Data availability for the evaluation of stock status of species without catch advice

Case study: Turbot (*Psetta maxima*) and Brill (*Scophthalmus rhombus*)

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Summary

Several commercially important demersal fish stocks for the North Sea fisheries are classified as “category 11” in the light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241). For stocks in this category, there is no STECF (Scientific, technical and economic committee for fisheries) management advice, due to the unknown status of the stocks. The reason for this is that the data and information available to perform analytical stock assessments are highly uncertain or lacking.

This document describes existing data and options for collecting new data for the evaluation of the state of category 11 stocks. We focus on turbot and brill in the North Sea. Existing data from logbooks and the market sampling program can be used to estimate LPUE series used in age-based stock assessment methods, similar to other commercially important flatfish species such as plaice and sole.

Landings Per Unit of Effort (LPUE) data of the Dutch beam trawl fleet > 221 kW were standardised for engine power and corrected for targeting behaviour as described below and graphically shown in Figure 3.2.1. The methods are similar to those used to analyse commercial LPUE data for North Sea plaice, described in Quirijns and Poos (2010). Landing rates (LPUE) by market category were calculated for the period 2002-2010.

The corrected LPUE series indicate an increase in commercial LPUE for both species during the period 2002-2006. For turbot, the LPUE stays stable in the first five years, increases between 2006 and 2008, and decreases afterwards. The increase in brill LPUE is larger, and occurs throughout the study period.

Compared to other commercially important flatfish species relatively few brill and turbot market samples are taken. This reduces the ability to track the cohorts in the LPUE series of the older ages which is a prerequisite for reliable stock assessment estimates. Also, the time series currently spans only 9 years.

Collection of additional data may therefore be desirable. Expanding the BTS survey will provide industry independent data and would therefore give easily interpretable results. The option of an industry survey is also a good option if the survey is already being executed for sole and plaice. However, both options are costly. Therefore, the option of increasing the samples of turbot and brill at the auction is relatively easy and relatively inexpensive and therefore at present the most promising.

The methods used for this document will not per definition be applicable for all category 11 species. For dab, flounder, lemon sole and tub gurnard, samples at the auctions are taken to collect biological data. For these species it may be possible to raise the data in a similar way as was done in this report to estimate the age composition of the stock. For other species (witch flounder, horse mackerel, silver smelt, red mullet and squid) there is no market sampling. For these species, other methods will have to be developed.

1 Introduction

Several commercially important demersal fish stocks for the North Sea fisheries are classified as “category 11” in the light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241). For stocks in this category, there is no STECF (Scientific, technical and economic committee for fisheries) management advice, due to the unknown status of the stocks. The reason for this is that the data and information available to perform analytical stock assessments are highly uncertain or lacking. For species of these stocks, the European Commission adjusts the TAC (Total Allowable Catch) towards recent catch levels but the TAC should not be changed by more than 15% per year. Alternatively, if Member States can develop an implementation plan to provide advice within a short time, the European Committee can set the TAC on the basis of that plan. Finally, where relevant, there should be no increase in fishing effort on these stocks.

2 Assignment

The Ministry of Economic affairs, Agriculture and Innovation (EL&I) in the Netherlands is in favour of setting TACs on the basis of actual stock status instead of basing it on catch levels. Therefore, the Ministry of EL&I requested IMARES to consider possibilities for using existing data or collecting new data to get more information on stock status and development of category 11 stocks. Category 11 stocks that are relevant to the Netherlands are listed in table 2.1.1.

Table 2.1.1 Category 11 species of specific interest to the Netherlands

Area	Species
North Sea	Turbot
	Brill
	Dab
	Flounder
	Lemon Sole
	Witch Flounder
	Horse Mackerel
Western waters	Silver Smelt
English Channel	Red Mullet
	Squid
	Tub Gurnard

2.1 Outline

This document describes existing data and options for collecting new data for the evaluation of the state of category 11 stocks. We focus on turbot and brill in the North Sea.
Existing data from logbooks and the market sampling program could be used to evaluate the status of turbot and brill in the North Sea. The status of these stocks could be evaluated using age-based stock assessment methods, similar to other commercially important flatfish species such as plaice and sole. Such age-based stock assessments generally use the age structured landings from a population in conjunction with SSB indices such as egg surveys and “tuning indices”. Such tuning indices provide proxies for the abundance per age.
Age-structured commercial LPUE (Landing Per Unit Effort) data and survey CPUE (Catch Per Unit Effort) data can be used in stock assessments as a tuning index if (i) they are not affected by changes in targeting behaviour of fisheries and (ii) they accurately show cohort signals. The changes in targeting behaviour result from fishers adapting to changing management or economic circumstances and are largely achieved by shifting fishing grounds.

