

# Stichting DLO Centre for Fishery Research (CVO)

P.O. Box  
1970 AB IJMUIDEN  
Phone: 0255 564600  
Fax: 0255 564765  
Visitor address: Haringkade 1, IJmuiden

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# Discard sampling of the Dutch beam trawl fleet in 2003

Ir. O. A. van Keeken, drs. M.A. Pastoors

Commissioned by: Ministerie van Landbouw, Natuur en Voedselkwaliteit  
Drs. R.J.T. van Lint  
Postbus 20401  
2500 EK DEN HAAG

Project number: 3.22.12130.01

Approved by: Drs. F.A. van Beek  
Head WOT, Centre for Fishery Research

Signature: \_\_\_\_\_

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## Summary

The Dutch beam trawl fishery is one of the main fisheries in the southern North Sea, targeting plaice and sole. It has been recognized that sampling of discards is an important element of fisheries statistics and therefore discards sampling schemes have been set up in a European context.

This report contains results of the discards sampling program on the Dutch beam trawl fishery in the North Sea in 2003, which was instigated as part of the EC regulations 1543/2000 and 1639/2001 on data collection in European fisheries. 10 trips with beam trawl vessels were sampled, of which nine were with vessels larger than 300 HP and one with a vessel of 300 HP. Samples of the discards and landings were counted and measured and raised to catches per hour, per trip, per quarter and per year. The sampling is carried out as a pilot-survey (see annex of EC 1639/2001, chapter III, E1c).

The sampled fleet segment (beam trawlers with engine power larger than 300 HP fishing with 80 mm mesh size) is responsible for most plaice and sole landings. This indicates that the most important fleet segment has been covered by the discard sampling program. The spatial distribution of fishing effort of the Dutch beam trawl fleet larger than 300 HP and fishing with 80 mm mesh size is similar to the effort distribution in the discard sampling, except for the area in the centre of the southern North Sea.

The major fish species in the discards were dab and plaice. The percentage plaice discards in 2003 was around 83% in numbers and 58% in weight for large vessels. The percentage discards for sole in weight was around 14% for large vessels and 22% for eurocutters. The variation in the discard rates between trips was relatively low.

The percentage discarding of plaice in 2003 appeared to be higher than in earlier periods, e.g. 2002 (77% in numbers, 51% in weight), 1999-2001 (73% in numbers, 46% in weight) and 1976-1990 (42%-53% in numbers, 18%-31% in weight). There was no apparent trend in discard percentages of sole compared to 2002 (13%), 1999-2001 (8%) or 1976-1990 (3%-13%).

Length frequency distributions showed that smaller plaice were being caught in recent periods compared to the 1970s and 1980s. This could be caused by a shift in spatial distribution of small plaice to more offshore areas, whereby they become vulnerable to the beam trawl fleet. The high amount of discards was mainly caused by a relatively strong 2001 year class, in 2003 at the age of 2.

## Samenvatting

De Nederlandse boomkor visserij is één van de belangrijkste visserijen in de zuidelijke Noordzee. De belangrijkste doelsoorten zijn schol en tong. Jonge vissen die kleiner zijn dan de minimum aanvoermaat worden hierbij weer overboord gezet, hetgeen discarding genoemd wordt. Het is algemeen erkend dat het bemonsteren van discards een belangrijk onderdeel is de visserij statistiek en om die reden zijn programma's voor de bemonstering van discards in een Europese context opgezet.

Dit rapport bevat de resultaten van het discardsbemonsteringsprogramma van de Nederlandse boomkorvisserij in de Noordzee in 2003, dat is opgezet als invulling van EC regelingen 1543/2000 en 1639/2001 voor gegevensverzameling in Europese visserijen. 10 reizen aan boord van boomkorschepen werden bemonsterd; negen aan boord van schepen met een motorvermogen groter dan 300 PK en één aan boord van een eurokotter met een motorvermogen van 300 PK. De discards en de aanlandingen werden geteld en gemeten en vervolgens opgewerkt tot vangsten per visuur, per reis, per kwartaal en per jaar. De bemonstering werd uitgevoerd als een "pilot-survey" (zie annex van EC 1639/2001, hoofdstuk III, E1c)

Het bemonsterde vlootsegment (boomkorschepen met een motorvermogen groter dan 300 PK met 80 mm maaswijdte) is verantwoordelijk voor de meeste schol en tong aanlandingen. Dit geeft aan dat het belangrijkste Nederlandse vlootsegment is bemonsterd. De ruimtelijke verdeling van de visserij-inspanning van de boomkorvisserij groter dan 300 PK vissend met 80 mm maaswijdte is vergelijkbaar met de verdeling van de visserij-inspanning in het bemonsteringsprogramma, met uitzondering van het centrale gedeelte van de zuidelijke Noordzee.

De discards in de boomkorvisserij bestaan voornamelijk uit schol en tong. Het percentage discards van schol was in 2003 rond de 83% in aantallen en 58% in gewicht voor grote schepen. Voor tong was het percentage discards in gewicht ongeveer 14% voor grote kotters en 22% voor eurokotters. De variatie in percentages discards tussen de verschillende reizen was relatief laag.

Het percentage discards van schol lijkt hoger te zijn dan in eerdere periodes, bijvoorbeeld 2002 (77% in aantal, 51% in gewicht), 1999-2001 (73% in aantal, 47% in gewicht) en 1976-1990 (42%-53% in aantal, 18%-31% in gewicht). Er was geen duidelijke trend in percentage discards van tong vergeleken met 2002 (13%), 1999-2001 (6%) of 1976-1990 (3%-13%).

De lengteverdelingen van schol laten zien dat in recente periodes gemiddeld kleinere schol werd bijgevangen dan in de periode 1976-1990. Deze verandering hangt mogelijk samen met een verandering in de ruimtelijke verspreiding van ondermaatse schol, waardoor deze nu verder uit de kust voorkomt en daarom beschikbaar is voor de visserij. Mogelijk is het aantal discards hoog door een relatief sterke 2001 jaarklas, die in 2003 2 jaar oud waren.

# 1. Introduction

Most demersal fisheries are mixed fisheries, targeting a limited number of species and sizes. In general other catches will be thrown overboard, a practice called discarding (Van Beek, 1998). Alverson et al. (1994) estimated that worldwide between 17.9 en 39.5 million tonnes fish is discarded annually. As a comparison, worldwide the annual fish catch was estimated at 84 million tonnes for that period (FAO, 1997).

There are four main categories of discards:

- specimens of commercial species below the minimum legal landing size
- over-quota fish which is not allowed to be landed when this result to exceeding legal quota
- bycatch species of no commercial value
- fish with an undesired quality, high-grading

Discarding leads to lower profits from fish stocks, because a large part of the discards will not survive the sorting process (Van Beek et al., 1990; Jennings and Kaiser, 1998). However, discards also form an important food item for other organisms like birds (Camphuysen and Garthe, 2000) and benthic invertebrates (Lindeboom and De Groot, 1998). Discarding, and most important variation in discarding, may result in bias in fish stock assessments when these assessment are based only on landings numbers at age (Pastoors et al., 2000). To date discards are only incorporated into a few stock assessments (ICES, 2002) but the intention is to incorporate discards estimates for all stocks where relevant information becomes available.

One of the main fisheries in the southern North Sea is the Dutch beam trawl fishery, targeting mainly sole (*Solea solea*) and plaice (*Pleuronectes platessa*). Trips made on beam trawl vessels between 1976 and 1990 showed great variation in the quantity of plaice discarded (18-31% by weight)(Van Beek, 1998). Recent sampling in 1999-2001 suggested that the percentage discarded has increased (average 47% by weight, range 8%-73%, Netherlands Institute for Fisheries Research, unpublished data). These higher discard rates could be caused by changes in the growth rate of plaice such as the slower growth of the strong 1996 year class. The slower growth rates could extend the period the fish are susceptible to discarding (ICES, 2002). Also a shift in the distribution of smaller plaice (ICES, 1999) could make them more susceptible to commercial fishing (Pastoors et al., 2000). The proportion discarded could also increase because the biomass of marketable fish declines (Pastoors et al., 2000; ICES, 2002).

From 1999 to 2001 discarding practices of the Dutch beam trawl fleet in the North Sea have been monitored within an EC funded international research project (Anon., 2002). From 2002 onwards discards data are collected under the EC Data Collection Regulations 1543/2000 and 1639/2001 (EC., 2000, 2001; Anon., 2002; ICES, 2003). This report gives an overview of the Dutch demersal discard sampling program for 2002, which was carried out as a pilot-survey (see annex of EC 1639/2001, chapter III, E1c).

## 2. Methods

### 2.1 Sampling procedures

Selection of the vessels is quasi-random and based on co-operative sampling (ICES, 2000). This means that co-operation of a skipper with the project is on voluntarily basis. On forehand it is difficult to predict the sampling location, since this depends on the fishing strategy of the skipper. However vessels from different regions are selected during a quarter to obtain widespread coverage. During 2003 a total of 9 trips were made on board beam trawl vessels with engine power larger than 300 HP (221 kW). In addition one trip was conducted with a eurocutter with engine power up to 300 HP.

For a discard sampling trip, two observers went onboard a vessel, sampling at least 60% of the hauls (Van Beek, 2001). For each sampled haul, a sub-sample of the discards was measured. All fish were counted and measured. Benthic invertebrates were only counted. Total and sampled volume of discards was recorded. A sub-sample of the fish landed was measured, and total and sampled landings weight was recorded. If possible otoliths were collected from the major discarded fish species (plaice, sole, dab, cod, whiting) for age readings. All data was entered into a computer program on haul-by-haul basis and later transported into the central database.

### 2.2 Raising procedures

This paragraph gives a short description of the raising procedures used. A more mathematical description is given in Appendix I.

Sampled numbers of fish per haul were raised to numbers at length and at age for both discards and landings. Different raising procedures were used for discards and landings because different sources of information were available for these catch components. For the landings the total landed weight per species was available, while such data was not available for discards.

Discards were raised from sampled numbers in a haul to total numbers in a haul with the ratio of estimated haul volume to sampled haul volume. Total numbers per haul were summed over all sampled hauls in a trip and divided by duration of the sampled hauls to obtain total numbers discarded per hour per trip. Total weight in the trip was calculated from total numbers using length-weight relationships.

Landings were raised from sampled numbers per haul to total numbers per trip with the ration of total landings weight in the trip to sampled landings weight. Total numbers landed were calculated by dividing total numbers in the trip by the trip duration. Landings weight per hour was calculated by dividing total landings weight by trip duration.

Numbers landed and discarded at length were calculated per period (quarter or year) by multiplying total numbers at length in a trip over the trips in this period and dividing this by total duration of the trips in this period. Numbers at age were calculated from numbers at length using age-length keys, which calculates the proportion of fish at length ( $l$ ) with age ( $a$ ). Numbers at age landed and discarded by the fleet were calculated by multiplying total numbers at age in the sampled trips with the ratio of total fleet effort to effort of sampled trips, both measured in effort corrected for engine power.

## 3. Results

### 3.1 Sampling

A total of 10 trips were sampled, all using 80 mm mesh size. Nine trips were carried out on vessels with engine power between 1467-1489 KW (1991-2021 HP) and one on a beam trawl vessel of 221 KW (300 HP) (Table 3.1.1).

The total number of hauls in the trips varied between 36 and 51, with an average fishing duration of 77 hours per trip (Table 3.1.2.). 79% of the hauls were sampled for discards and 72% for landings. Otoliths were collected from the discards samples for plaice (269 otoliths) and sole (94 otoliths).

Per quarter between 0.11% and 0.17% of the Dutch beam trawl fleet with engine power larger than 300 HP was sampled in HP effort (Table 3.1.3a). Fleet coverage by year was 0.14% in HP effort for the beam trawl fleet larger than 300 HP (Table 3.1.3a) and 0.09% for the beam trawl fleet with engine power of 300 HP (Table 3.1.3b).

The spatial distribution of fishing effort of the Dutch beam trawl fleet larger than 300 HP fishing is shown in Figure 3.1.1a, the segment of this fleet fishing with 80 mm mesh size is shown in Figure 3.1.1b. Figures 3.1.2a and 3.1.2b show the spatial distribution for beam trawl vessels of 300 HP. Effort of the beam trawl fleet larger than 300 HP is mainly distributed off-shore from the Dutch coast, while the effort of the smaller vessels is mainly distributed along the Dutch coast. The effort distribution in the discard sampling of vessels larger than 300 HP (Figure 3.1.1c.) and of vessels of 300 HP (Figure 3.1.2c.) can be compared to the spatial distribution of fleet effort. The comparison of the beam trawl fleet larger than 300 HP indicate that the overall pattern in effort distribution in the discard sampling is similar to the whole fleet, with exception of the areas above 53.5 latitude and between 2-4 longitude. Because only one vessel of 300 HP was sampled, effort distributions could only be compared for 3 rectangles.

### 3.2 Numbers and weight

The average weight of all discards (both fish and invertebrate discards) during a trip was 34 tonnes (CV 56%, Table 3.2.1) for vessels larger than 300 HP. Of the catch in weight, 17% consisted of fish landed and 28% in fish discards (Figure 3.2). Dab and plaice were the most abundant species in the discards (Table 3.2.2, Figure 3.2) Brittle stars, common starfish, swimming crab, hermit crab and masked crab were the most abundant benthos species.

The number discarded per rectangle per hour varied for vessels larger than 300 HP between 611-2464 for plaice and 0-120 for sole (Figure 3.3.1a) and for the vessel of 300 HP between 228-392 for plaice and 26-37 for sole (Figure 3.3.1b).

The total landings weight by trip for vessels larger than 300 HP varied for plaice between 1313 and 7622 kg and for sole between 513 and 3085 kg (Table 3.2.3a). The landings weight for the vessel of 300 HP was 778 kg for plaice and 772 kg for sole. Sampled landings weight for vessels larger than 300 HP varied for plaice between 40 and 224 kg and for sole between 96 and 203 kg (Table 3.2.3b).

### 3.3 Species

#### *Plaice*

On average 5200 kg of plaice were discarded per trip (CV 50%, Table 3.2.1). The average number of discards per hour was 936 to 189 individuals landed for vessels with engine power larger than 300 HP and 334 discarded to 26 individuals landed for the vessel with engine power of 300 HP. This resulted in an average discard percentage of 83% in numbers and 58% in weight for large vessels and 93% in numbers and 70% in weight for the vessel with engine power of 300 HP (Table 3.3.1). The average discard percentage per quarter for large vessels varied between 81% and 85% in numbers and 49% and 62% in weight (Table 3.3.2).

The peak of the discard length distribution for large vessels was around 19 cm (Table 3.3.3, Figure 3.4.1) and 20 cm for the vessel of 300 HP (Table 3.3.3, Figure 3.4.2), whereas the minimum landing size is 27 cm. Plaice were discarded up to 31 cm.

Most discards were between ages 1 to 4, with most of the discards being age 2 (yearclass 2001) (Table 3.3.4). Plaice from the strong 1996 yearclass, now at the age of 7, were still being discarded in small numbers.

Landings and discards in numbers at age were raised to fleet level for vessels larger than 300 HP (Table 3.3.5) using an effort multiplier (Table 3.1.3a).

#### *Sole*

On average 240 kg of sole were discarded per trip (CV 120%, Table 3.2.1). For all trips, landings were higher than discards both in numbers and in weight per hour (Table 3.3.6). The average discard percentage was 25% in number and 14% in weight for large vessels and 43% in number and 22% in weight for the vessel of 300 HP. Per quarter the discard percentage in number varied between 21 and 27% in number and 11% and 22% in weight for large vessels (Table 3.3.7).

The peak of the discard length distribution was around 22 cm for large vessels (Table 3.3.8, Figure 3.4.1) and 21 cm for the vessel of 300 HP (Table 3.3.8, Figure 3.4.2) Sole were discarded up to 29 cm.

