0	0	0	0.05	0	0	0
Pomatoschistus minutus	0	0	0	0	0	0	0.04	0
Pomatoschistus sp.	0	0.17	0.08	0	0	0	0.55	15.7
Raja brachyura	0.34	0	0.06	0	0	0	1.47	0.18
Raja clavata	0.64	0.13	0.54	0	0	0.21	5.26	1.36
Raja montagui	2.4	0.95	3.12	2.16	0.16	0.4	4.54	0.33
Rhincodon typus	0	0	0	0	0	0	0.01	0
Saccopharynx ampullaceus	0	0	0	0	0	0	0.02	0
Scomber scombrus	0	0.47	0	0	0	0	0	0.02
Scophthalmus maximus	0.55	0.73	0	0	0	5.63	2.06	9.14
Scophthalmus rhombus	0	0	0	0	0.26	0.39	1.36	6.35
Scyliorhinus canicula	4.4	0.9	1.12	0	0.13	0.05	6.79	0
Scyliorhinus stellaris	0	0	0	0	0	0	0.11	0
Solea solea	0	0.9	0.32	1.23	0.83	14.37	73.36	179.41
Solea sp.	0	0	0	0	0	0	0	2.19
Sprattus sprattus	0.36	0	0.61	0	0.12	0.1	1.1	0.87
Syngnathus acus	0	0	0	0	0	0	0.03	0.19
Syngnathus rostellatus	0	0	0	0	0	0	0	2.89
Taurulus bubalis	0	0	0	0	0	0.08	0.03	0.19
Trachinus draco	0	0	0	0	0.13	0	0.76	0.4
Trachurus	0	0	0	0	0	0	0.03	0

Table 8. Continued.

Metier	OTB_DEF_100-119	OTB_CRU_70-99	OTB_MCD_70-99	OTB_DEF_70-99	TBB_DEF_>=120	TBB_DEF_100-119	TBB_DEF_70-99_G300hp	TBB_DEF_70-99_S300hp
Trachurus trachurus	0	0	0	0	0	0	0.18	0.09
Trisopterus luscus	0	0.61	2.4	0	0	0	6.37	1.9
Trisopterus minutus	0	0.89	0.08	0	0	0	2.4	3.8
Uria aalge	0	0.27	0	0	0	0	0	0
Zeugopterus punctatus	0	0	0	0	0	0	0.03	0
Zeus faber	0	0.12	0	0	0	0	0.07	0.05

Table 9. Average numbers per hour of discarded benthos species in Dutch demersal fisheries by metier in **2019**.

Scientific name	OTB_DEF_100-119	OTB_CRU_70-99	OTB_MCD_70-99	OTB_DEF_70-99	TBB_DEF_>=120	TBB_DEF_100-119	TBB_DEF_70-99_G300hp	TBB_DEF_70-99_S300hp
Abra alba	0	0	0	0	0	0	0	63.02
Abra prismatica	0	0	0	0	0	0	0.04	0
Abra sp.	0	0	0	0	0	0	0.05	0
Acanthocardia echinata	0.68	0.78	2.91	2.7	19.1	1.18	46.09	0.24
Adamsia carciniopados	0	0	0	0	0	0	3.59	0.53
Aequipecten opercularis	0	0.38	1.3	0	0.44	0.85	38.98	0.99
Alcyonidium	0	0	0	0	0	0	0.02	0
Alcyonidium diaphanum	0.18	0	0.08	0	0	1.55	7.44	8.85
Alcyonium digitatum	2.29	0.12	6.37	3.52	6.47	1.7	13.49	2.18
Alitta virens	0.15	0.28	1.16	0	0.04	0.23	0.39	0
Alloteuthis subulata	0.24	0.45	2.48	0	0	0	1.1	0.48
Anthozoa	0.16	0	2.71	0.54	0	0.43	2.56	4.52
Aphrodita aculeata	6.51	105.63	48.32	21.3	82.37	17.8	58.62	10.48
Arctica islandica	0.17	0.27	0.99	0	8.75	3.95	6.67	0
Ascidiacea	0	0	0	2.88	0	0	0.36	0
Ascidiella scabra	0	0	0.06	0	8.21	0	0.13	0.75
Asterias rubens	47.25	174.56	48.13	83.3	449.29	468.59	894.12	1344.21
Astropecten irregularis	457.36	319.72	24.46	1054.17	3891.21	1617.13	6978.15	80.8
Atelecyclus rotundatus	0	0	0	0	0	0	1.97	0
Atelecyclus undecimdentatus	0	0	0	0	0	0	0.1	1.03
Balanidae	115.25	3.64	16	0	6.85	148.48	50.75	4.52
Buccinum undatum	7.19	0.14	2.05	2.16	9.02	10.25	34.53	2.97
Callianassa sp.	0	0	0	0	0	0	0.02	0
Cancer pagurus	0.85	0.92	2.71	0	40.57	14.96	4.35	0.56
Carcinus maenas	0	0	0	0	0	0	0.03	19.15
Cephalopoda	0	0	0	0.54	0	0	0	0
Chamelea striatula	0	0	0	0	0	0	0.19	0.41
Chrysaora hysoscella	0	0	0	0	0	0	0.02	0.11
Colus gracilis	0.05	0	0	0	0	0	0.06	0
Corystes cassivelaunus	16.62	28.65	2.81	0.41	61.32	65.8	151.99	422.58
Crangon crangon	0	0	0	0	0	0.22	5.74	135.87
Crassostrea gigas	0	0	0	0	0	0	0.1	0
Crepidula fornicata	0	0	0	0	0	0.1	40.09	77.47