Methods for reducing the effects of targeting behaviour in the Dutch beam trawl fleet are available from earlier analyses carried out for North Sea plaice and sole (Quirijns, 2010). In short, these methods rely on reducing the effects of spatial shifts in fishing effort by calculating the fishing effort by ICES rectangle and subsequently averaging these over the entire fishing areas. In this report, these methods are applied to data on turbot and brill. The strengths of cohort signals in the resulting corrected LPUE estimates is indicated by the correlation strength of subsequent ages within the LPUE within year-classes.
The LPUE data are retrieved by combining EU logbooks, auction data, and market sampling data. In addition to the use of existing data, new data to evaluate the state of the stocks can be collected. Examples of the options are more extensive research surveys, data collection by commercial vessels and collection of more samples in the existing market sampling programme. We provide suggestions on what type of data could be collected, discussing the advantages and disadvantages of the different options.

3 Analysis of existing LPUE data

Existing fishery dependent data on turbot and brill in the North Sea may give insight in the stock status of these two species. Processing methods applied to the data are derived from methods developed for North Sea plaice and sole (Quirijns 2010).

3.1 Data sources

Several data sources were used in the analyses described below: landings and effort data were obtained from the EU logbooks; market category composition of landings was obtained from the auction data (sale slips); and age-length sampling data was used to characterize the relation between size and age.Only landings and effort data from Dutch beam trawl vessels were used in the analyses.

3.1.1 EU logbook data

Official EU logbook data of the entire Dutch fleet are owned by the General Inspection Service (AID), part of the Dutch Ministry of Economic Affairs, Agriculture and Innovation (EL&I). IMARES has access to these logbooks and stores the data in a database called VISSTAT. EU logbook data contain information on:

- landings (kg): by vessel, trip, ICES statistical rectangle and species;
- effort (days absent from port): by vessel, trip and ICES statistical rectangle, calculated from trip departure and arrival; and
- vessel information: length, engine power and gear used.

Logbook data are available of the entire Dutch fishing fleet and of foreign vessels landing their catches in the Netherlands. For the analyses, only information from the Dutch fishing fleet is used. Logbook data on turbot and brill are available from 1997 onwards.

3.1.2 Auction data: landings by market category

Auction data on turbot and brill are available from 1997 onwards. The data cover both the total Dutch fishing fleet and foreign vessels landing their catches on Dutch auctions. These data are also stored in VISSTAT and contain information on:

- landings by market category (kg): by vessel, trip (landing date) and species

3.1.3 Market sampling data

In the IMARES market sampling, data on length, age, sex and weight are collected for several commercially important species. Market sampling on turbot and brill has been carried out since 1981. However, this was done on an irregular basis and many years are missing (see appendices; Table A.4). Since 2002, sampling was executed annually. As the analyses require data on a yearly basis, only the

data from 2002 onwards is used. The market sampling data served to calculate numbers per age per market category per year.

3.2 Methods

Landings Per Unit of Effort (LPUE) data of the beam trawl fleet were standardised for engine power and corrected for targeting behaviour as described below and graphically shown in Figure 3.2.1. The methods are similar to those used to analyse commercial LPUE data for North Sea plaice, described in Quirijns and Poos (2010). Landing rates (LPUE) by market category were calculated for the period 2002-2010.

3.2.1 Standardisation of engine power

Engine power has an effect on LPUE. With higher engine power, a vessel can trawl heavier gear or fish at higher speed, which likely results in higher landing rates. The majority of the Dutch beam trawl fleet consists of vessels with engine powers around 1471 kW (=2000 hp). The analyses have been restricted to the large cutters with engine power above 221 kW. LPUE data were standardized to a vessel with an 1471 kW engine by applying the estimated relationship for this fleet (Rijnsdorp et al. 2006):

$$LPUE = \frac{L}{\left(E * kW^{\beta} / 1471^{\beta}\right)}$$

where L are landings in kilograms; E is effort in days at sea; kW is engine power in kW; and β is a constant that varies between species. As the values of β for turbot and brill are unknown, β is set at 1 for both species. More analyses should be carried out to estimate the β values.