Most sole discards were between ages 1 and 4, with most discards being age 2 (Table 3.3.9). Landings and discards in numbers at age were raised to fleet level for vessels larger than 300 HP (Table 3.3.10) using an effort multiplier (Table 3.1.3a).

#### *Dab*

On average 4800 kg of dab were discarded per trip (CV 76%, Table 3.2.1). On average 64 kg were discarded to 8 kg landed per hour for large vessels while 10 kg was discarded to 1 kg landed for the vessel of 300 HP (Table 3.3.11). The average discard percentage was 95% and 97% in numbers and 89% and 88% in weight for large vessels and the vessel of 300 HP respectively. Per quarter the discard percentage varied in weight between 84% and 90% in weight for large vessels (Table 3.3.12).

#### *Cod*

On average 24 kg of cod were discarded per trip (CV 95%, Table 3.2.1) and per hour less than 1 kg were landed and discarded (Table 3.3.13). The average discard percentage was 15% in weight. The estimate however is highly uncertain because of the low catches, expressed by the discard percentage in weight per quarter varying between 0% and 55% for large vessels (Table 3.3.14).



*Whiting*

On average 215 kg of whiting were discarded (CV 114%, Table 3.2.1). For large vessels discards were higher than landings with less than 1 kg whiting landed to 3 kg discarded per hour (Table 3.3.15). Landings and discards per hour for the vessel of 300 HP were lower than 1 kg per hour. The average discard percentage, taking discards from all trips into account, was 96% in number and 86% in weight for large vessels. Per quarter the discard percentage in weight varied between 68% and 96% (Table 3.3.16).

## 4. Discussion

The discards sampling programme for the Dutch beam trawl fleet in 2003 was instigated as part of the EC regulations 1543/2000 and 1639/2001 on data collection in European fisheries. Results of the discard sampling on Dutch beam trawl vessels in 2003 were presented. A total of 10 trips were sampled, of which nine were on vessels with engine power larger than 300 HP and one on a vessel of 300 HP. The mesh size used during all trips was 80 mm. The sampling was carried out as a pilot-survey (see annex of EC 1639/2001, chapter III, E1c).

The discard sampling program of vessels larger than 300 HP covers the most important fleet fishing for North Sea plaice and sole. The fleet of vessels larger than 300 HP fishing with 80 mm mesh size is responsible for most of the plaice and sole landings. The spatial distribution of fishing effort of the Dutch beam trawl fleet larger than 300 HP and fishing with 80 mm mesh size is similar to the effort distribution in the discard sampling, except for the area in the centre of the southern North Sea.

Plaice is one of the two important target species of the Dutch beam trawl fishery. The average discard percentage of plaice in 2003 was around 83% in numbers and 58% in weight. These discard rates are higher than the rates observed in 2002 (77% in numbers and 51% in weight), 1999-2001 (73% in numbers and 47% in weight) and 1976-1990 (51% in numbers and 27% in weight, Table 4.1). The discard fraction in 2003 was dominated by the strong 2001 yearclass, at the age of 2. This strong yearclass also dominated the discard fraction in 2002.

Since the late 1990's a shift in spatial distribution of plaice is apparent, whereby relatively small plaice move towards deeper, more offshore water (Pastoors et al., 2000; Van Keeken et al., 2004), making the fish more vulnerable to the fishery. The recent discard trips were carried out outside the plaice-box. Nevertheless the size of the smallest plaice corresponded to those lengths at which plaice in the 1970s and '80s were only caught inside the 12-mile zone and the plaice box (Figure 4.1) (Rijnsdorp and Van Beek, 1991; ICES, 1999).

Changes in plaice discard rates in the recent period could also be caused by the decrease in landings due to quota restrictions or by gear modifications. Plaice landings per hour were lower (50 kg/hour) than in 2002 (63 kg/hour) and 1999-2001 (56 kg/hour), and substantially lower than in the 1970s and 1980s (around 110 kg/hour) (Table 4.1). On the other hand, discards per hour fishing in recent periods were either the same or higher compared the 1970s and 1980s. The historical length frequency distribution over 1976-1990 (Figure 4.1) showed more landings of larger plaice compared to recent period (Figure 3.4, Figure 4.2). The mean weight per fish landed was also higher (0.36 kg per fish in 1970 and 1980s, around 0.25 kg in recent years). Illegal gear modifications like double cod-ends and liners could also result in higher discard percentages. However, given that the beam trawl fishery is a mixed fishery for plaice and sole, and that the discard rates for sole seemed to be relatively stable over time (see below), changes in gears are unlikely to be the major source for the higher discard rates of plaice.

The discard percentage of sole in 2003 was within the range of discard percentages in earlier periods (Table 4.2). The length frequency distributions showed no apparent trends 1999-2002 compared to the 1970s and 1980s.

The catches of cod in 2003 were very low. It is very clear that the absolute numbers caught per hour has decreased substantially compared to the 1970s and 1980s. It is also clear that the length distribution of the landings has been reduced from a maximum length around 80 cm to a maximum length of around 60 cm in recent years (Van Keeken et al., 2003b).

Due to the absence of sufficient discards data on most stocks in the North Sea, discards have only been included into the stock assessments of haddock and whiting (ICES, 2002). For these two species the Scottish discards sampling program has been used to estimate discards of these species for all international fleets. Estimates of discards for other species have started to be collected from 1999 onwards for all countries involved in the EU study project (Anon., 2002). Some countries have started their sampling programs even before 1999 (e.g. Denmark, England) or have historical sampling programs (e.g. The Netherlands). When discards are included into the stock assessment process, it is essential that estimates of discards are available for the whole time series of catch data. This implies, that for years where no samples are available, discards need to be estimated from other sources of data (e.g. survey data, growth data).

An exploration of the consequences of including discards into the assessment of plaice was presented at the ICES Annual Science Conference 2003 (Van Keeken et al., 2003a). The exploration was based on a reconstruction of discards based on growth and selectivity characteristics of the gears. The exploration indicated that the perception of stock trends could be different when discards were included, especially in periods of high recruitments and associated slow growth, which could lead to high discard rates. It is therefore important to put effort in sampling discards onboard vessels to obtain sufficiently long discard time-series so that these data can be included in the stock assessments and that they can be used to validate discard-models that aim to fill the gaps of unsampled years. In this way, stock assessments for those stocks that suffer from substantial discarding are thought to become more reliable (and less biased).

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## Appendix I

**Table I.** Explanation of the abbreviations used in the formulas in appendix I.

| explanation |   | sub-script | explanation |
|-------------|---|------------|-------------|
| n           | sampled number                                      | l          | length      |
| N           | total number  | h          | haul        |
| w           | sampled weight                                      | o          | hour        |
| W           | total weight  | t          | trip        |
| v           | sampled discards volume                             | p          | period      |
| V           | total discards volume                               | y          | year        |
| u           | sampled duration                                    | s          | species     |
| U           | total duration                                      | f          | fleet       |
| wt          | sampled landings weight                             |            |             |
| WT          | total landings weight                               |            |             |
| e           | sampled fleet effort                                |            |             |
| E           | total fleet effort                                  |            |             |
| T           | Number of trips                                     |            |             |
| DN          | total discard number                                |            |             |
| LN          | total landings number                               |            |             |
| CN          | total catch number (landings and discards combined) |            |             |

### *Raising discards per trip*

The sampled number per length and haul were raised per species to total number per length and haul

$$DN_{l,h,s} = \frac{V_h}{v_h} Dn_{l,h,s}$$

where  $DN_{l,h,s}$  is the total number discarded at length (l) in haul (h) for species (s),  $V_h$  is total volume of haul (h),  $v_h$  is sampled volume of haul (h) and  $Dn_{l,h,s}$  sampled number discarded at length (l) in haul (h) for species (s).

The total number discarded at length per haul and species was summed over the sampled hauls to obtain the total sampled number discarded at length (l) for species (s) over all sampled hauls (h). The total number discarded ( $DN_{l,t,s}$ ) at length (l) per trip (t) and species (s) was calculated by multiplying the total number discarded ( $DN_{l,h,s}$ ) over all sampled hauls with the ratio of total trip duration ( $U_t$ ) and duration of all sampled hauls ( $\sum u_h$ ).

$$DN_{l,t,s} = \frac{U_t}{\sum u_h} \sum_{h=i}^h DN_{l,h,s}$$

The number discarded at length per hour and species ( $DN_{l,o,t,s}$ ) was calculated by dividing the total number at length per trip ( $DN_{l,t,s}$ ) by total trip duration ( $U_t$ ).

$$DN_{l,o,t,s} = \frac{DN_{l,t,s}}{U_t}$$

The obtained number discarded at length per hour ( $DN_{l,o,t,s}$ ) was summed over length to obtain the number discarded per hour ( $DN_{o,t,s}$ ):

$$DN_{o,t,s} = \sum_{l=i} DN_{l,o,t,s}$$

Discarded weight per hour per species at length was calculated using length-weight relationships:

$$DW_{l,o,t,s} = \sum_l \left( \frac{DN_{l,o,t,s} * A_s * l^{B_s}}{U_t} \right)$$

where  $DW_{l,o,t,s}$  is the weight per length, per hour and per species,  $DN_{l,o,t,s}$  is the number discarded at length, per hour and per species and  $A_s$  and  $B_s$  species specific constants.

The variance over the total weight of all discards combined per trip  $VAR(DW_y)$  was calculated per year (Anon. 2003):

$$Var(DW_y) = \sum_t VAR(DW_{t,y})$$

where  $DW_{t,y}$  is the total weight of all discards in a trip.

Second the variance over the total weight per species per trip  $VAR(DW_{y,s})$  was calculated per year:

$$Var(DW_{y,s}) = \sum_t VAR(DW_{t,y,s})$$

where  $DW_{t,y,s}$  is the total weight of a species discarded in a trip.

#### *Raising landings per trip*

The sampled number landed at length per haul and species ( $Ln_{l,h,s}$ ) were summed over all sampled hauls ( $h$ ) to calculate the sampled number at length for the trip ( $ln_{l,t,s}$ ). The total number landed at length for the entire trip ( $LN_{l,t,s}$ ) was calculated by multiplying the sampled number at length for the trip ( $ln_{l,t,s}$ ) with the ratio of total trip weight obtained from auction or VIRIS data ( $WT_{t,s}$ ) to sampled landings weight of the trip ( $wt_{t,s}$ ):

$$LN_{l,t,s} = \frac{WT_{t,s}}{wt_{t,s}} \left( \sum_{h=i}^h Ln_{l,h,s} \right)$$

Number landed at length per hour per species ( $LN_{l,o,t,s}$ ) was calculated by dividing total number landed at length per trip ( $LN_{l,t,s}$ ) by the trip duration ( $U_t$ ).

$$LN_{l,o,t,s} = \frac{LN_{l,t,s}}{U_t}$$

The obtained total number at length per hour ( $LN_{l,o,t,s}$ ) was summed to calculate number per hour per species ( $LN_{o,t,s}$ ):



$$LN_{o,t,s} = \sum_{l=i} LN_{l,o,t,s}$$

Total landings weight per hour ( $LW_{o,t,s}$ ) was calculated per species by dividing total landings weight ( $WT_{t,s}$ ) per species by total trip duration ( $U_t$ ).

$$LW_{o,t,s} = \frac{WT_{t,s}}{U_t}$$

#### *Numbers at length, per quarter and year*

The number of discards and landings ( $CN_{l,o,p,s}$ ) at length per hour was calculated per quarter/year by summing the total number landings or discards at length per trip ( $CN_{l,t,s}$ ) over all trips in that period (p) and then dividing this by the sum of the duration of all trips ( $U_t$ ) in this period:

$$CN_{l,o,p,s} = \left( \sum_p CN_{l,t,s} \right) / \sum_p U_t$$

Confidence limits around length-frequency distributions show weighted standard deviation ( $VAR(CN_{l,o,p,s})$ ):

$$VAR(CN_{l,o,p,s}) = \sqrt{\left[ \left( T_t / (T_y - 1) \right) * \frac{\sum_l [(N_{l,o,t} - N_{l,o,y})^2 * (U_t)^2]}{U_y} \right]}$$

where  $T_y$  is the number of trips per year,  $N_{l,o,t}$  the number at length per hour and trip,  $N_{l,o,y}$  the number at length per hour and year,  $U_t$  trip duration and  $U_y$  total duration over all sampled trips in the concerning year (Sokal & Rohlf, 1981).

Total numbers discards or landings ( $CN_{o,p,s}$ ) were calculated by summing over length. Trip duration data was excluded from calculation numbers per hour per period if landings were not measured during a trip, but auction records existed for this species.

$$CN_{o,p,s} = \sum_{l=i} CN_{l,o,p,s}$$

#### *Numbers at age, per quarter and year*

The age structure of both plaice and sole discard and landings was calculated by distribution of numbers at length over age groups using age-length-keys (ALK). The number landed and discarded ( $CN_{l,a,t,s}$ ) at length and age per trip and species was calculated by distribution of the proportion ( $f_{l,a}$ ) of fish at length (l) with age (a) over the number ( $CN_{l,t,s}$ ) at length per trip and species. Because  $f_{l,a}$  is dependent on the period, ALK were taken from discards and market samples from the quarter where discards were sampled.

$$CN_{l,a,t,s} = f_{l,a} * CN_{l,t,s}$$

The number landed and discarded ( $CN_{a,t,s}$ ) at age per trip and species was calculated by multiplying the number landed and discarded ( $CN_{l,a,t,s}$ ) at length and age per trip and species over length:

$$CN_{a,t,s} = \sum_{l=i} CN_{l,a,t,s}$$

The number of discards and landings ( $CN_{a,o,p,s}$ ) at age per hour was calculated per quarter/year by summing the total number landings or discards at age per trip ( $CN_{a,t,s}$ ) over all trips in that period (p) and then dividing this by the sum of the duration of all trips ( $U_t$ ) in this period:

$$CN_{a,o,p,s} = \left( \sum_p CN_{a,t,s} \right) / \sum_p U_t$$

The variance of the numbers at age per species per trip  $VAR(DN_{a,y,s})$  was calculated per year (for the major species) as:

$$Var(DN_{a,y,s}) = \sum_t VAR(DN_{a,y,s,t})$$

where  $DN_{a,y,s,t}$  is the total weight of a species discarded in a trip.

#### *Numbers at age, per quarter and year per fleet*

Total landings en discards ( $CN_{a,p,s,f}$ ) at age per quarter/year were calculated for the entire fleet by multiplying the total numbers of discards and landings ( $N_{a,p,s}$ ) at age per quarter/year with the ratio effort of the entire fleet ( $E_{p,f}$ ) per quarter/year measured in Hpeffort (proportion fishing duration per day multiplied with engine power) to the effort of the sampled part of the fleet in Hpeffort per quarter ( $e_{p,f}$ ).

$$CN_{a,p,s,f} = \frac{E_{p,f}}{e_{p,f}} CN_{a,p,s}$$

Trip duration data was excluded from calculation numbers per hour per period if landings were not measured during a trip, but auction records existed for this species.