Table 9. Continued

Scientific name	OTB_DEF_100-119	OTB_CRU_70-99	OTB_MCD_70-99	OTB_DEF_70-99	TBB_DEF_>=120	TBB_DEF_100-119	TBB_DEF_70-99_G300hp	TBB_DEF_70-99_S300hp
Diogenes pugilator	0	0	0	0	0	0	0	12.24
Diphasia sp.	0	0	0	0	0	0	0.04	0
Donax vittatus	0	0	0	0	0	0	0.07	5.93
Dosinia exoleta	0	0	0	0	0.64	0	0.27	0
Dosinia lupinus	0	0	0	0	0	0	0.02	0
Dosinia sp.	0.11	0	0	0	0	0	0.26	0
Ebalia tuberosa	0	0	0	0	0	0	0.03	0
Echinocardium cordatum	1.15	8.02	7.42	13.24	1057.8	8.48	545.09	97.54
Echinodermata	0	0	0	0	3.1	0	0	0
Echiurus echiurus	0	0	0	0	0	0	0.03	0
Ectopleura larynx	0	0	0	0	0	0.1	0.11	0
Ensis siliqua	0	0	0	0	0	0	0.08	0
Ensis sp.	0	0	0	0	0	0.05	0.18	18.99
Euspira catena	0	0	0	0	0.08	0.11	9.68	50.83
Facelina bostoniensis	0	0	0	0	0	0.06	0	0
Flustra foliacea	0	0	0.18	0	0.77	0.44	0.21	0
Fucus sp.	0	0	0	0	1.27	0	0.06	0
Fucus vesiculosus	0	0	0	0	0	0	0.19	0
Galathea sp.	0	0	0	0	0	0	0.02	0
Gari fervensis	0	0	0	0	0	0	0.04	0
Geryon trispinosus	0.05	0	0	0	0	0	0	0
Glycymeris glycymeris	0	0	0	0	0	0	0.39	0
Goneplax rhomboides	8.58	93.94	29.68	10.83	0.05	4.81	117.14	1.04
Halecium halecinum	0	0.46	0.21	0	0	0.13	2.44	0.36
Halichondria panicea	20.62	5.88	2.98	4.6	0.78	1.82	5.46	0.28
Henricia sp.	0	0	0	0	0.15	0	0	0
Holothuroidea	0	0	0	0	1.55	0	0.02	0
Homarus gammarus	0	0	0.06	0	0	0	0	0
Hyas araneus	0	0	0.03	0	0	0.32	1.21	0
Hyas coarctatus	0.05	0.09	0.07	0	0	0	1.72	0.5
Hyas sp.	0	0	0.06	0	0	0	0.12	0
Hydrozoa	0	0	0.07	0	0	0	0	0
Inachus dorsettensis	0	0	0	0	0	0	1.66	1.81
Inachus phalangium	0	0	0	0	0	0	0.2	0.47
Laevicardium crassum	0	0	0	0	0.59	0	0.7	0.2

Table 9. Continued

Scientific name	OTB_DEF_100-119	OTB_CRU_70-99	OTB_MCD_70-99	OTB_DEF_70-99	TBB_DEF_>=120	TBB_DEF_100-119	TBB_DEF_70-99_G300hp	TBB_DEF_70-99_S300hp
Limecola balthica	0	0	0	0	0	0	0.38	3.69
Liocarcinus depurator	44.69	139.93	88.87	27.65	374.55	92.47	220.58	39
Liocarcinus holsatus	36.92	283.37	158.12	22.41	293.29	77.75	1000.7	1153.32
Liocarcinus marmoreus	0	0	0	0	4.85	0	5.03	9.27
Liocarcinus navigator	0	0	0	0	0	0	0.02	32.22
Lithodes maja	0	0	0	0	0.15	0	0.04	0
Loliginidae	0	0	0	0	0	0	0.05	0.19
Loligo forbesii	0	0.33	1.13	0	1.86	0	0.32	0
Loligo sp.	0	0	0.73	0	0	0	0.08	0.06
Loligo vulgaris	0	0	0	0	0.23	0	0.12	0
Lolliguncula sp.	0	0	0	0	0	0	0	0
Luidia sarsii	1.15	0.02	4.88	7.04	40.85	1.74	2.77	0.49
Lutraria lutraria	0	0	0	0	0	0	0.03	1.68
Macropodia rostrata	0	0.04	0.08	0	0	0	10.79	16.31
Macropodia tenuirostris	0	0	0	0	0	0.05	0.04	0
Mactra sp.	0	0	0	0	0	0	0	0.19
Mactra stultorum	0	0.12	0	0	0.85	2.07	11.88	0.38
Maja squinado	0	0	0	0	0	0	0.28	0.29
Marthasterias glacialis	0	0	0	0	0.81	0	0	0
Metridium dianthus	0	0	0	0	0	0	0.02	0
Mya truncata	0.05	0.16	0.16	0	0	0	0.18	2.82
Mytilus edulis	0	0	0.08	0	0.05	10.16	10.7	302.35
Nassarius incrassatus	0	0	0	0	0	0.05	0.01	0
Nassarius reticulatus	0	0	0	0	0	0	0.14	9.2
Nassarius sp.	0	0	0	0	0	0	0	45.67
Natica sp.	0.25	0	0	0	0	0	0.65	0
Necora puber	0	2.82	0.18	0	0	0	17	4.85
Nemertea	0	0	0	0	0	0	0.13	0
Nemertesia antennina	0	0	0	0	0	0	0.41	0.76
Nemertesia sp.	0	0.12	0	0	0	0	2.88	0.34
Nephrops norvegicus	73.67	684.63	1107.3	0	6.87	11.34	3.43	0
Neptunea antiqua	1.89	0.71	1.23	1.08	3.53	3.18	0.11	0
Nereis sp.	0	0	0	0	0	0	0.07	0
Nudibranchia	0	0	0	0	0	0	0.32	0
Ophiothrix fragilis	5.25	3.24	25.18	0.54	0	1.53	0.93	0.92