3.2.2 Correction for targeting behaviour

Fishers target fishing areas with high concentrations of fish. Dividing total landings by total effort without taking in account targeting behaviour will result in bias of commercial LPUE because of possible changes in the spatial distribution of fishing effort. Therefore, a correction was carried out using EU logbook data. The first step was to calculate landings by market category per unit of effort. For this step, logbook data and auction data were merged based on vessel name, end-of-trip date and date of unloading the catch (Figure 3.2.1). The different market categories of turbot and brill were taken into account (Table 3.2.1). LPUE was calculated per ICES rectangle, per year. Next, a selection was made in which only those rectangles visited by at least one vessel in each of the 9 years were selected. This ensures that the LPUEs are valid for the core area of the fleet, and not influenced by missing values in some years. Subsequently, the LPUE's by ICES rectangles were averaged to calculate the LPUE by year for the core fishing area of the Dutch beam trawlers in the North Sea (those ICES rectangles highlighted in grey in tables A.3 and B.3). This removes the major effects of changes in spatial effort allocation due to – for instance – changing targeting behaviour.

3.2.3 Landings by age

Because stock assessments are usually based on information by age class, LPUE data needs to be converted to landings by age, per unit of effort. Therefore, landings by market category were converted into landings by age using the numbers per age per market category estimated from the market sampling data.

Table 3.2.1 Official turbot and brill market categories

Market Category	Turbot	Brill
1+	>6 kg	>2 kg
1	4-6 kg	1-2 kg
2	3-4 kg	0.4 -1 kg
3	2-3 kg	25cm-0.4 kg
4	1-2 kg	
5	0.5-1 kg	
6	25 cm -0.5 kg	

Weights landed per market category data were obtained from auction data, which were merged to EU logbook data in order to get an estimate of the LPUE for every trip per ICES rectangle and market category. The merging was based on vessel name, end-of-trip date and date of unloading the catch (Figure 3.2.1).

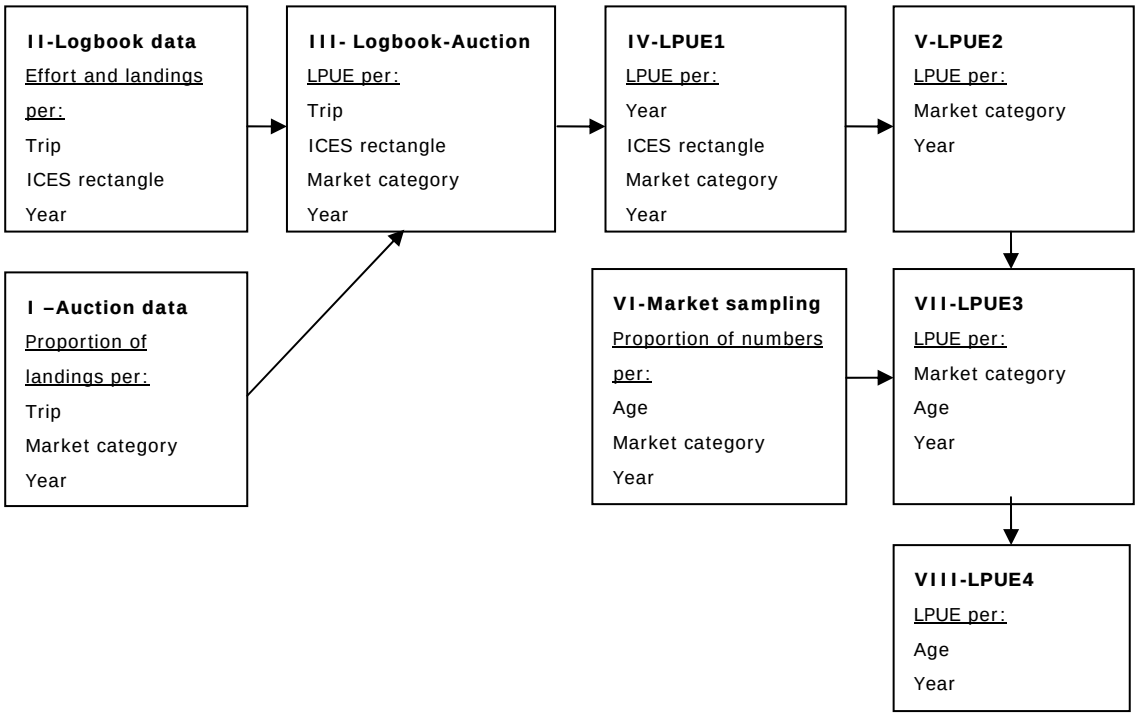

Figure 3.2.1. Flow diagram of LPUE correction based on landings and effort registered in logbooks, market category data from the auction, and age data per market category from the market sampling; Roman numerals indicate the different steps. Intermediate results are printed in Appendix A and B.