## Tables and Figures

**Table 3.1.1.** Characteristics per trip. For each vessel the engine power in KW, the mesh size and sampled rectangles are presented.

| Vessel | Quarter | KW   | Mesh size | Sampled rectangles                              |
|--------|---------|------|-----------|---|
| R41    | 2       | 221  | 80        | 34/F4, 35/F4, 35/F5, 36/F5                      |
| R37    | 1       | 1471 | 80        | 33/F3, 33/F4, 34/F2, 34/F3, 34/F4, 35/F2, 35/F3 |
| R38    | 1       | 1469 | 80        | 33/F3, 34/F3, 34/F4, 35/F3                      |
| R39    | 2       | 1471 | 80        | 38/F6, 39/F7,                                   |
| R40    | 2       | 1470 | 80        | 36/F4, 36/F5,                                   |
| R44    | 3       | 1489 | 80        | 33/F2, 33/F3, 34/F2, 34/F3, 35/F2               |
| R45    | 2       | 1471 | 80        | 32/F3, 33/F3, 34/F3, 35/F3                      |
| R48    | 3       | 1471 | 80        | 34/F2, 34/F3, 35/F2, 35/F3                      |
| R49    | 4       | 1467 | 80        | 37/F5, 37/F6, 38/F6                             |
| R50    | 4       | 1471 | 80        | 36/F0, 37/F0, 37/F1, 38/F0, 38/F1               |

**Table 3.1.2.** Sampling effort per trip. For each trip the duration and number of hauls sampled for landings and discards and total duration and number of hauls for the total trip are given, and the number of plaice and sole otoliths taken from the discard fraction.

| HP class | Vessel | Number of hauls |      |     | Duration (hour) |      |     | Plaice Otolith | Sole Otolith |
|----------|--------|-----------------|------|-----|-----------------|------|-----|----------------|--------------|
|          |        | Land            | Disc | Tot | Land            | Disc | Tot |                |              |
| 300      | R41    | 31              | 26   | 51  | 57              | 49   | 96  | 30             |              |
| >300     | R37    | 21              | 31   | 36  | 37              | 54   | 63  | 25             | 22           |
|          | R38    | 18              | 41   | 44  | 32              | 72   | 78  | 41             |              |
|          | R39    | 28              | 29   | 39  | 50              | 52   | 70  | 28             |              |
|          | R40    | 25              | 30   | 44  | 44              | 53   | 80  | 19             | 16           |
|          | R44    | 23              | 37   | 45  | 39              | 63   | 76  | 36             | 22           |
|          | R45    | 17              | 33   | 39  | 34              | 67   | 79  | 35             | 21           |
|          | R48    | 34              | 40   | 45  | 58              | 69   | 78  | 25             | 13           |
|          | R49    | 20              | 31   | 39  | 41              | 64   | 81  |                |              |
|          | R50    | 21              | 34   | 40  | 38              | 60   | 71  | 30             |              |
|          | Total  |                 | 238  | 332 | 422             | 430  | 603 | 772            | 269          |
| % Total  |        | 72%             | 79%  |     | 71%             | 78%  |     |                |              |

**Table 3.1.3a.** Sampling effort in days at sea (D.A.S.) and hp-effort (HPeff, days at sea corrected for engine power) per trip, and per quarter for the sampled trips and for the fleet larger than 300 HP and fleet coverage by the sampled trips in 2003.

| Quarter | Vessel | Sampled effort |        | Fleet effort |            | Fleet coverage |       |
|---------|--------|----------------|--------|--------------|------------|----------------|-------|
|         |        | D.A.S.         | HPeff  | D.A.S.       | HPeff      | D.A.S.         | HPeff |
| 1       | R37    | 4              | 8.000  |              |            |                |       |
|         | R38    | 3              | 5.991  |              |            |                |       |
|         | Total  | 7              | 13.991 | 5.465        | 12.449.672 | 0.13%          | 0.11% |
| 2       | R39    | 3              | 6.000  |              |            |                |       |
|         | R40    | 4              | 7.996  |              |            |                |       |
|         | R45    | 4              | 8.000  |              |            |                |       |
|         | Total  | 11             | 21.996 | 5.591        | 12.681.939 | 0.20%          | 0.17% |
| 3       | R44    | 4              | 8.000  |              |            |                |       |
|         | R48    | 5              | 10.000 |              |            |                |       |
|         | Total  | 9              | 18.000 | 5.329        | 11.975.298 | 0.17%          | 0.15% |
| 4       | R49    | 4              | 7.980  |              |            |                |       |
|         | R50    | 4              | 8.000  |              |            |                |       |
|         | Total  | 8              | 15.980 | 5.727        | 12.913.554 | 0.14%          | 0.12% |
| All     | Total  | 35             | 69.967 | 22.112       | 50.020.463 | 0.16%          | 0.14% |

**Table 3.1.3b.** Sampling effort in days at sea and hp-effort (days at sea corrected for engine power) per trip, and per quarter for the sampled trip and for the fleet larger than 300 HP and fleet coverage by the sampled trip in 2003.

| Quarter | Vessel | Sampled effort |       | Fleet effort |           | Fleet coverage |       |
|---------|--------|----------------|-------|--------------|-----------|----------------|-------|
|         |        | D.A.S.         | HPeff | D.A.S.       | HPeff     | D.A.S.         | HPeff |
| 1       | Total  |                |       | 898          | 269.259   | -              | -     |
| 2       | R41    | 5              | 1.500 |              |           |                |       |
|         | Total  | 5              | 1.500 | 2.320        | 695.184   | 0.22%          | 0.22% |
| 3       | Total  |                |       | 1.523        | 456.879   | -              | -     |
| 4       | Total  |                |       | 636          | 190.834   | -              | -     |
| All     | Total  | 5              | 1.500 | 5.378        | 1.612.156 | 0.09%          | 0.09% |

**Table 3.2.1.** Total weight (kg) of all discards and of plaice, sole, dab, cod and whiting for beam trawl vessels larger than 300 HP by trip and summed over trips with the CV in 2003.

| HP class | Vessel  | All discards | Plaice | Sole  | Dab    | Cod   | Whiting |
|----------|---------|--------------|--------|-------|--------|-------|---------|
| 300 HP   | R41     | 19.489       | 1.845  | 214   | 952    | -     | 17      |
| >300 HP  | R37     | 21.161       | 2.788  | 177   | 1.001  | -     | 229     |
|          | R38     | 22.289       | 5.073  | 202   | 2.930  | 3     | 71      |
|          | R39     | 51.714       | 10.345 | 7     | 12.243 | -     | 1       |
|          | R40     | 37.445       | 3.548  | 256   | 4.706  | -     | 241     |
|          | R45     | 18.631       | 3.956  | 80    | 1.970  | 21    | 71      |
|          | R44     | 67.506       | 4.600  | 970   | 7.054  | -     | 393     |
|          | R48     | 37.458       | 2.697  | 30    | 2.358  | -     | 29      |
|          | R49     | 67.326       | 8.676  | 218   | 2.917  | -     | 121     |
|          | R50     | 42.432       | 5.302  | 222   | 7.906  | 49    | 780     |
|          | Average |              | 33.720 | 5.220 | 240    | 4.787 | 8       |
| CV       |         | 56%          | 50%    | 120%  | 76%    | 216%  | 114%    |

**Table 3.2.2.** Numbers per hour discarded per species in 2003 in descending order for beam trawl vessels larger than 300 HP and a beam trawl vessel of 300 HP.

| <b>Fish species</b>   | <b>&gt;300 HP</b> | <b>300 HP</b> | <b>Benthic species</b>         | <b>&gt;300 HP</b> | <b>300 HP</b> |
|-----------------------|-------------------|---------------|--------------------------------|-------------------|---------------|
| Dab                   | 1166              | 238           | <i>Astropecten irregularis</i> | 2421              | 316           |
| Plaice                | 936               | 334           | <i>Ophiura ophiura</i>         | 2107              | 4195          |
| Solenette             | 89                | 167           | <i>Asterias rubens</i>         | 1411              | 2743          |
| Grey gurnard          | 69                | 24            | <i>Liocarcinus holsatus</i>    | 721               | 106           |
| Scaldfish             | 60                | 37            | <i>Echinocardium cordatum</i>  | 443               |               |
| Dragonet              | 46                | 28            | <i>Corystes cassivelaunus</i>  | 346               | 125           |
| Whiting               | 40                | 3             | <i>Anthozoa</i>                | 241               | 3             |
| Sole                  | 32                | 29            | <i>Macropipus sp.</i>          | 189               |               |
| Lesser weever         | 12                | 5             | <i>Pagurus bernhardus</i>      | 120               |               |
| Lemon sole            | 12                | <1            | <i>Liocarcinus depurator</i>   | 115               |               |
| Hooknose              | 8                 | 3             | <i>Pagurus sp.</i>             | 112               | 262           |
| Long rough dab        | 6                 |               | <i>Aphrodita aculeata</i>      | 77                |               |
| Four-bearded rockling | 5                 |               | <i>Echinocardium sp.</i>       | 33                |               |
| Tub gurnard           | 5                 |               | <i>Nephrops norvegicus</i>     | 28                |               |
| Ammodytes sp.         | 3                 |               | <i>Psammechinus miliaris</i>   | 24                | 2             |
| Starry ray            | 2                 |               | <i>Buccinum undatum</i>        | 11                |               |
| Pomatoschistus sp.    | 2                 |               | <i>Crangon sp.</i>             | 10                |               |
| Striped red mullet    | 2                 |               | <i>Liocarcinus marmoreus</i>   | 8                 |               |
| Greater sand-eel      | 2                 | 41            | <i>Acanthocardia echinata</i>  | 7                 |               |
| Horse mackerel        | 2                 |               | <i>Spisula sp.</i>             | 7                 |               |
| Raitt's sand-eel      | 1                 |               | <i>Ascidacea</i>               | 6                 |               |
| Sprat                 | 1                 |               | <i>Lunatia alderi</i>          | 6                 |               |
| Haddock               | 1                 |               | <i>Lanice conchilega</i>       | 6                 |               |
| Bull-rout             | 1                 | 4             | <i>Arctica islandica</i>       | 5                 |               |
| Herring               | 1                 |               | <i>Cancer pagurus</i>          | 5                 | 3             |
| Flounder              | 1                 | 3             | <i>Alloteuthis subulata</i>    | 2                 | 1             |
| Viviparous blenny     |                   | 1             | <i>Aequipecten opercularis</i> | 2                 |               |
| Five-bearded rockling | <1                |               | <i>Necora puber</i>            | 1                 |               |
| Red gurnard           | <1                |               | <i>Echinidae</i>               | 1                 |               |
| Roker                 | <1                |               | <i>Mactra corallina</i>        | 1                 |               |
| Cod                   | <1                |               | <i>Alcyonidium diaphanum</i>   | 1                 |               |
| bib                   | <1                | <1            | <i>Luidia sp.</i>              | 1                 |               |
| Cuckoo ray            | <1                |               | <i>Pilumnus hirtellus</i>      | <1                |               |

**Table 3.2.2.** Continued.

| <b>Name</b>            | <b>&gt;300 HP</b> | <b>300 HP</b> | <b>Name</b>                   | <b>&gt;300 HP</b> | <b>300 HP</b> |
|------------------------|-------------------|---------------|-------------------------------|-------------------|---------------|
| Poor cod               | <1                |               | <i>Sepia officinalis</i>      | <1                |               |
| Lesser spotted dogfish | <1                |               | <i>Ensis sp.</i>              | <1                |               |
| Reticulated dragonet   | <1                |               | <i>Colus gracilis</i>         | <1                |               |
| Norwegian topknot      | <1                |               | <i>Gele spons</i>             | <1                |               |
| Brill                  | <1                |               | <i>Portumnus latipes</i>      | <1                |               |
| Syngnathus sp.         | <1                |               | <i>Eledone cirrhosa</i>       | <1                |               |
| John Dory              | <1                |               | <i>Alcyonium digitatum</i>    | <1                |               |
| Raja sp.               | <1                |               | <i>Loligo sp.</i>             | <1                |               |
| Turbot                 | <1                |               | <i>Macropodia rostrata</i>    | <1                |               |
| Lumpsucker             | <1                |               | <i>Spisula solida</i>         | <1                |               |
| Mackerel               | <1                |               | <i>Donax vittatus</i>         | <1                |               |
| Snake pipefish         | <1                |               | <i>Crangon crangon</i>        | <1                |               |
| Twaite shad            | <1                |               | <i>Thia scutellata</i>        | <1                |               |
| Anglerfish             | <1                |               | <i>Hagfish</i>                | <1                | 11            |
| Garfish                | <1                |               | <i>Nereis sp.</i>             | <1                |               |
| Spotted ray            | <1                |               | <i>Atelecyclus rotundatus</i> | <1                |               |
| Blonde ray             | <1                |               | <i>Ensis siliqua</i>          |                   | 60            |
| Spotted dragonet       | <1                |               | <i>Carcinus maenas</i>        |                   | 15            |
|                        |                   |               | <i>Lunatia catena</i>         |                   | 11            |
|                        |                   |               | <i>Hyas sp.</i>               |                   | 4             |



**Table 3.2.3a.** Total landings weight per trip for the plaice, sole, cod, whiting, dab, turbot and brill for beam trawl vessels larger than 300 HP and for a beam trawl vessel of 300 HP (vessel R41).

| HP class          | Vessel       | Quarter | Plaice       | Sole         | Cod        | Whiting    | Dab         | Turbot      | Brill       |
|-------------------|--------------|---------|--------------|--------------|------------|------------|-------------|-------------|-------------|
| 300 HP            | R41          | 2       | 778          | 772          | 8          | 5          | 129         | 192         | 43          |
| >300 HP           | R37          | 1       | 6539         | 1279         | 201        | 124        | 224         | 190         | 233         |
|                   | R38          | 1       | 1625         | 1789         | 53         | 17         | 535         | 243         | 445         |
|                   | R39          | 2       | 7622         | 513          | 0          | 0          | 2230        | 592         | 43          |
|                   | R40          | 2       | 1689         | 1163         | 13         | 90         | 215         | 221         | 68          |
|                   | R45          | 2       | 1728         | 1008         | 40         | 25         | 575         | 241         | 81          |
|                   | R44          | 3       | 1313         | 1489         | 46         | 26         | 487         | 186         | 109         |
|                   | R48          | 3       | 4053         | 3085         | 38         | 0          | 568         | 152         | 114         |
|                   | R49          | 4       | 3871         | 1328         | 0          | 4          | 67          | 574         | 164         |
|                   | R50          | 4       | 5142         | 2143         | 40         | 35         | 520         | 301         | 293         |
| <b>&gt;300 HP</b> | <b>Total</b> |         | <b>33582</b> | <b>13797</b> | <b>431</b> | <b>321</b> | <b>5421</b> | <b>2700</b> | <b>1550</b> |

**Table 3.2.3b.** Sampled landings weight per trip for the plaice, sole, cod, whiting, dab, turbot and brill for beam trawl vessels larger than 300 HP and for a beam trawl vessel of 300 HP (vessel R41).

| HP class          | Vessel       | Quarter | Plaice     | Sole          | Cod       | Whiting  | Dab          | Turbot    | Brill      |
|-------------------|--------------|---------|------------|---------------|-----------|----------|--------------|-----------|------------|
| 300 HP            | R41          | 2       | 56.6       | 62.3          | 6         | 0        | 4            | 36.3      | 0          |
| >300 HP           | R37          | 1       | 39.4       | 179.9         | 0         | 0        | 1.1          | 0         | 0          |
|                   | R38          | 1       | 92.1       | 115.4         | 0         | 0        | 0            | 0         | 0          |
|                   | R39          | 2       | 224        | 96            | 7         | 0        | 107          | 0         | 0          |
|                   | R40          | 2       | 88.5       | 104.5         | 1.5       | 4        | 0            | 45        | 5.5        |
|                   | R45          | 2       | 40         | 152           | 0         | 0        | 69           | 0         | 0          |
|                   | R44          | 3       | 58.5       | 146           | 0         | 0        | 38           | 0         | 0          |
|                   | R48          | 3       | 126        | 203           | 29.5      | 0        | 41           | 0         | 0          |
|                   | R49          | 4       | 61         | 109.5         | 0         | 0        | 3.5          | 3         | 2          |
|                   | R50          | 4       | 81.5       | 100.5         | 0         | 0        | 0            | 0         | 0          |
| <b>&gt;300 HP</b> | <b>Total</b> |         | <b>811</b> | <b>1206.8</b> | <b>38</b> | <b>4</b> | <b>259.6</b> | <b>48</b> | <b>7.5</b> |

**Table 3.3.1.** Plaice. Landings (L), discards (D) and percentage discards (%D) per hour in numbers (left) and weight (right) for a beam trawl vessels of 300 HP and beam trawl vessels larger than 300 HP.