Table 9. Continued

Scientific name	OTB_DEF_100-119	OTB_CRU_70-99	OTB_MCD_70-99	OTB_DEF_70-99	TBB_DEF_>=120	TBB_DEF_100-119	TBB_DEF_70-99_G300hp	TBB_DEF_70-99_S300hp
Ophiura albida	0	0	0	0	2.17	0	4.66	111.05
Ophiura ophiura	0.1	0.07	0	59.65	157.39	66.97	809.23	5835.58
Pagurus bernhardus	48.04	55.77	46.39	73.58	75.28	64.44	150.29	267.01
Pagurus prideaux	0	0	0	0	0	0	4.28	0.1
Palaemon serratus	0	0	0	0	0	0	0.04	0
Palaemon sp.	0	0	0	0	0	0	0.49	0.5
Palaemonidae	0	0	0	0	0	0	0.37	0.03
Pecten maximus	0	0	0.06	0	0	0	0	0
Phaeophyceae	0	0	0	0	0	0	0	0
Philocheras trispinosus	0	0.09	0	0	0	0	0	0
Pilumnus hirtellus	0	0	0	0	0	0	1.06	0
Pinnotheres pisum	0	0	0	0	0	0	0.01	0
Pisidia longicornis	0	0	0.58	0	0	0	1.94	0
Porifera	0	0	0	0	0	0	0.07	0
Portumnus latipes	0	0	0	0	0	0	0	2.39
Psammechinus miliaris	1.18	0	0.06	0	33.47	6.18	249.03	102.17
Psolus phantapus	0	0	0	0	0.15	0	0	0
Rhizostoma pulmo	0	0	0	0	0	0	0	0.27
Sabellaria	0	0	0	0	0	0	10.01	0
Sabellaria alveolata	0	0	0	0	0	0	2.75	0
Scaphander lignarius	0	0	0	0	0	0.06	0.03	0
Scyphozoa	0.02	0.11	0	0	0	0	0.06	0
Sepia officinalis	0	0	0	0	0	0	1.06	1.36
Sepiola sp.	0	0	0.1	0	0	0	0.19	0.03
Solen marginatus	0	0	0	0	0.12	0.05	0.31	0
Spatangus purpureus	0	0.32	0.13	0	0	0	0.64	0.1
Spisula elliptica	0	0	0	0	0	0	0.15	0.06
Spisula solida	0	0	0	0	0	0	0.16	1.86
Spisula sp.	0.12	0	0	0	0	0.06	1.73	9.01
Spisula subtruncata	0	0	0	0	0.05	0.11	0.62	455.95
Styela clava	0	0	0	0	0	0	0.07	0
Theutida	0.44	0.17	0.63	0	0	0	0.38	0
Todarodes sp.	0.16	0	0	0	0	0	0.46	0
Tritonia hombergii	0	0	0	0	0	0	0.05	0
Tubularia indivisa	0	0	0	0	0	0	0.23	1.68

Table 9. Continued

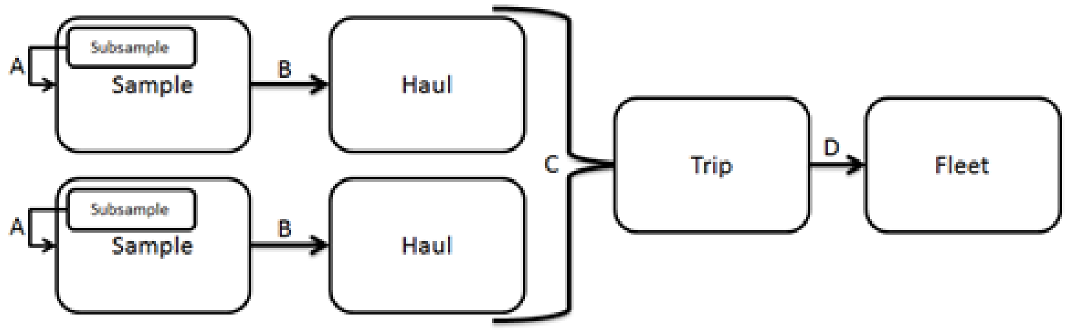
Scientific name	OTB_DEF_100-119	OTB_CRU_70-99	OTB_MCD_70-99	OTB_DEF_70-99	TBB_DEF_>=120	TBB_DEF_100-119	TBB_DEF_70-99_G300hp	TBB_DEF_70-99_S300hp
Tubularia sp.	0	0	0	0	0	0	0.16	0.79
Upogebia deltaura	0	0	0	0	0	0	0.02	0
Veneridae	0	0	0	0	0	0	0	1.94
Venus sp.	0	0	0	0	0	0	0.21	0
Virgularia mirabilis	0	0	0	0	0	0	0.07	0

Table 10a. Average weights (kg) and numbers per hour of landed (L) and discarded (D) plaice (PLE) and sole (SOL) in the beam trawl fisheries (TBB_DEF_70-99_>221kW) between 1976 and 2019. Nm, not measured; n/a, not available. (Before 2009, data is based on observer trips. 2009 and onwards is based on self-sampling trips.)

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%
2011	67	Nm	921	n/a	72	85	54%	Nm	50	n/a	23	5	18%
2012	61	Nm	934	n/a	90	87	49%	Nm	72	n/a	29	6	17%
2013	57	Nm	1189	n/a	81	106	57%	Nm	52	n/a	35	5	13%
2014	84	Nm	1191	n/a	81	104	56%	Nm	64	n/a	33	5	14%
2015	69	Nm	1057	n/a	65	95	59%	Nm	51	n/a	36	4	11%
2016	81	Nm	1061	n/a	74	99	57%	Nm	37	n/a	34	3	8%
2017	89	Nm	1035	n/a	65	92	59%	Nm	42	n/a	31	3	9%
2018	102	Nm	995	n/a	45	91	67%	Nm	35	n/a	25	3	11%
2019	91	Nm	953	n/a	34	75	69%	Nm	73	n/a	24	5	18%

Table 10b. Average weights (kg) and numbers per hour of landed (L) and discarded (D) dab (DAB) and whiting (WHG) in the beam trawl fisheries (TBB_DEF_70-99_>221kW) between 1976 and 2019. Nm, not measured; n/a, not available. (Before 2009, data is based on observer trips. 2009 and onwards is based on self-sampling trips.)