| HP class | Vessel      | Quarter | Numbers    |            |           | Weight    |           |           |
|----------|-------------|---------|------------|------------|-----------|-----------|-----------|-----------|
|          |             |         | L          | D          | %D        | L         | D         | %D        |
| 300      | R41         | 2       | 26         | 334        | 93        | 8         | 19        | 70        |
|          | <b>Mean</b> |         | <b>26</b>  | <b>334</b> | <b>93</b> | <b>8</b>  | <b>19</b> | <b>70</b> |
| >300     | R37         | 1       | 300        | 668        | 69        | 104       | 44        | 30        |
|          | R38         | 1       | 76         | 1210       | 94        | 21        | 65        | 76        |
|          | R39         | 2       | 549        | 2384       | 81        | 110       | 149       | 58        |
|          | R40         | 2       | 77         | 682        | 90        | 21        | 44        | 68        |
|          | R45         | 2       | 120        | 724        | 86        | 22        | 50        | 70        |
|          | R44         | 3       | 87         | 688        | 89        | 17        | 61        | 78        |
|          | R48         | 3       | 134        | 367        | 73        | 52        | 35        | 40        |
|          | R49         | 4       | 191        | 1046       | 85        | 48        | 107       | 69        |
|          | R50         | 4       | 230        | 737        | 76        | 73        | 75        | 51        |
|          | <b>Mean</b> |         | <b>189</b> | <b>936</b> | <b>83</b> | <b>50</b> | <b>70</b> | <b>58</b> |

**Table 3.3.2.** Plaice. Landings (L), discards (D) and percentage discards (%D) per hour and per quarter in numbers (left) and weight (right) for beam trawl vessel larger than 300 HP.

| Quarter | Numbers |      |    | Weight |    |    |
|---------|---------|------|----|--------|----|----|
|         | L       | D    | %D | L      | D  | %D |
| 1       | 176     | 967  | 85 | 58     | 56 | 49 |
| 2       | 236     | 1215 | 84 | 48     | 78 | 62 |
| 3       | 110     | 525  | 83 | 35     | 48 | 58 |
| 4       | 210     | 902  | 81 | 59     | 92 | 61 |

**Table 3.3.3. Plaice.** Number landed and discarded per hour per length class (with weighted standard deviation between brackets) for beam trawl vessels larger than 300 HP ( $\geq 300$ HP) and for a beam trawl vessels of 300 HP.

| Length<br>(cm) | >300 HP  |                  | 300 HP   |                 |
|----------------|----------|------------------|----------|-----------------|
|                | Discards | >300 HP Landings | Discards | 300 HP Landings |
| 10             | 0.07     | (0.1)            |          |                 |
| 11             | 0.2      | (0.1)            | 1.5      |                 |
| 12             | 1        | (1.1)            | 8.2      |                 |
| 13             | 4        | (2.0)            | 29.4     |                 |
| 14             | 9        | (4.4)            | 32.9     |                 |
| 15             | 25       | (11.5)           | 32.7     |                 |
| 16             | 56       | (22.6)           | 30.6     |                 |
| 17             | 101      | (34.9)           | 16.3     |                 |
| 18             | 135      | (49.7)           | 25.3     |                 |
| 19             | 136      | (46.7)           | 29.2     |                 |
| 20             | 111      | (28.6)           | 38.2     |                 |
| 21             | 91       | (14.7)           | 0.03     | (0.0)           |
| 22             | 77       | (17.9)           | 0.05     | (0.1)           |
| 23             | 66       | (18.9)           | 0.2      | (0.1)           |
| 24             | 51       | (15.9)           | 0.4      | (0.2)           |
| 25             | 37       | (9.9)            | 1        | (0.6)           |
| 26             | 23       | (5.2)            | 7        | (2.1)           |
| 27             | 8        | (2.6)            | 28       | (7.3)           |
| 28             | 2        | (0.6)            | 30       | (9.0)           |
| 29             | 0.6      | (0.2)            | 30       | (9.2)           |
| 30             | 0.5      | (0.2)            | 20       | (6.5)           |
| 31             | 0.07     | (0.1)            | 16       | (5.3)           |
| 32             |          |                  | 14       | (4.8)           |
| 33             |          |                  | 9        | (2.9)           |
| 34             |          |                  | 7        | (2.5)           |
| 35             |          |                  | 6        | (2.3)           |
| 36             |          |                  | 5        | (2.3)           |
| 37             |          |                  | 3        | (0.8)           |
| 38             |          |                  | 3        | (0.7)           |
| 39             |          |                  | 3        | (0.9)           |
| 40             |          |                  | 1        | (0.3)           |
| 41             |          |                  | 2        | (1.5)           |

**Table 3.3.3.** Continued.

| <b>Length<br/>(cm)</b> | <b>&gt;300 HP Discards</b> | <b>&gt;300 HP Landings</b> | <b>300 HP Discards</b> | <b>300 HP Landings</b> |
|------------------------|----------------------------|----------------------------|------------------------|------------------------|
| 42                     |                            | 0.8 (0.3)                  |                        | 0.3                    |
| 43                     |                            | 0.6 (0.2)                  |                        |                        |
| 44                     |                            | 0.2 (0.1)                  |                        | 0.1                    |
| 45                     |                            | 0.1 (0.1)                  |                        |                        |
| 46                     |                            | 0.3 (0.3)                  |                        |                        |
| 47                     |                            | 0.05 (0.0)                 |                        |                        |
| 48                     |                            | 0.1 (0.1)                  |                        |                        |
| 49                     |                            | 0.08 (0.1)                 |                        |                        |
| 50                     |                            |                            |                        |                        |
| 51                     |                            | 0.05 (0.05)                |                        |                        |
| 58                     |                            | 0.05 (0.05)                |                        |                        |

**Table 3.3.4.** Plaice. Numbers landed (L) and discarded (D) at age per hour and per quarter and year, and discard coefficient of variation (CV) at age per year.

| Age | Quarter 1 |     | Quarter 2 |        | Quarter 3 |     | Quarter 4 |     | Year |     |      |
|-----|-----------|-----|-----------|--------|-----------|-----|-----------|-----|------|-----|------|
|     | L         | D   | L         | D      | L         | D   | L         | D   | L    | D   | CV   |
| 0   | 0         | 0.3 | 0         | 0      | 0         | 0   | 0         | 0   | 0    | 0.1 | 300% |
| 1   | 0         | 117 | 0.4       | 97.1   | 4         | 159 | 13        | 3   | 4    | 94  | 90%  |
| 2   | 0.6       | 767 | 58        | 1075.2 | 40        | 347 | 68        | 767 | 44   | 776 | 69%  |
| 3   | 25        | 45  | 51        | 41.9   | 25        | 13  | 50        | 97  | 39   | 48  | 72%  |
| 4   | 62        | 34  | 50        | 0.4    | 18        | 5   | 37        | 19  | 42   | 13  | 121% |
| 5   | 40        | 0   | 28        | 0.3    | 14        | 0.9 | 17        | 15  | 25   | 4   | 179% |
| 6   | 22        | 0   | 21        | 0.3    | 4         | 0.3 | 8         | 0.0 | 15   | 0.2 | 136% |
| 7   | 21        | 3   | 20        | 0      | 5         | 0.2 | 15        | 0.2 | 16   | 0.7 | 184% |
| 8   | 0.3       | 0   | 2         | 0      | 0.8       | 0   | 1         | 0   | 1    | 0   | -    |
| 9   | 0.7       | 0   | 0.6       | 0      | 0.1       | 0   | 0.2       | 0   | 0.4  | 0   | -    |
| 10  | 4         | 0   | 4         | 0      | 0.3       | 0   | 0.6       | 0   | 2    | 0   | -    |

**Table 3.3.5.** Plaice. Landings (L) and discards D) raised estimates of total fleet numbers (\*1000) and mean length (left), total weight (\*1000) and mean weight (right) at age per quarter.

| Quarter | age        | Numbers (*1000) |               | Mean length   |             | Weight (*1000) |             | Mean_weight  |              |
|---------|------------|-----------------|---------------|---------------|-------------|----------------|-------------|--------------|--------------|
|         |            | L               | D             | L             | D           | L              | D           | L            | D            |
| 1       | 0          | 0               | 41            | -             | 10.0        | 0              | 0           | -            | 0.009        |
|         | 1          | 0               | 14684         | -             | 14.7        | 0              | 414         | -            | 0.028        |
|         | 2          | 81              | 96053         | 25.5          | 18.4        | 12             | 5506        | 0.147        | 0.057        |
|         | 3          | 3118            | 5684          | 28.7          | 23.5        | 667            | 662         | 0.214        | 0.116        |
|         | 4          | 7780            | 4247          | 30.6          | 20.4        | 2022           | 351         | 0.260        | 0.083        |
|         | 5          | 5006            | 0             | 33.3          | -           | 1714           | 0           | 0.342        | -            |
|         | 6          | 2790            | 0             | 34.1          | -           | 1028           | 0           | 0.368        | -            |
|         | 7          | 2693            | 350           | 36.3          | 27.0        | 1201           | 62          | 0.446        | 0.176        |
|         | 8          | 36              | 0             | 39.6          | -           | 20             | 0           | 0.569        | -            |
|         | 9          | 83              | 0             | 42.8          | -           | 60             | 0           | 0.722        | -            |
|         | 10         | 445             | 0             | 40.9          | -           | 277            | 0           | 0.623        | -            |
|         | <b>all</b> | <b>22032</b>    | <b>121059</b> | <b>32.3</b>   | <b>18.3</b> | <b>7003</b>    | <b>6995</b> | <b>0.318</b> | <b>0.058</b> |
| 2       | 1          | 56              | 12782         | 26.0          | 15.9        | 9              | 465         | 0.157        | 0.036        |
|         | 2          | 7677            | 141600        | 28.6          | 19.1        | 1618           | 9029        | 0.211        | 0.064        |
|         | 3          | 6680            | 5521          | 29.9          | 25.0        | 1634           | 776         | 0.245        | 0.141        |
|         | 4          | 6553            | 51            | 30.4          | 27.0        | 1698           | 9           | 0.259        | 0.176        |
|         | 5          | 3657            | 34            | 30.7          | 27.0        | 980            | 6           | 0.268        | 0.176        |
|         | 6          | 2808            | 41            | 30.8          | 27.0        | 762            | 7           | 0.271        | 0.176        |
|         | 7          | 2625            | 0             | 31.9          | -           | 801            | 0           | 0.305        | -            |
|         | 8          | 320             | 0             | 32.7          | -           | 109            | 0           | 0.340        | -            |
|         | 9          | 80              | 0             | 40.5          | -           | 50             | 0           | 0.618        | -            |
|         | 10         | 566             | 0             | 33.6          | -           | 225            | 0           | 0.397        | -            |
|         |            | <b>all</b>      | <b>31024</b>  | <b>160028</b> | <b>30.1</b> | <b>19.1</b>    | <b>7885</b> | <b>10291</b> | <b>0.254</b> |
| 3       | 1          | 427             | 16240         | 27.5          | 19.0        | 80             | 1038        | 0.188        | 0.064        |
|         | 2          | 4060            | 35389         | 28.4          | 22.1        | 845            | 3480        | 0.208        | 0.098        |
|         | 3          | 2544            | 1283          | 30.6          | 26.6        | 673            | 216         | 0.264        | 0.169        |
|         | 4          | 1804            | 550           | 32.0          | 26.4        | 556            | 90          | 0.308        | 0.164        |
|         | 5          | 1400            | 90            | 30.9          | 28.8        | 390            | 19          | 0.279        | 0.214        |
|         | 6          | 433             | 26            | 32.9          | 28.7        | 150            | 5           | 0.345        | 0.213        |
|         | 7          | 481             | 25            | 33.6          | 28.7        | 178            | 5           | 0.370        | 0.211        |
|         | 8          | 77              | 0             | 42.7          | -           | 56             | 0           | 0.726        | -            |
|         | 9          | 7               | 0             | 40.9          | -           | 4              | 0           | 0.619        | -            |
|         | 10         | 32              | 0             | 31.0          | -           | 9              | 0           | 0.267        | -            |

**Table 3.3.5.** Continued.

|     | <b>all</b> | <b>11266</b> | <b>53602</b>  | <b>30.3</b> | <b>21.3</b> | <b>2939</b>  | <b>4854</b>  | <b>0.261</b> | <b>0.091</b> |
|-----|------------|--------------|---------------|-------------|-------------|--------------|--------------|--------------|--------------|
| 4   | 1          | 1557         | 337           | 27.0        | 17.9        | 275          | 21           | 0.177        | 0.063        |
|     | 2          | 8295         | 94203         | 28.0        | 22.0        | 1654         | 9087         | 0.199        | 0.096        |
|     | 3          | 6181         | 11913         | 29.0        | 23.8        | 1379         | 1471         | 0.223        | 0.124        |
|     | 4          | 4526         | 2330          | 31.4        | 27.1        | 1304         | 416          | 0.288        | 0.179        |
|     | 5          | 2099         | 1853          | 31.0        | 26.1        | 585          | 295          | 0.278        | 0.159        |
|     | 6          | 1025         | 6             | 33.9        | 29.0        | 372          | 1            | 0.363        | 0.218        |
|     | 7          | 1801         | 24            | 32.7        | 29.0        | 605          | 5            | 0.336        | 0.218        |
|     | 8          | 147          | 0             | 36.5        | -           | 67           | 0            | 0.458        | -            |
|     | 9          | 20           | 0             | 39.8        | -           | 12           | 0            | 0.577        | -            |
|     | 10         | 68           | 0             | 41.9        | -           | 46           | 0            | 0.674        | -            |
|     | <b>all</b> | <b>25718</b> | <b>110665</b> | <b>29.7</b> | <b>22.3</b> | <b>6299</b>  | <b>11296</b> | <b>0.245</b> | <b>0.102</b> |
| all | 0          |              | 33            |             | 10.0        |              | 0            |              | 0.009        |
|     | 1          | 1906         | 45396         | 27.1        | 16.8        | 341          | 2043         | 0.179        | 0.045        |
|     | 2          | 21285        | 374114        | 28.3        | 19.9        | 4387         | 27397        | 0.206        | 0.073        |
|     | 3          | 18991        | 23331         | 29.6        | 24.3        | 4505         | 3028         | 0.237        | 0.130        |
|     | 4          | 20319        | 6127          | 30.8        | 23.3        | 5482         | 758          | 0.270        | 0.124        |
|     | 5          | 11918        | 1777          | 31.6        | 26.3        | 3528         | 289          | 0.296        | 0.162        |
|     | 6          | 7096         | 83            | 32.4        | 27.7        | 2260         | 16           | 0.319        | 0.191        |
|     | 7          | 7528         | 329           | 33.5        | 27.3        | 2685         | 60           | 0.357        | 0.181        |
|     | 8          | 639          |               | 35.1        |             | 271          |              | 0.424        |              |
|     | 9          | 192          |               | 41.2        |             | 125          |              | 0.650        |              |
|     | 10         | 1155         |               | 36.2        |             | 551          |              | 0.478        |              |
|     | <b>all</b> | <b>91028</b> | <b>451191</b> | <b>19.9</b> | <b>30.5</b> | <b>24135</b> | <b>33591</b> | <b>0.074</b> | <b>0.265</b> |

**Table 3.3.6.** Sole. Landings (L), discards (D) and percentage discards (%D) per hour in numbers (left) and weight (right) for a beam trawl vessels of 300 HP and beam trawl vessels larger than 300 HP.