		DAB						**WHG**					
Year/		**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	n/a	<1	10	93%
2000	12	28	951	97%	6	49	89%	Nm	117	n/a	2	9	85%
2001	4	125	2268	95%	12	97	89%	Nm	69	n/a	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	n/a	<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%	33	62	65%	Nm	58	n/a	<1	5	89%
2010	74	48	1178	96%	10	65	87%	Nm	70	n/a	1	5	82%
2011	67	Nm	1350	n/a	12	74	86%	Nm	54	n/a	3	4	57%
2012	61	Nm	1106	n/a	8	63	89%	Nm	73	n/a	2	6	75%
2013	57	Nm	1543	n/a	8	84	91%	Nm	42	n/a	1	3	75%
2014	84	Nm	1508	n/a	5	79	94%	Nm	79	n/a	1	4	88%
2015	69	Nm	1212	n/a	4	59	94%	Nm	73	n/a	<1	4	95%
2016	81	Nm	1481	n/a	7	73	92%	Nm	61	n/a	<1	4	90%
2017	89	Nm	814	n/a	2	42	95%	Nm	73	n/a	<1	5	92%
2018	102	Nm	783	n/a	3	47	94%	Nm	82	n/a	<1	7	99%
2019	91	Nm	733	n/a	2	40	96%	Nm	133	n/a	<1	8	100%



A: $number\ in\ subsample * subsample\ fraction$

B: $number\ in\ sample * \frac{Volume\ of\ (total\ catch\ of\ haul - total\ landings\ in\ haul)}{volume\ of\ discard\ sample}$

C: $sum\ of\ numbers\ in\ both\ samples * \frac{Total\ duration\ all\ hauls\ of\ the\ trip}{Duration\ both\ sampled\ hauls}$

D: $number\ per\ trip * \frac{effort\ (kWDays)\ national\ fleet\ (per\ métier)}{effort\ (kWDays)\ sampled\ trips\ (per\ métier)}$

Figure 1. Flowchart of the raising process

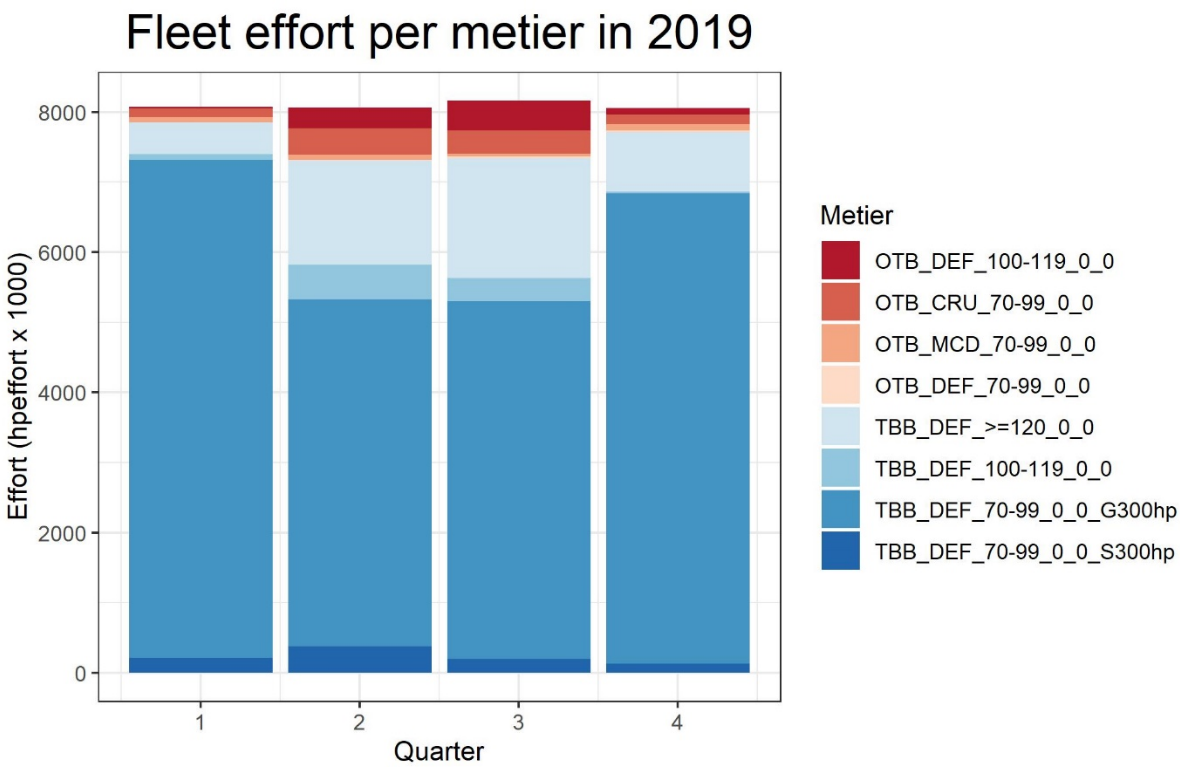


Figure 2. Effort of the Dutch Demersal fleet (in kW*days x 1000) in 2019 per quarter and metier

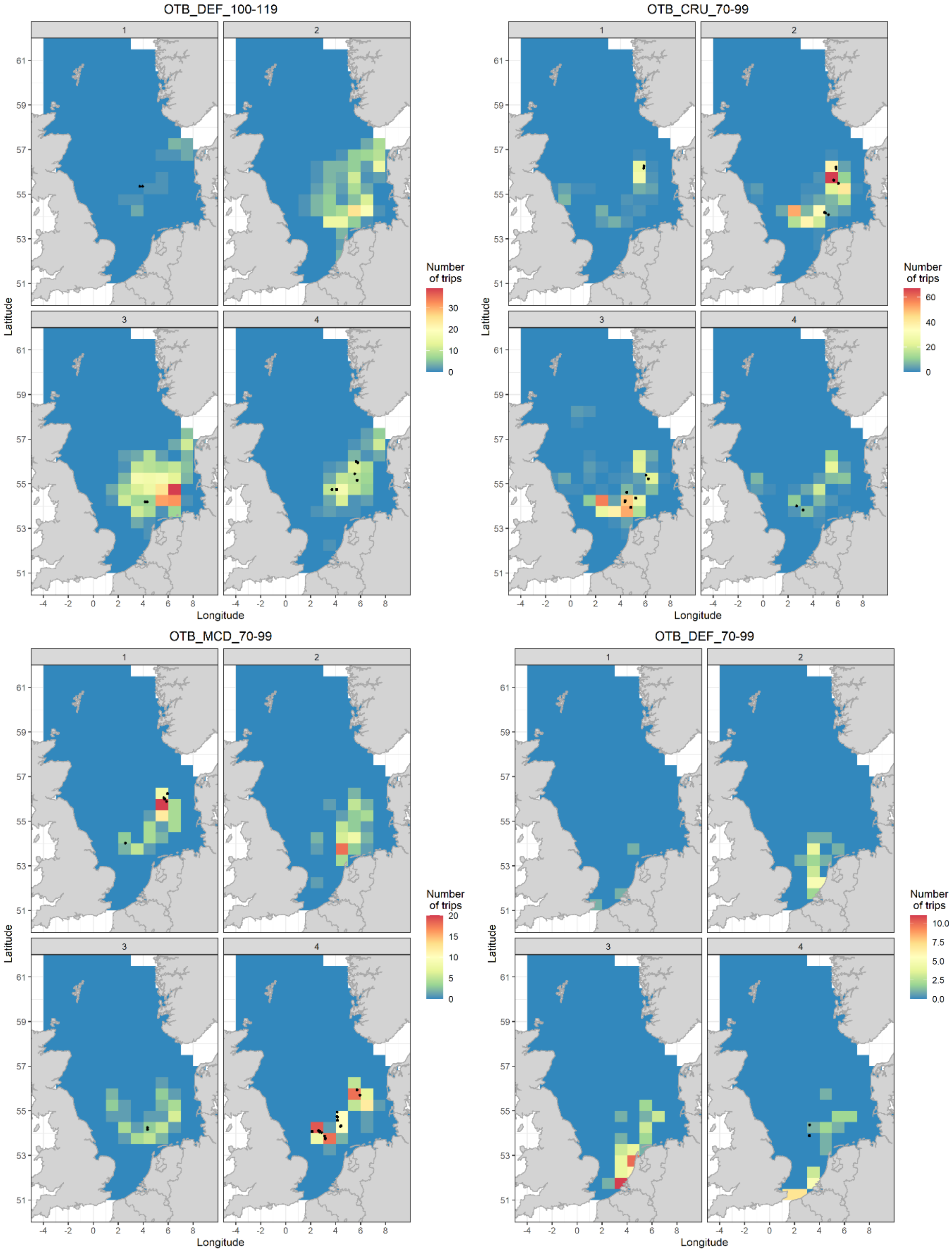


Figure 3. Distribution of total effort (expressed in number of trips at sea, shaded colours per ICES rectangle) and positions of sampled trawls (black dots) for the sampled demersal metiers in **2019** by quarter.