| HP class | Vessel      | Quarter     | Numbers   |           |           | Weight    |           |           |
|----------|-------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|
|          |             |             | L         | D         | %D        | L         | D         | %D        |
| 300      | R41         | 2           | 38        | 29        | 43        | 8         | 2         | 22        |
|          | <b>Mean</b> |             | <b>38</b> | <b>29</b> | <b>43</b> | <b>8</b>  | <b>2</b>  | <b>22</b> |
| >300     | R37         | 1           | 75        | 33        | 31        | 20        | 3         | 12        |
|          | R38         | 1           | 90        | 29        | 24        | 23        | 3         | 10        |
|          | R39         | 2           | 28        | 1         | 4         | 7         | <1        | 1         |
|          | R40         | 2           | 72        | 39        | 35        | 15        | 3         | 18        |
|          | R45         | 2           | 70        | 10        | 13        | 13        | 1         | 7         |
|          | R44         | 3           | 115       | 113       | 50        | 20        | 13        | 39        |
|          | R48         | 3           | 187       | 4         | 2         | 40        | <1        | 1         |
|          | R49         | 4           | 63        | 28        | 31        | 16        | 3         | 14        |
|          | R50         | 4           | 152       | 28        | 16        | 30        | 3         | 9         |
|          |             | <b>Mean</b> |           | <b>95</b> | <b>32</b> | <b>25</b> | <b>20</b> | <b>3</b>  |

**Table 3.3.7.** Sole. Landings (L), discards (D) and percentage discards (%D) per hour and per quarter in numbers (left) and weight (right) for large vessels.

| Quarter | Numbers |    |    | Weight |   |    |
|---------|---------|----|----|--------|---|----|
|         | L       | D  | %D | L      | D | %D |
| 1       | 83      | 31 | 27 | 8      | 2 | 22 |
| 2       | 58      | 17 | 23 | 22     | 3 | 11 |
| 3       | 152     | 58 | 28 | 12     | 2 | 11 |
| 4       | 104     | 28 | 21 | 30     | 7 | 18 |



**Table 3.3.8. Sole.** Number landed and discarded per hour per length class (with weighted standard deviation between brackets) for beam trawl vessels larger than 300 HP ( $\geq 300$ HP) and for a beam trawl vessels of 300 HP.

| Length (cm) | >300 HP Discards | >300 HP Landings | 300 HP Discards | 300 HP Landings |
|-------------|------------------|------------------|-----------------|-----------------|
| 10          |                  |                  |                 |                 |
| 11          |                  |                  |                 |                 |
| 12          |                  |                  | 0.5             |                 |
| 13          | 0.1 (0.1)        |                  | 0.5             |                 |
| 14          | 0.2 (0.2)        |                  | 0.9             |                 |
| 15          | 0.3 (0.2)        |                  |                 |                 |
| 16          | 0.2 (0.1)        |                  |                 |                 |
| 17          | 0.2 (0.1)        |                  | 1.7             |                 |
| 18          | 0.6 (0.2)        | 0.07 (0.1)       |                 |                 |
| 19          | 2 (0.6)          |                  | 4.6             |                 |
| 20          | 4 (1.2)          | 0.04 (0.0)       | 7.3             | 0.1             |
| 21          | 6 (1.4)          | 0.1 (0.1)        | 7.7             | 0.1             |
| 22          | 7 (3.0)          | 0.5 (0.4)        | 4.6             | 0.3             |
| 23          | 6 (2.5)          | 3 (1.0)          | 1.5             | 4.5             |
| 24          | 4 (2.5)          | 11 (1.9)         |                 | 7.2             |
| 25          | 1 (1.0)          | 16 (3.6)         |                 | 5.8             |
| 26          | 0.4 (0.3)        | 13 (3.7)         |                 | 4.5             |
| 27          | 0.2 (0.1)        | 11 (3.0)         |                 | 2.8             |
| 28          |                  | 9 (1.8)          |                 | 1.4             |
| 29          | 0.01 (0.0)       | 7 (1.0)          |                 | 1.7             |
| 30          |                  | 5 (0.6)          |                 | 1.4             |
| 31          |                  | 5 (0.5)          |                 | 1.2             |
| 32          |                  | 4 (0.3)          |                 | 1.5             |
| 33          |                  | 3 (0.3)          |                 | 1.4             |
| 34          |                  | 2 (0.3)          |                 | 0.8             |
| 35          |                  | 2 (0.3)          |                 | 0.9             |
| 36          |                  | 1 (0.2)          |                 | 0.9             |
| 37          |                  | 0.7 (0.2)        |                 | 0.8             |
| 38          |                  | 0.6 (0.1)        |                 | 0.3             |
| 39          |                  | 0.4 (0.1)        |                 | 0.3             |
| 40          |                  | 0.3 (0.1)        |                 |                 |
| 41          |                  | 0.2 (0.1)        |                 | 0.3             |

**Table 3.3.8.** Continued.

| <b>Length<br/>(cm)</b> | <b>&gt;300 HP Discards</b> | <b>&gt;300 HP Landings</b> | <b>300 HP Discards</b> | <b>300 HP Landings</b> |
|------------------------|----------------------------|----------------------------|------------------------|------------------------|
| 42                     |                            | 0.07 (0.0)                 |                        |                        |
| 43                     |                            | 0.04 (0.0)                 |                        |                        |
| 44                     |                            | 0.05 (0.0)                 |                        |                        |
| 45                     |                            | 0.05 (0.0)                 |                        |                        |
| 46                     |                            | 0.02 (0.0)                 |                        |                        |
| 47                     |                            |                            |                        |                        |
| 48                     |                            | 0.06 0.0                   |                        |                        |
| 49                     |                            |                            |                        |                        |
| 50                     |                            | 0.02 0.0                   |                        |                        |

**Table 3.3.9.** Sole. Numbers landed (L) and discarded (D) at age per hour and per quarter and year, and discard coefficient of variation (CV) at age per year.

| Age | Quarter 1 |     | Quarter 2 |     | Quarter 3 |     | Quarter 4 |     | Year |     |      |
|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|------|-----|------|
|     | L         | D   | L         | D   | L         | D   | L         | D   | L    | D   | CV   |
| 0   | 0         | 0   | 0         | 0   | 0         | 0   | 0         | 0   | 0    | 0   | -    |
| 1   | 0         | 0.3 | 0         | 2   | 3         | 0.4 | 5         | 1   | 2    | 1   | 154% |
| 2   | 9         | 29  | 5         | 15  | 86        | 50  | 45        | 18  | 33   | 26  | 109% |
| 3   | 19        | 0.3 | 12        | 0.3 | 25        | 8   | 21        | 7   | 19   | 3   | 161% |
| 4   | 29        | 0.5 | 16        | 0.9 | 24        | 0.1 | 14        | 1   | 20   | 0.7 | 108% |
| 5   | 7         | 0.1 | 9         | 0.1 | 5         | 0   | 9         | 0.1 | 8    | 0.1 | 142% |
| 6   | 10        | 0.1 | 7         | 0   | 2         | 0   | 8         | 0.1 | 7    | 0.1 | 180% |
| 7   | 8         | 0.1 | 6         | 0   | 4         | 0   | 2         | 0   | 5    | 0   | 246% |
| 8   | 0.2       | 0   | 1         | 0   | 0.4       | 0   | 0         | 0   | 0.6  | 0   | -    |
| 9   | 0.4       | 0   | 0.3       | 0   | 0.2       | 0   | 0         | 0   | 0.3  | 0   | -    |
| 10  | 0.5       | 0   | 1         | 0   | 0.8       | 0   | 0.3       | 0   | 0.7  | 0   | -    |

**Table 3.3.10.** Sole. Landings (L) and discards D) raised estimates of total fleet numbers (\*1000) and mean length (left), total weight (\*1000) and mean weight (right) at age per quarter.

| Quarter | age        | Numbers (*1000) |             | Mean length |             | Weight (*1000) |            | Mean_weight  |              |
|---------|------------|-----------------|-------------|-------------|-------------|----------------|------------|--------------|--------------|
|         |            | L               | D           | L           | D           | L              | D          | L            | D            |
| 1       | 0          |                 |             |             |             |                |            |              |              |
|         | 1          | 0               | 36          |             | 13.3        | 0              | 1          |              | 0.019        |
|         | 2          | 1155            | 3669        | 23.9        | 20.8        | 155            | 316        | 0.134        | 0.086        |
|         | 3          | 2418            | 37          | 27.4        | 24.6        | 524            | 5          | 0.217        | 0.149        |
|         | 4          | 3663            | 62          | 29.0        | 24.6        | 974            | 9          | 0.266        | 0.147        |
|         | 5          | 820             | 14          | 28.6        | 24.6        | 218            | 2          | 0.266        | 0.147        |
|         | 6          | 1236            | 18          | 30.8        | 24.3        | 419            | 2          | 0.339        | 0.141        |
|         | 7          | 1010            | 6           | 31.4        | 26.4        | 366            | 1          | 0.362        | 0.187        |
|         | 8          | 30              | 0           | 39.7        |             | 22             | 0          | 0.717        |              |
|         | 9          | 52              | 0           | 48.9        |             | 81             | 0          | 1.549        |              |
|         | 10         | 60              | 0           | 47.9        |             | 87             | 0          | 1.451        |              |
|         | <b>all</b> | <b>10444</b>    | <b>3841</b> | <b>28.7</b> | <b>20.9</b> | <b>2845</b>    | <b>337</b> | <b>0.272</b> | <b>0.088</b> |
| 2       | 1          | 0               | 196         |             | 15.0        | 0              | 6          |              | 0.028        |
|         | 2          | 630             | 1919        | 25.0        | 21.0        | 100            | 169        | 0.159        | 0.088        |
|         | 3          | 1644            | 35          | 27.2        | 24.1        | 345            | 5          | 0.210        | 0.137        |
|         | 4          | 2136            | 115         | 28.3        | 24.2        | 524            | 16         | 0.245        | 0.141        |
|         | 5          | 1164            | 13          | 29.6        | 24.3        | 336            | 2          | 0.288        | 0.142        |
|         | 6          | 974             | 2           | 30.2        | 26.0        | 306            | 0          | 0.314        | 0.176        |
|         | 7          | 728             | 0           | 31.5        |             | 258            | 0          | 0.354        |              |
|         | 8          | 153             | 0           | 31.0        |             | 53             | 0          | 0.345        |              |
|         | 9          | 44              | 0           | 35.1        |             | 22             | 0          | 0.496        |              |
|         | 10         | 127             | 0           | 30.7        |             | 43             | 0          | 0.341        |              |
|         | <b>all</b> | <b>7601</b>     | <b>2281</b> | <b>28.7</b> | <b>20.7</b> | <b>1987</b>    | <b>198</b> | <b>0.261</b> | <b>0.087</b> |
| 3       | 1          | 332             | 36          | 22.1        | 18.0        | 34             | 2          | 0.103        | 0.052        |
|         | 2          | 8797            | 5062        | 25.8        | 22.6        | 1518           | 570        | 0.173        | 0.113        |
|         | 3          | 2567            | 796         | 28.2        | 22.8        | 622            | 91         | 0.242        | 0.115        |
|         | 4          | 2462            | 8           | 29.8        | 27.0        | 720            | 2          | 0.293        | 0.199        |
|         | 5          | 520             | 0           | 30.1        |             | 155            | 0          | 0.298        |              |
|         | 6          | 179             | 0           | 33.3        |             | 76             | 0          | 0.423        |              |
|         | 7          | 442             | 0           | 29.4        |             | 127            | 0          | 0.288        |              |
|         | 8          | 45              | 0           | 37.0        |             | 26             | 0          | 0.571        |              |
|         | 9          | 24              | 0           | 39.3        |             | 18             | 0          | 0.733        |              |
|         | 10         | 79              | 0           | 37.8        |             | 52             | 0          | 0.655        |              |

**Table 3.4.10.** Continued.

|     | <b>all</b> | <b>15447</b> | <b>5903</b> | <b>27.2</b> | <b>22.6</b> | <b>3349</b> | <b>665</b> | <b>0.217</b> | <b>0.113</b> |
|-----|------------|--------------|-------------|-------------|-------------|-------------|------------|--------------|--------------|
| 4   | 1          | 655          | 188         | 24.3        | 17.0        | 92          | 9          | 0.140        | 0.046        |
|     | 2          | 5534         | 2228        | 26.6        | 22.0        | 1077        | 231        | 0.195        | 0.104        |
|     | 3          | 2567         | 853         | 28.0        | 22.9        | 599         | 98         | 0.233        | 0.115        |
|     | 4          | 1668         | 161         | 27.6        | 20.4        | 378         | 13         | 0.227        | 0.081        |
|     | 5          | 1058         | 10          | 27.9        | 27.0        | 250         | 2          | 0.236        | 0.199        |
|     | 6          | 1000         | 10          | 27.8        | 27.0        | 229         | 2          | 0.229        | 0.199        |
|     | 7          | 291          | 0           | 29.7        |             | 82          | 0          | 0.281        |              |
|     | 8          | 2            | 0           | 38.0        |             | 1           | 0          | 0.617        |              |
|     | 9          |              |             |             |             |             |            |              |              |
|     | 10         | 43           | 0           | 34.2        |             | 19          | 0          | 0.436        |              |
|     | <b>all</b> | <b>12818</b> | <b>3451</b> | <b>27.2</b> | <b>21.9</b> | <b>2726</b> | <b>356</b> | <b>0.213</b> | <b>0.103</b> |
| all | 0          |              |             |             |             |             |            |              |              |
|     | 1          | 937          | 478         | 23.4        | 15.8        | 118         | 17         | 0.126        | 0.036        |
|     | 2          | 16059        | 12738       | 25.9        | 21.8        | 2833        | 1282       | 0.176        | 0.101        |
|     | 3          | 9010         | 1683        | 27.7        | 22.9        | 2048        | 196        | 0.227        | 0.116        |
|     | 4          | 9713         | 343         | 28.8        | 22.8        | 2542        | 41         | 0.262        | 0.119        |
|     | 5          | 3596         | 36          | 29.1        | 25.1        | 979         | 6          | 0.272        | 0.157        |
|     | 6          | 3278         | 26          | 29.9        | 25.4        | 999         | 4          | 0.305        | 0.165        |
|     | 7          | 2446         | 5           | 30.9        | 26.4        | 823         | 1          | 0.336        | 0.187        |
|     | 8          | 264          |             | 32.9        |             | 111         |            | 0.422        |              |
|     | 9          | 123          |             | 40.7        |             | 111         |            | 0.906        |              |
|     | 10         | 329          |             | 35.4        |             | 196         |            | 0.595        |              |

**Table 3.3.11** Dab. Landings (L), discards (D) and percentage discards (%D) per hour in numbers (left) and weight (right) for a beam trawl vessels of 300 HP and beam trawl vessels larger than 300 HP.

| HP class | Vessel      | Quarter     | Numbers  |            |             | Weight    |           |           |
|----------|-------------|-------------|----------|------------|-------------|-----------|-----------|-----------|
|          |             |             | L        | D          | %D          | L         | D         | %D        |
| 300      | R41         | 2           | 6        | 238        | 97          | 1         | 10        | 88        |
|          | <b>Mean</b> |             | <b>6</b> | <b>238</b> | <b>97</b>   | <b>1</b>  | <b>10</b> | <b>88</b> |
| >300     | R37         | 1           | 16       | 344        | 96          | 4         | 16        | 82        |
|          | R38         | 1           |          | 740        |             | 7         | 38        | 85        |
|          | R39         | 2           | 237      | 2434       | 91          | 32        | 176       | 85        |
|          | R40         | 2           |          | 1343       |             | 3         | 59        | 96        |
|          | R45         | 2           | 51       | 441        | 90          | 7         | 25        | 77        |
|          | R44         | 3           | 36       | 1971       | 98          | 6         | 93        | 94        |
|          | R48         | 3           | 29       | 432        | 94          | 7         | 30        | 81        |
|          | R49         | 4           | 4        | 901        | 100         | <1        | 36        | 98        |
|          | R50         | 4           |          | 1976       |             | 7         | 111       | 94        |
|          |             | <b>Mean</b> |          | <b>60</b>  | <b>1166</b> | <b>95</b> | <b>8</b>  | <b>64</b> |

**Table 3.3.12.** Dab. Landings (L), discards (D) and percentage discards (%D) per hour and per quarter in numbers (left) and weight (right) for large vessels.