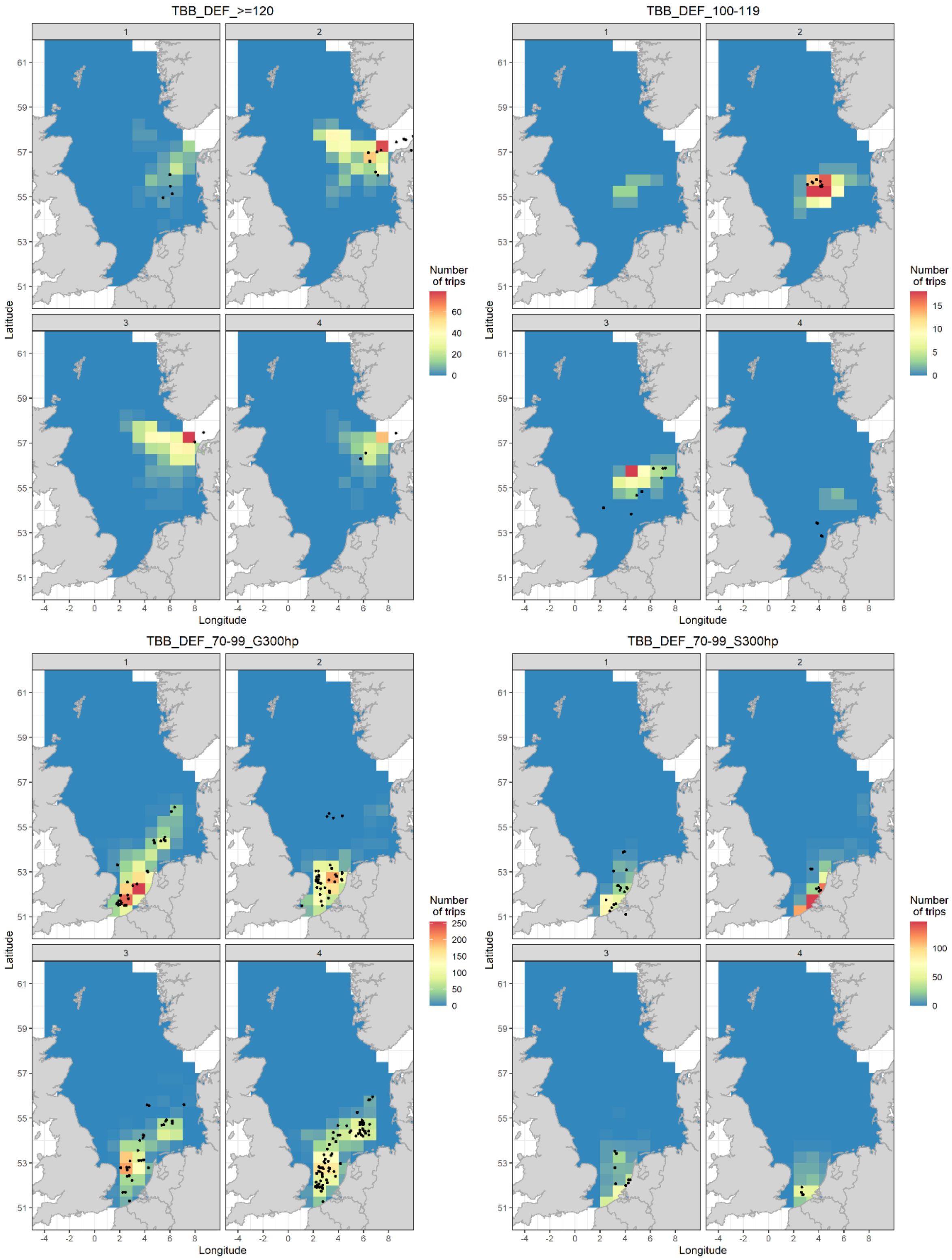


Figure 3. Continued.

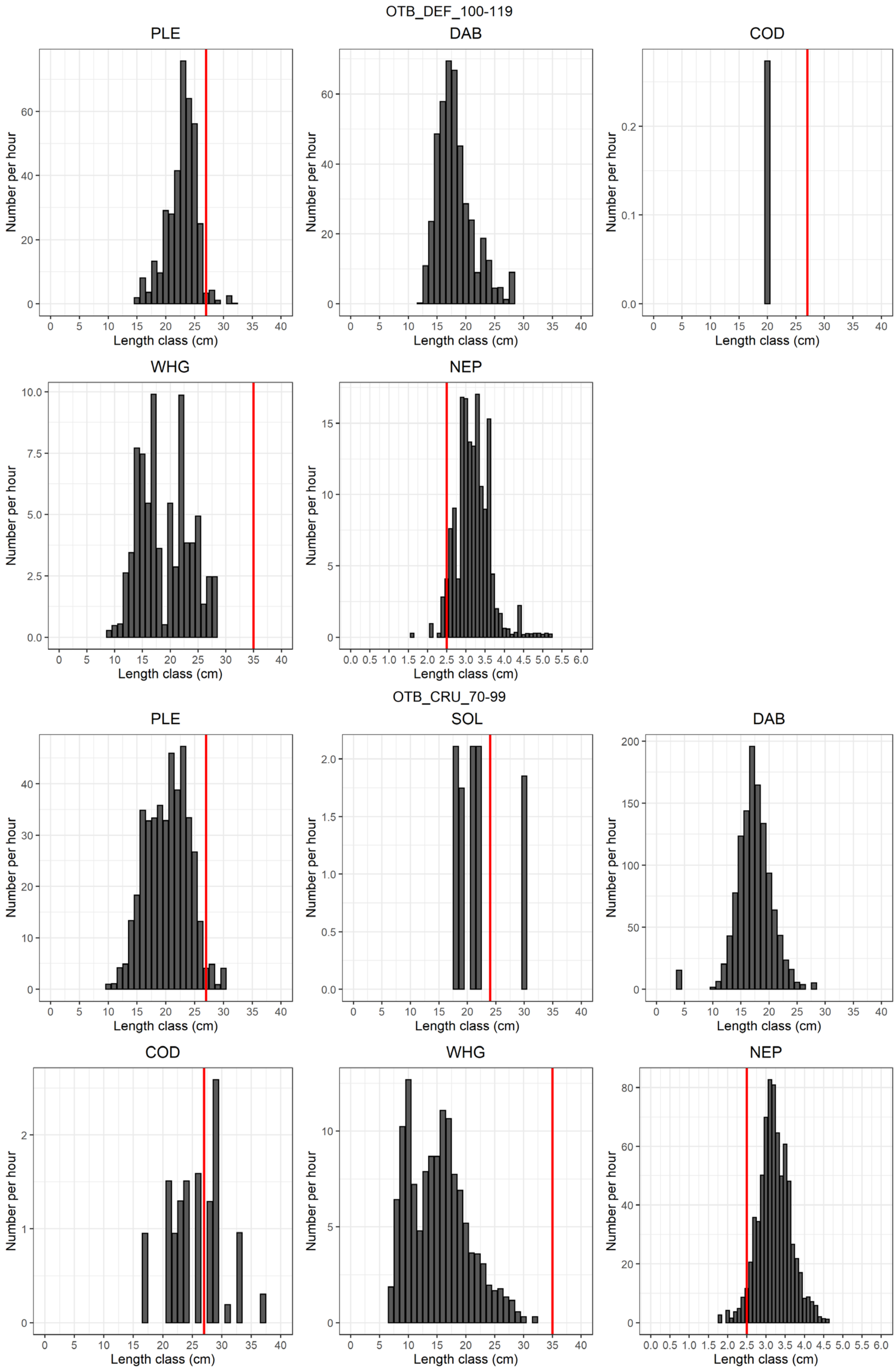


Figure 4. Number per hour discarded per length class (cm) for several discarded species for the sampled demersal metiers in **2019** (red line = Minimum Landing Size).

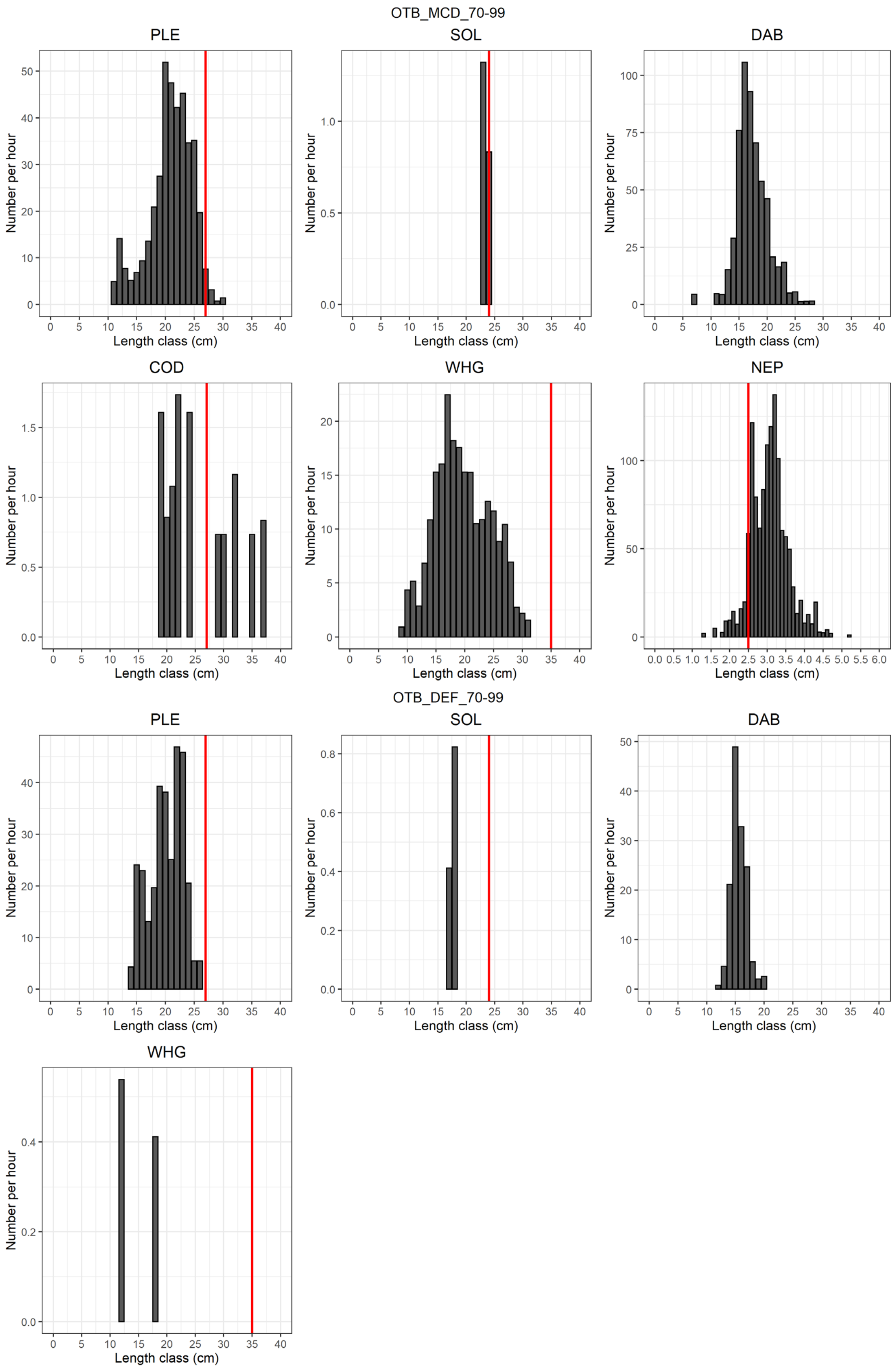


Figure 4. Continued.