| Quarter | Numbers |      |     | Weight |    |    |
|---------|---------|------|-----|--------|----|----|
|         | L       | D    | %D  | L      | D  | %D |
| 1       | 16      | 563  | 97  | 1      | 10 | 88 |
| 2       | 138     | 1364 | 91  | 5      | 28 | 84 |
| 3       | 32      | 1192 | 97  | 13     | 83 | 86 |
| 4       | 4       | 1403 | 100 | 7      | 61 | 90 |

**Table 3.3.13.** Cod. Landings (L), discards (D) and percentage discards (%D) per hour in numbers (left) and weight (right) for a beam trawl vessels of 300 HP and beam trawl vessels larger than 300 HP.

| HP class | Vessel      | Quarter | Numbers      |              |           | Weight       |              |           |
|----------|-------------|---------|--------------|--------------|-----------|--------------|--------------|-----------|
|          |             |         | L            | D            | %D        | L            | D            | %D        |
| 300      | R41         | 2       | <1           | 0            | 0         | <1           | 0            | 0         |
|          | <b>Mean</b> |         | <b>&lt;1</b> | <b>0</b>     | <b>0</b>  | <b>&lt;1</b> | <b>0</b>     | <b>0</b>  |
| >300     | R37         | 1       |              | 0            |           | 3            | 0            | 0         |
|          | R38         | 1       |              | <1           |           | <1           | <1           | 6         |
|          | R39         | 2       | 0            | 0            | 0         | 0            | 0            | 0         |
|          | R40         | 2       | <1           | 0            | 0         | <1           | 0            | 0         |
|          | R45         | 2       |              | <1           |           | <1           | <1           | 34        |
|          | R44         | 3       |              | 0            |           | <1           | 0            | 0         |
|          | R48         | 3       | <1           | 0            | 0         | <1           | 0            | 0         |
|          | R49         | 4       | 0            | 0            | 0         | 0            | 0            | 0         |
|          | R50         | 4       |              | 2            |           | <1           | <1           | 55        |
|          | <b>Mean</b> |         | <b>&lt;1</b> | <b>&lt;1</b> | <b>68</b> | <b>&lt;1</b> | <b>&lt;1</b> | <b>15</b> |

**Table 3.3.14.** Cod. Landings (L), discards (D) and percentage discards (%D) per hour and per quarter in numbers (left) and weight (right) for large vessels.

| Quarter | Numbers |    |     | Weight |    |    |
|---------|---------|----|-----|--------|----|----|
|         | L       | D  | %D  | L      | D  | %D |
| 1       |         | <1 |     | 2      | <1 | 1  |
| 2       | <1      | <1 | 63  | <1     | <1 | 28 |
| 3       | <1      | 0  | 0   | <1     | 0  | 0  |
| 4       | 0       | <1 | 100 | <1     | <1 | 55 |

**Table 3.3.15.** Whiting. Landings (L), discards (D) and percentage discards (%D) per hour in numbers (left) and weight (right) for a beam trawl vessels of 300 HP and beam trawl vessels larger than 300 HP.

| HP class | Vessel      | Quarter | Numbers  |           |           | Weight       |              |           |
|----------|-------------|---------|----------|-----------|-----------|--------------|--------------|-----------|
|          |             |         | L        | D         | %D        | L            | D            | %D        |
| 300      | R41         | 2       |          | 3         |           | <1           | <1           | 77        |
|          | <b>Mean</b> |         |          | <b>3</b>  |           | <b>&lt;1</b> | <b>&lt;1</b> | <b>77</b> |
| >300     | R37         | 1       |          | 63        |           | 2            | 4            | 65        |
|          | R38         | 1       |          | 11        |           | <1           | <1           | 81        |
|          | R39         | 2       | 0        | 1         | 100       | 0            | <1           | 100       |
|          | R40         | 2       | 5        | 48        | 90        | 1            | 3            | 73        |
|          | R45         | 2       |          | 9         |           | <1           | <1           | 73        |
|          | R44         | 3       |          | 83        |           | <1           | 5            | 94        |
|          | R48         | 3       | 0        | 7         | 100       | 0            | <1           | 100       |
|          | R49         | 4       |          | 34        |           | <1           | 1            | 97        |
|          | R50         | 4       |          | 115       |           | <1           | 11           | 96        |
|          | <b>Mean</b> |         | <b>2</b> | <b>40</b> | <b>96</b> | <b>&lt;1</b> | <b>3</b>     | <b>86</b> |

**Table 3.3.16.** Whiting. Landings (L), discards (D) and percentage discards (%D) per hour and per quarter in numbers (left) and weight (right) for large vessels.

| Quarter | Numbers |    |     | Weight |   |    |
|---------|---------|----|-----|--------|---|----|
|         | L       | D  | %D  | L      | D | %D |
| 1       |         | 34 |     | 1      | 2 | 68 |
| 2       | 3       | 20 | 88  | <1     | 1 | 73 |
| 3       | 0       | 44 | 100 | <1     | 3 | 94 |
| 4       |         | 71 |     | <1     | 6 | 96 |

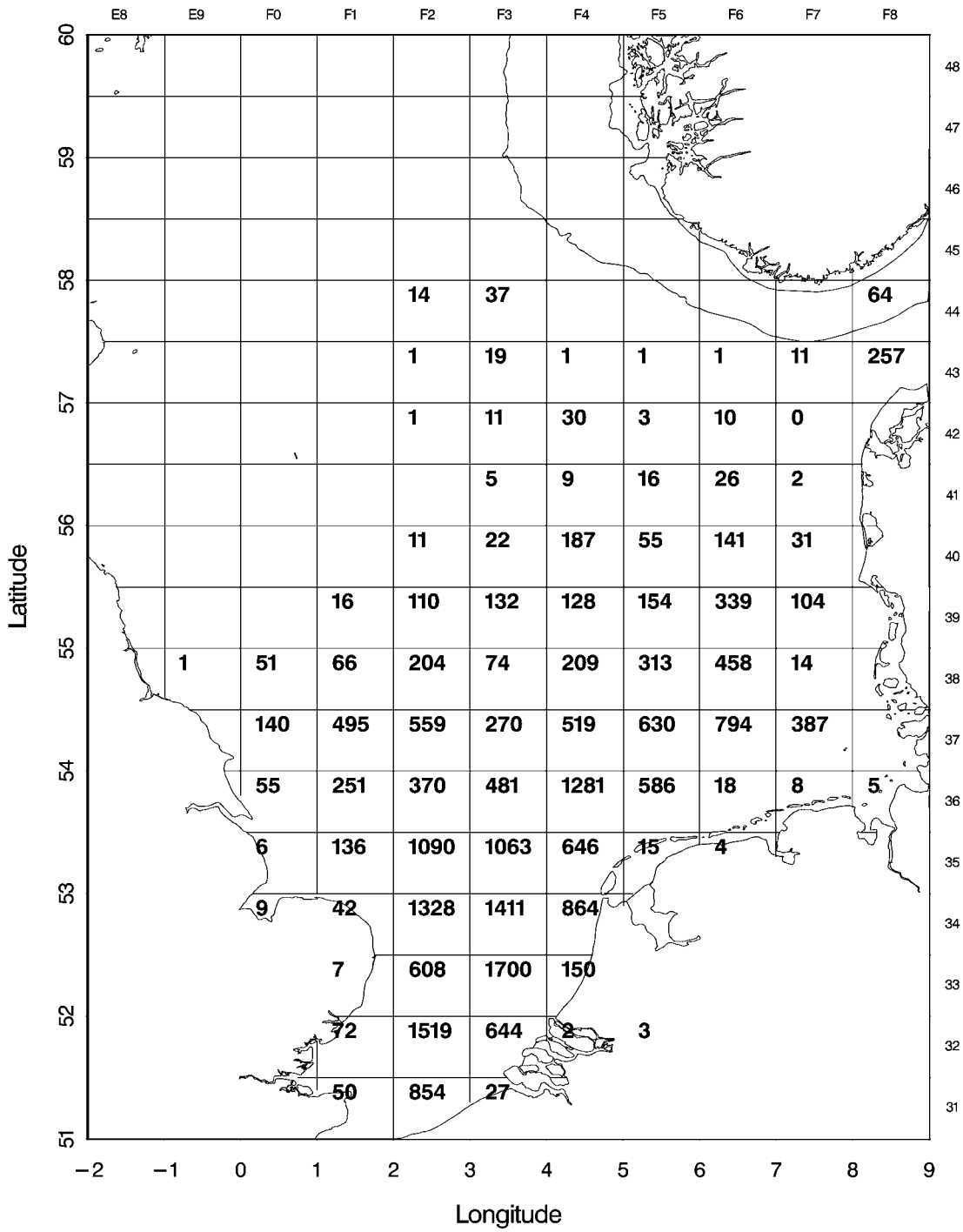


**Table 4.1.** Plaice. Landings (L), discards (D) and percentage discards (%D) per hour and per period in numbers (left) and weight (right). Results over 1976-1983 and 1989-1990 from Van Beek (1998), 1999-2001 from Netherlands Institute for Fisheries Research unpublished data.

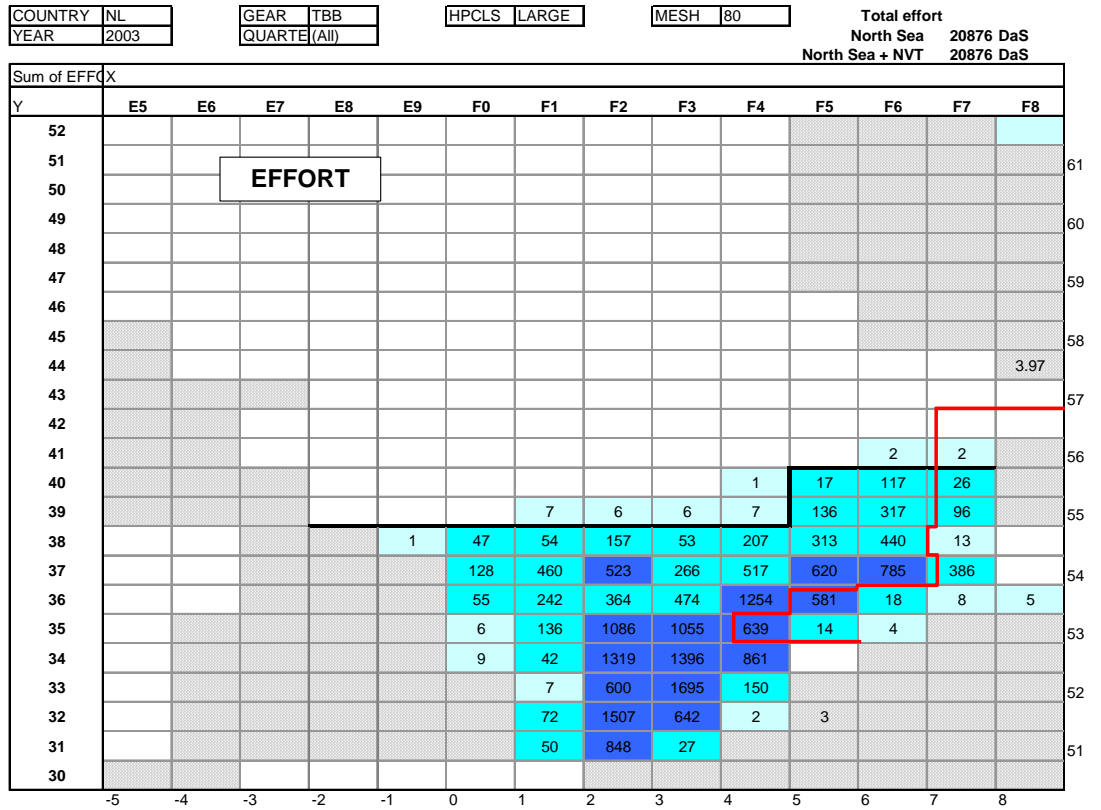
| Period    | N trips | Numbers |     |     | Weight |    |     |
|-----------|---------|---------|-----|-----|--------|----|-----|
|           |         | L       | D   | %D  | L      | D  | %D  |
| 1976-1979 | 21      | 253     | 185 | 42% | 104    | 24 | 18% |
| 1980-1983 | 22      | 336     | 380 | 53% | 107    | 49 | 31% |
| 1989-1990 | 6       | 392     | 330 | 46% | 136    | 40 | 23% |
| 1999-2001 | 20      | 214     | 575 | 73% | 56     | 47 | 46% |
| 2002      | 6       | 241     | 816 | 77% | 63     | 66 | 51% |
| 2003      | 9       | 189     | 936 | 83% | 50     | 70 | 58% |

**Table 4.2.** Sole. Landings (L), discards (D) and percentage discards (%D) per hour and per period in numbers (left) and weight (right). Results over 1976-1983 and 1989-1990 from Van Beek (1998), 1999-2001 from Netherlands Institute for Fisheries Research unpublished data.

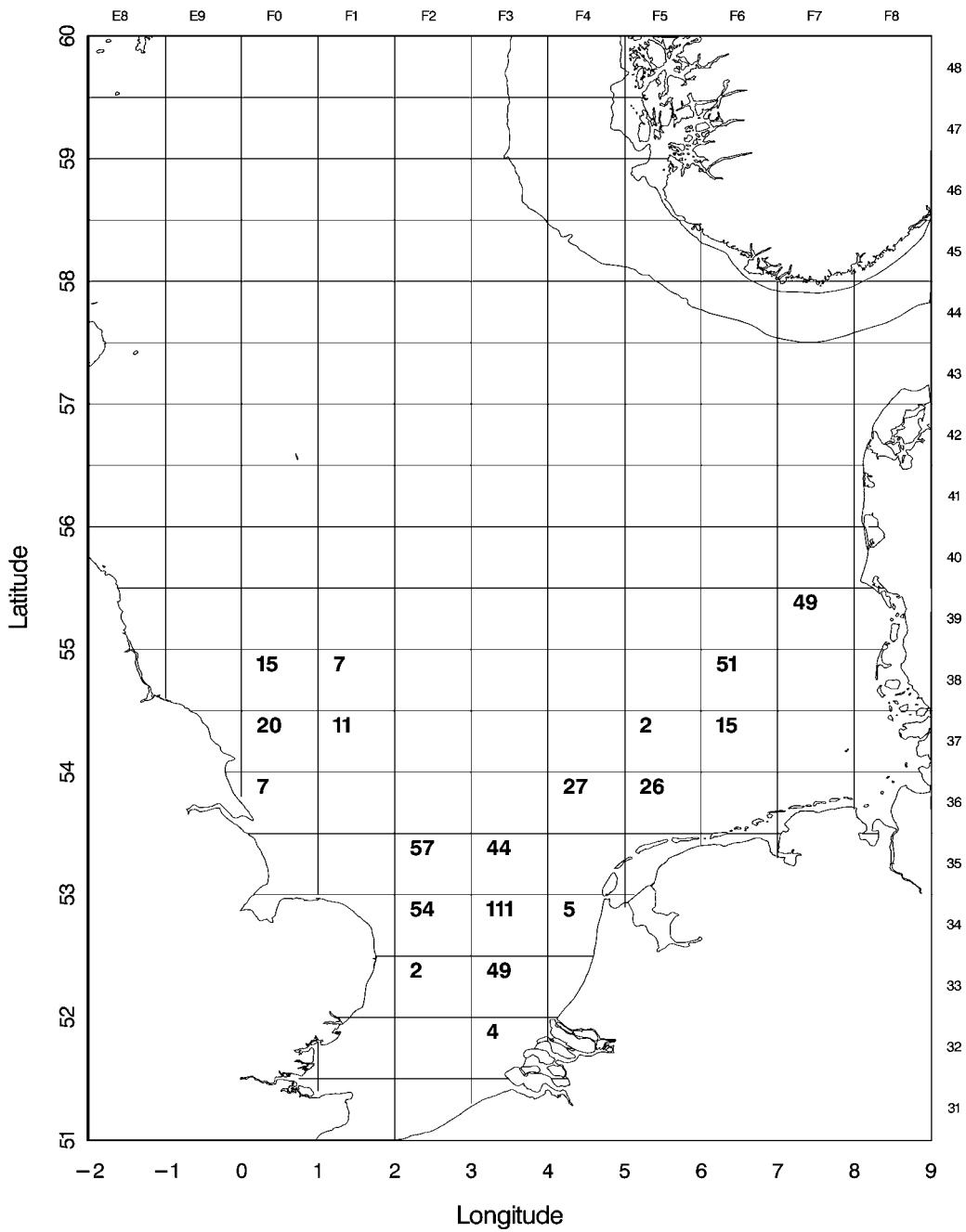
| Period    | N trips | Numbers |    |     | Weight |    |     |
|-----------|---------|---------|----|-----|--------|----|-----|
|           |         | L       | D  | %D  | L      | D  | %D  |
| 1976-1979 | 21      | 116     | 8  | 6%  | 38     | 1  | 3%  |
| 1980-1983 | 22      | 84      | 23 | 21% | 27     | 3  | 9%  |
| 1989-1990 | 6       | 286     | 83 | 22% | 72     | 11 | 13% |
| 1999-2001 | 20      | 92      | 21 | 19% | 22     | 2  | 8%  |
| 2002      | 6       | 124     | 37 | 24% | 18     | 3  | 13% |
| 2003      | 9       | 95      | 32 | 25% | 20     | 3  | 14% |