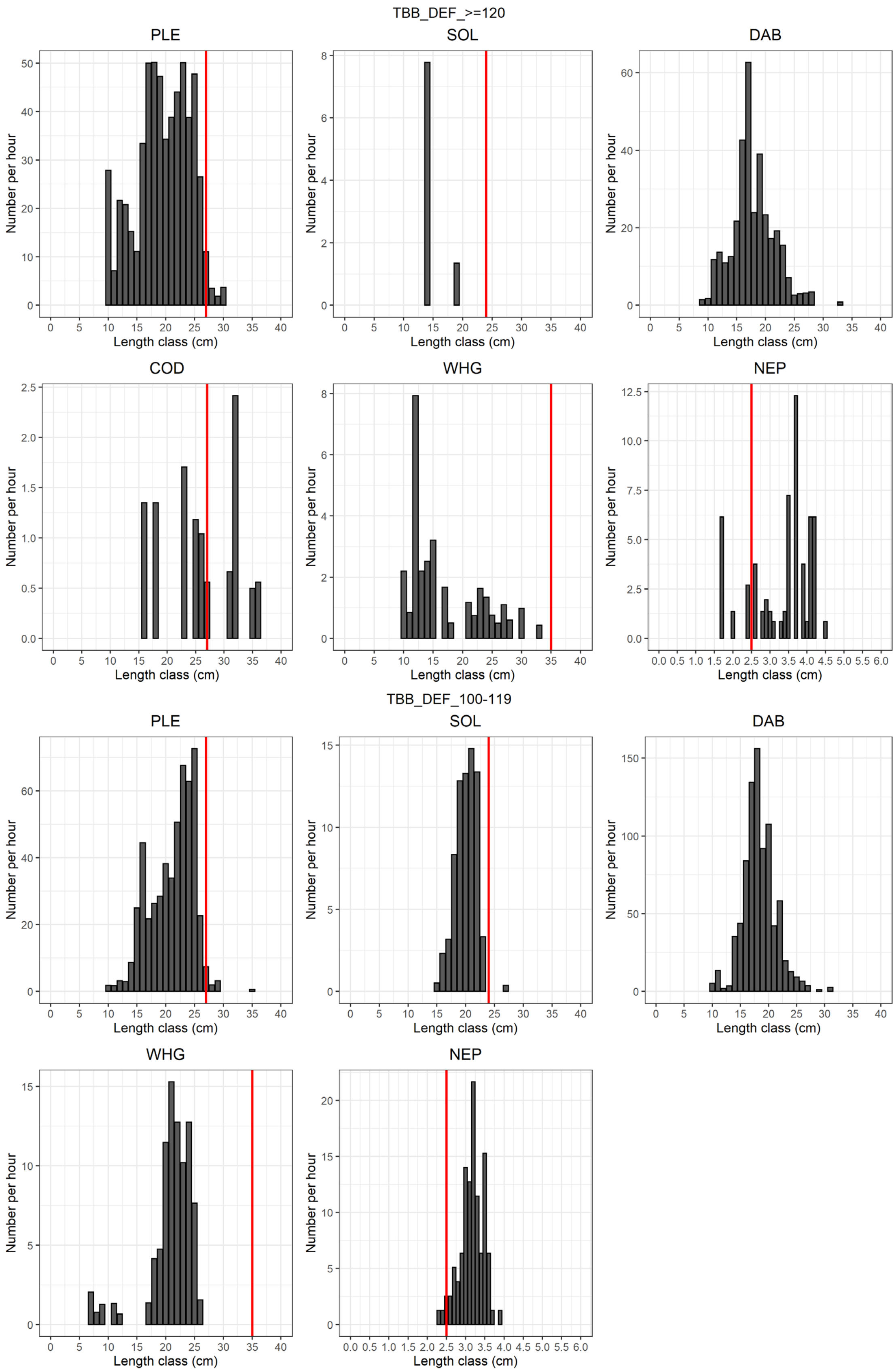


Figure 4. Continued.

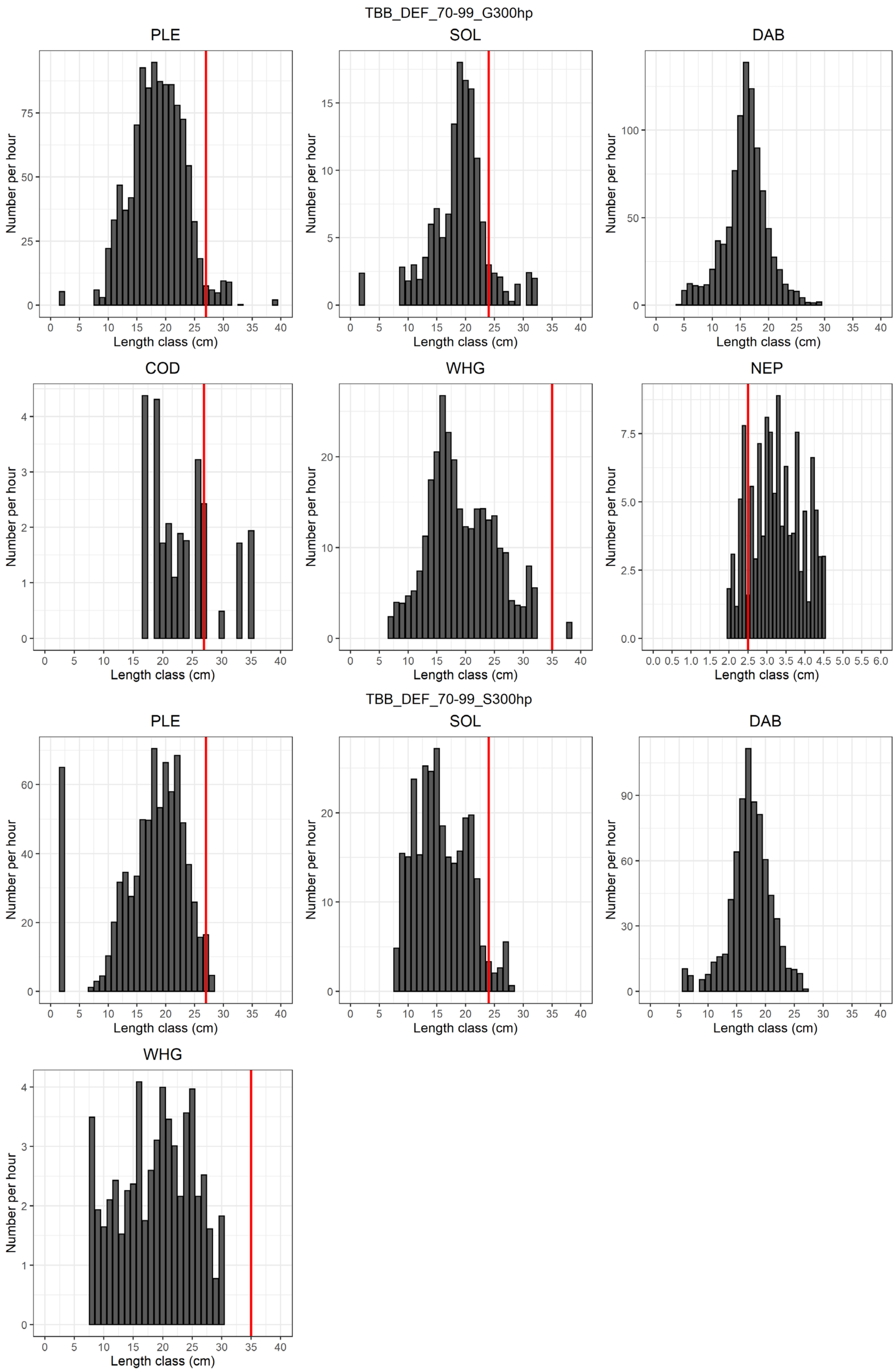


Figure 4. Continued.

Justification

CVO Report: 21.002

Project number: 4311213033

The quality of this report has been peer reviewed by a colleague scientist and the head of CVO.

Approved by: dr. E.D. Beukhof
Researcher

Signature:

Date: 15th January 2021

Approved by: Ing. S.W. Verver
Head Centre for Fisheries Research

Signature:

Date: 15th of January 2021