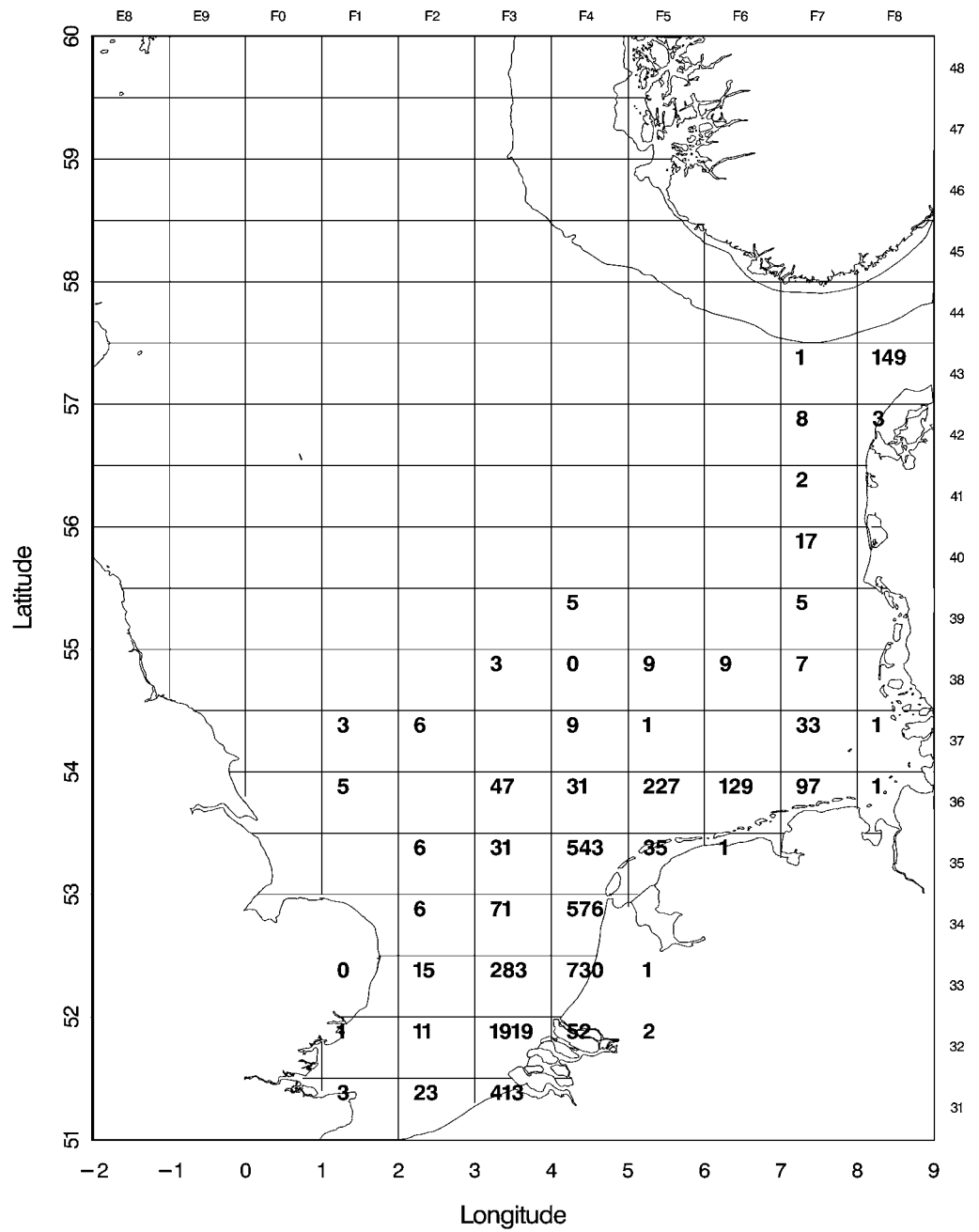
**Figure 3.1.1a.** Effort distribution of the Dutch beam trawl fleet in 2003, for vessels larger than 300 HP.



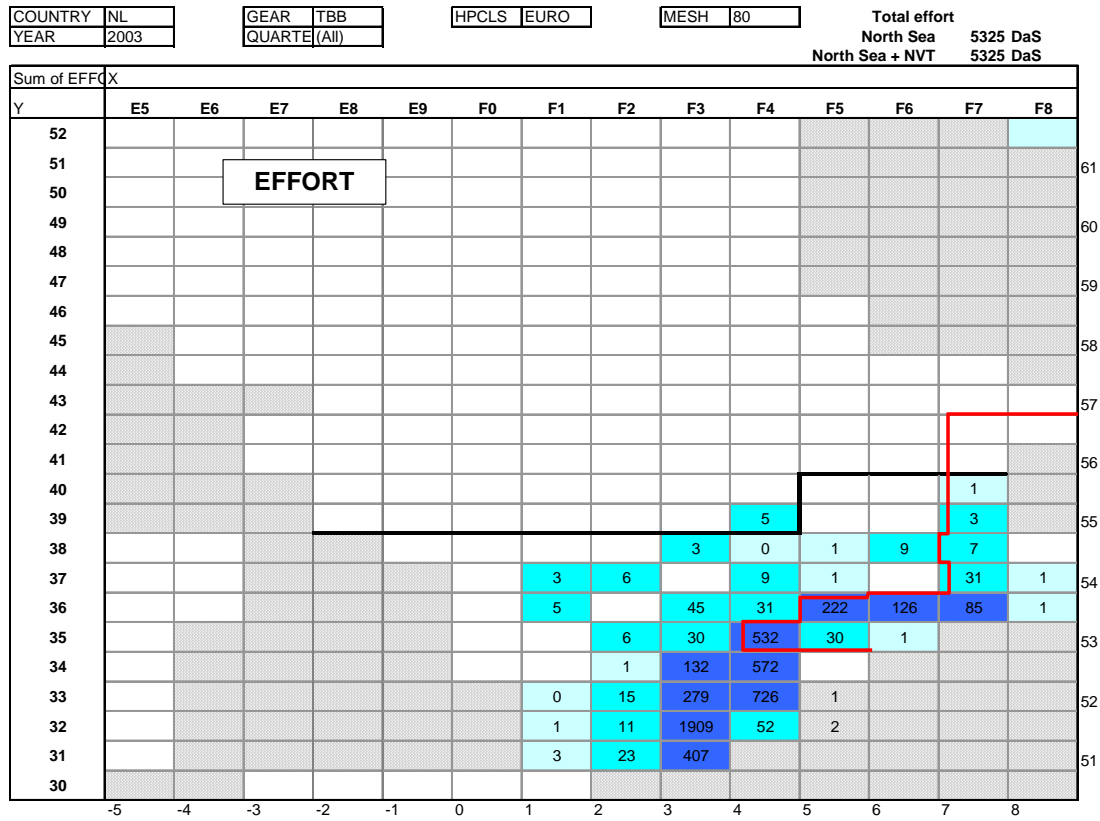
**Figure 3.1.1b.** Effort distribution of the Dutch beam trawl fleet in 2003, for vessels larger than 300 HP fishing with 80 mm mesh size.



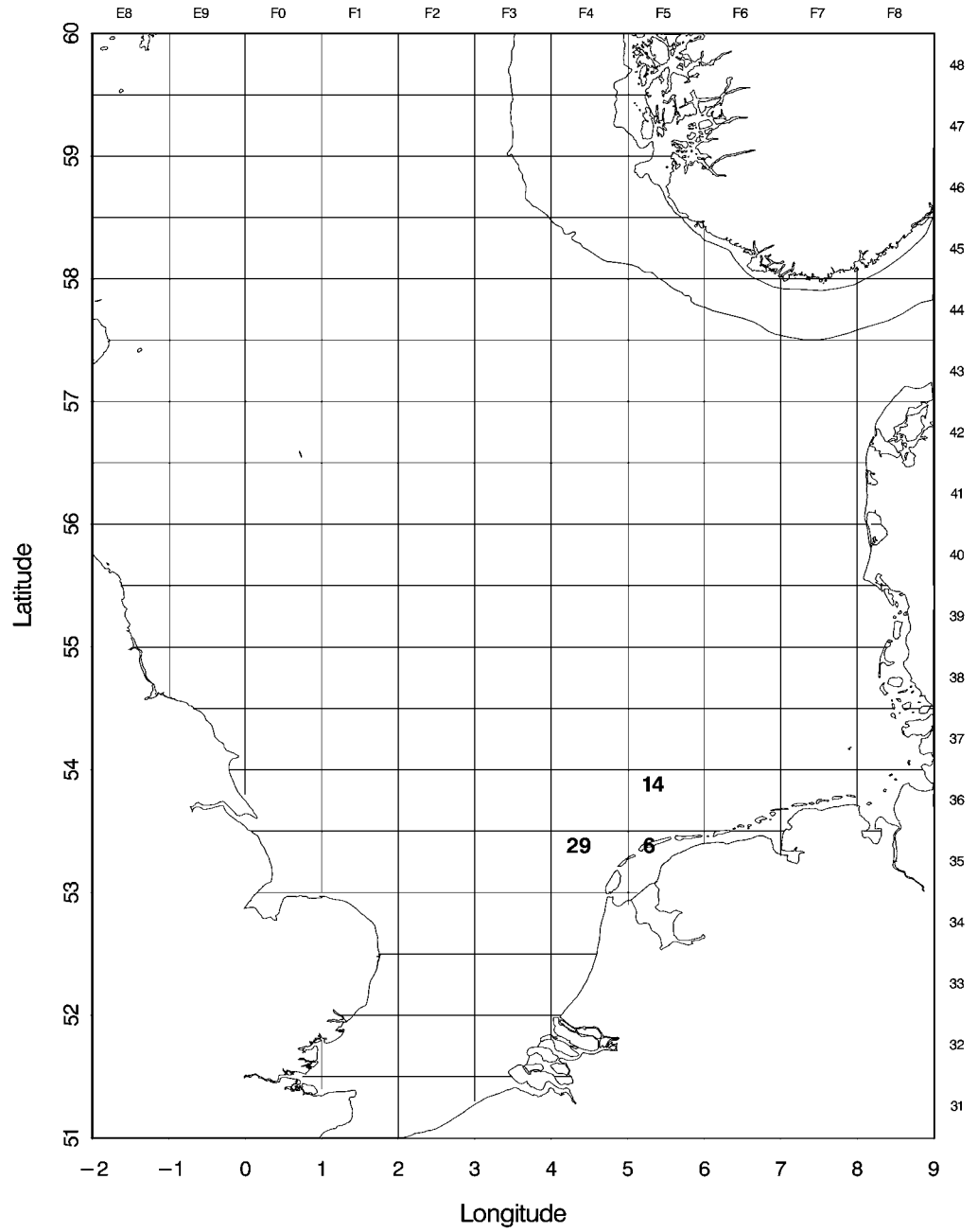
**Figure 3.1.1c.** Sampled effort in hours for beam trawl vessels with engine power larger than 300 HP.



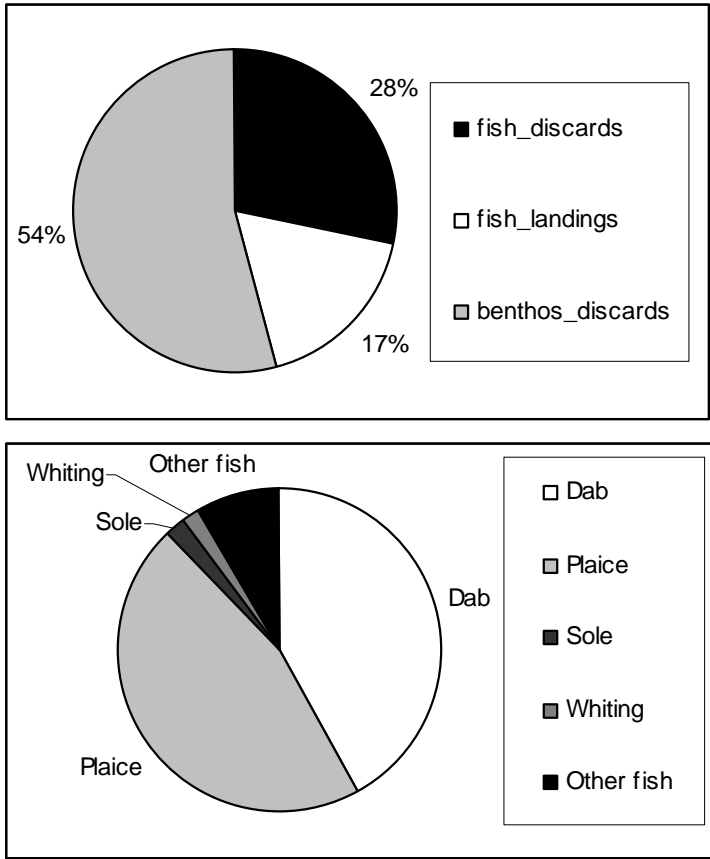
**Figure 3.1.2a.** Effort distribution of the Dutch beam trawl fleet in 2003, for vessels of 300 HP.



**Figure 3.1.2b.** Effort distribution of the Dutch beam trawl fleet in 2003, for vessels of 300 HP fishing with 80 mm mesh size.



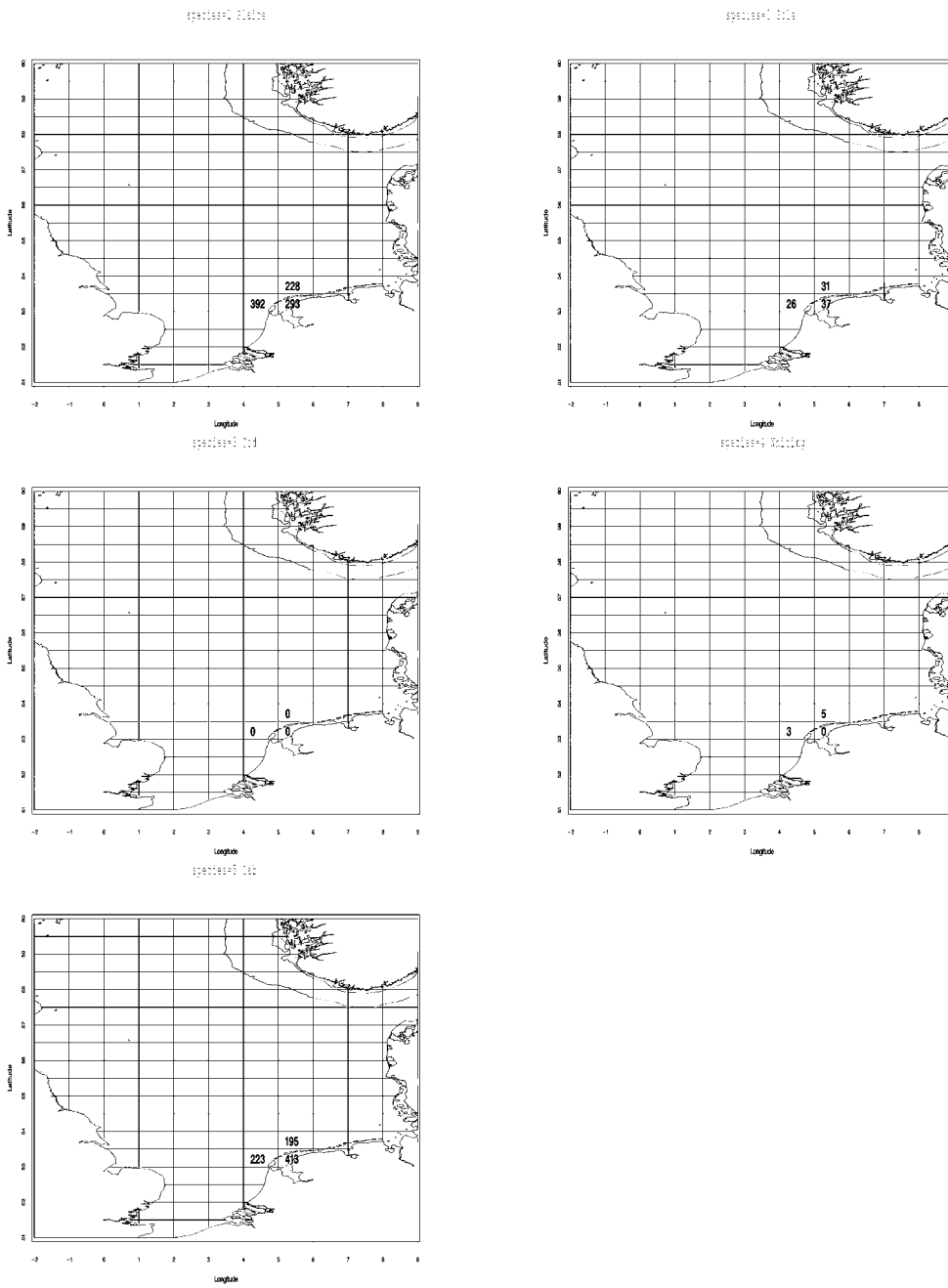
**Figure 3.1.2c.** Sampled effort in hours for beam trawl vessels with engine power of 300 HP.



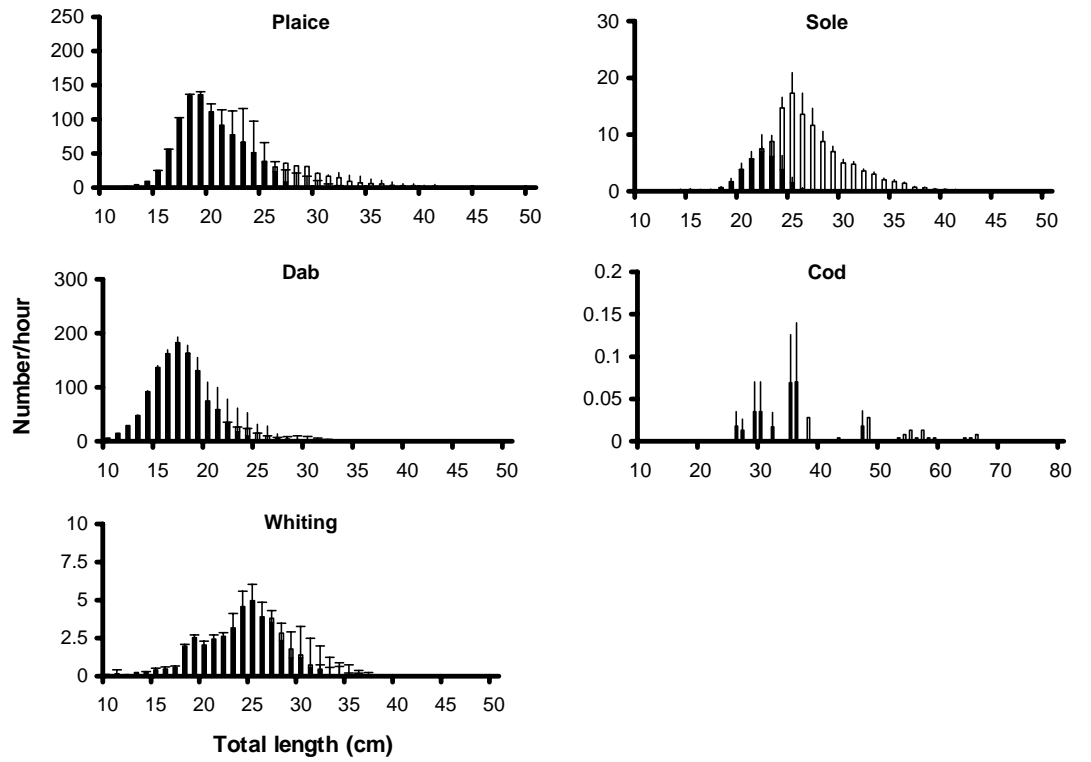
**Figure 3.2.** Composition of the catch (upper panel) and composition of the fish discards (lower panel).



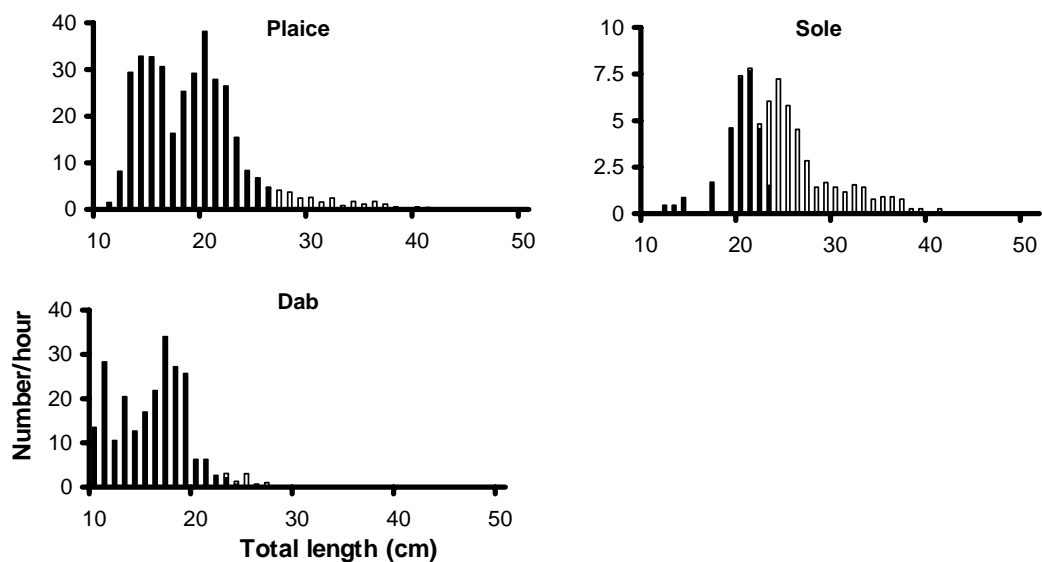




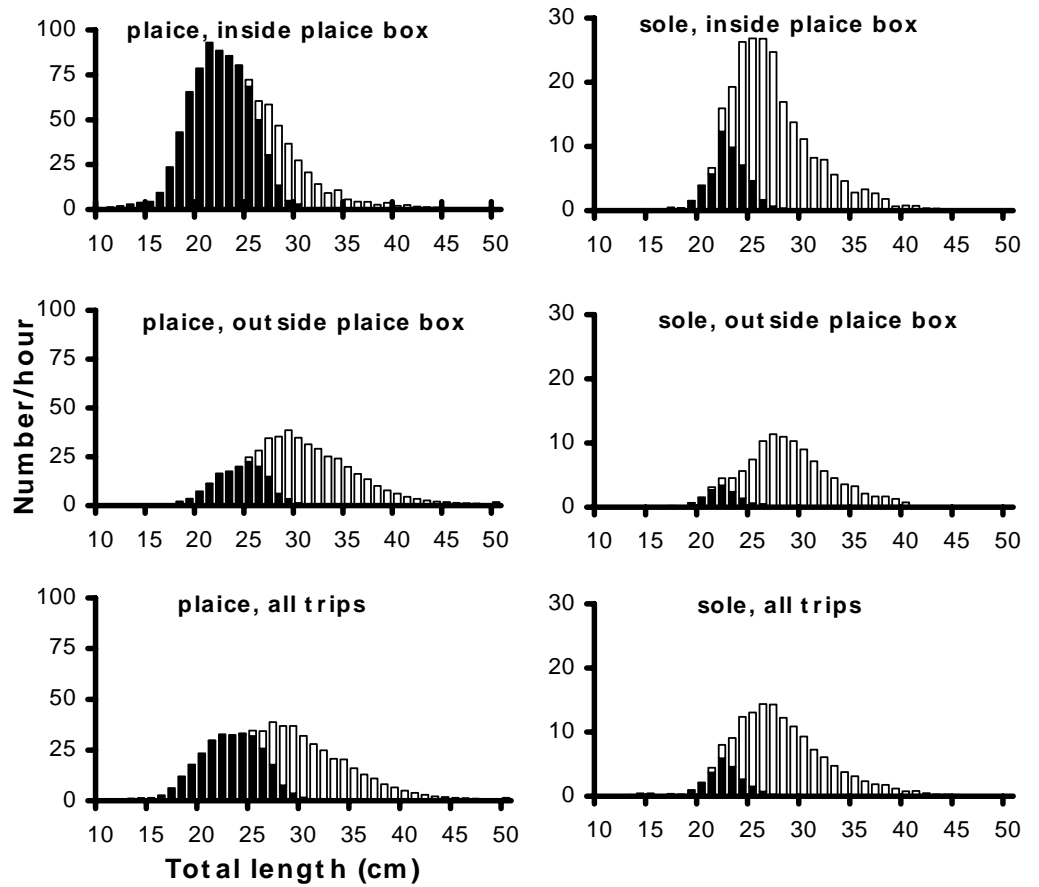
**Figure 3.3.1b.** Number of discards per hour per ICES area in 2003 for plaice (upper left), sole (upper right), cod (middle left), whiting (middle right) and dab (lower left) for a beam trawl vessel of 300 HP.



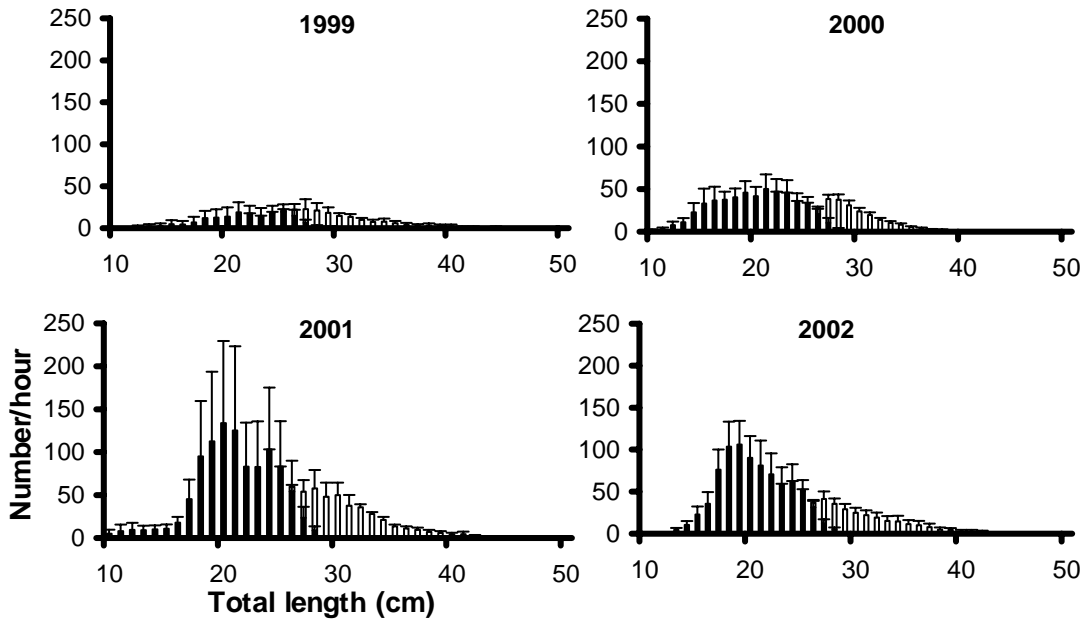
**Figure 3.4.1.** Length frequency distribution of plaice, sole, dab, whiting and cod in 2003, caught with beam trawl vessels larger than 300 HP. Black bars show discards, white landings.



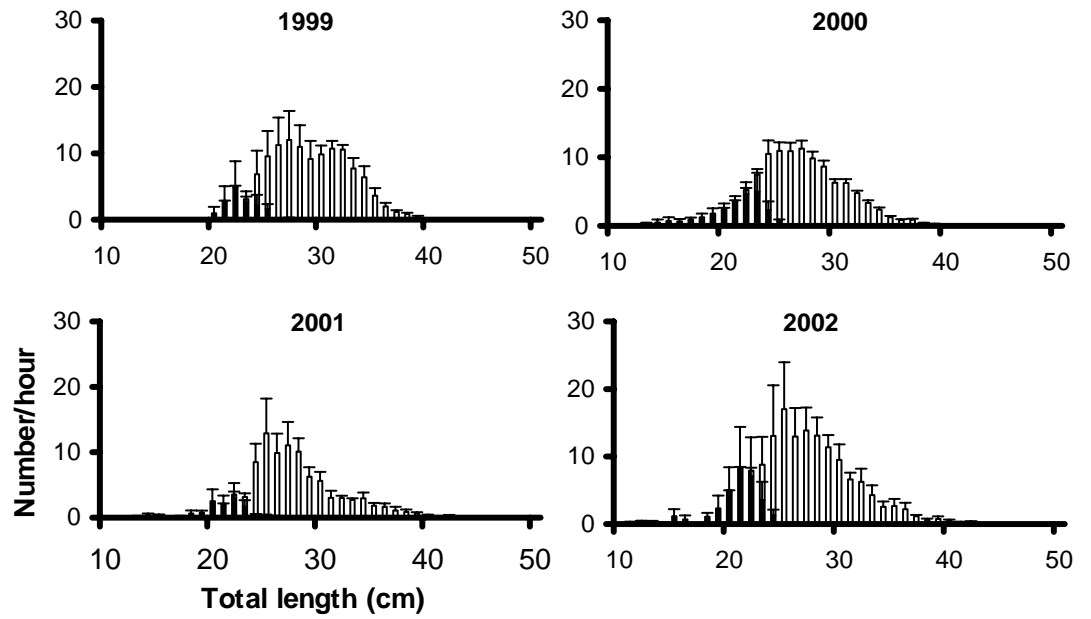
**Figure 3.4.2.** Length frequency distribution of plaice, sole and dab in 2003, caught with a beam trawl vessel of 300 HP. Black bars show discards, white landings.



**Figure 4.1.** Length frequency distribution for plaice and sole inside and outside the plaice box and over all trips combined from 1976-1990 (Van Beek, 1998).



**Figure 4.2.** Plaice. Length frequency distribution from 1999 - 2002 (Netherlands Institute for Fisheries Research, unpublished data). Black bars show discards, white landings.



**Figure 4.3.** Sole. Length frequency distribution from 1999 - 2002 (Netherlands Institute for Fisheries Research, unpublished data). Black bars show discards, white landings.