For every trip and ICES rectangle, LPUE – standardised to a 1471 kW vessel – was calculated by market category. The age composition for each market category was calculated, for every year using the market sampling data. This age composition was used to convert LPUE by market category to LPUE by age.

4 Results

4.1 Turbot

4.1.1 Step I: Proportions of landings per trip and market category

In the period used for this study, the official market categories span categories 1-6 (Table 3.2.1). The auctions also have a category with animals larger than 6 kilograms, but those individuals are very rare. Only data for categories 1-6 are used. Other categories have only been sparsely sampled at the auctions (Table A.4). Therefore, there is no information of their age distribution, which we need in step VII. This does not result in loss in the total weight, which is calculated using the weights registered in the logbooks (step II).

4.1.2 Step II: Effort and landings per ICES rectangle

Effort

The total effort of Dutch TBB vessels > 221 kW has decreased since 2002 (Table 4.1.1 and Figure 4.1.1). The difference between the uncorrected and corrected effort becomes smaller over time as a result of a strong decline in vessels >1471 kW active in the fleet. This decrease is the result of fisheries management measures prohibiting the entry of larger vessels. The effort of the vessels that caught turbot is slightly smaller compared to the effort by the whole Dutch beam trawl fleet (Figure 4.1.1, red dashed line). In approximately 1.4% of the trips, vessel power was missing from the logbook data. In these instances, vessel power was given the mean vessel power of the other vessels.

Table 4.1.1 Effort for the Dutch beam trawl fleet >221 kW (days at sea) in ICES area IV. Uncorrected effort: total days at sea. Corrected effort: days at sea standardized a 1471 kW vessel.

	year								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
Uncorrected	25705	23949	22754	22973	20974	20398	15654	16375	16121
Corrected	28902	26828	25129	25321	22745	22053	16342	16896	16585

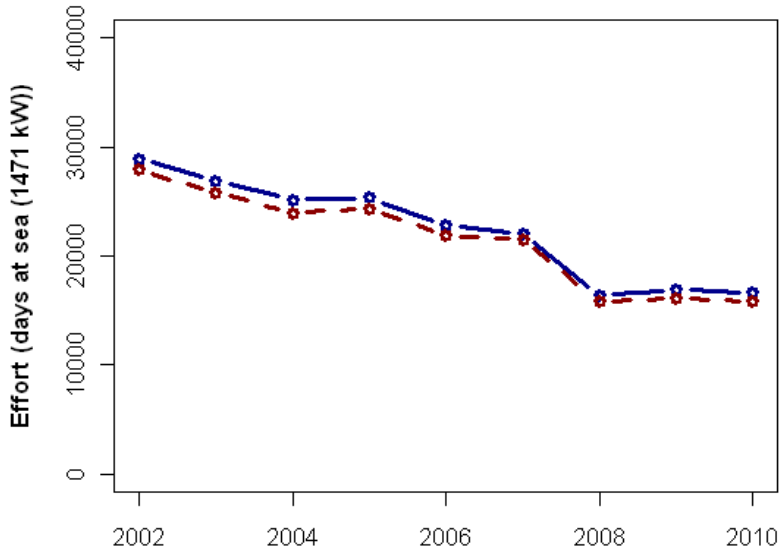

Figure 4.1.1 Time series of effort (days at sea per 1471 kW vessel) by the total Dutch beam trawl fleet (blue solid line) or the Dutch Beam trawl fleet that landed turbot (red dashed line).

Landings

The turbot landings (kg) per ICES rectangle and year for the Dutch beam trawl fleet are listed in appendix A (Table A.1). The total landings per year (Table 4.1.2 and Figure 4.1.2) show that the total amount of landings has remained relatively stable since 2002, with higher landings in 2007.

Table 4.1.2 Turbot landings (kg) per year in ICES area IV for the Dutch beam trawl fleet

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Landing	158823	153489	146084	152707	145222	192446	144723	143435	126469

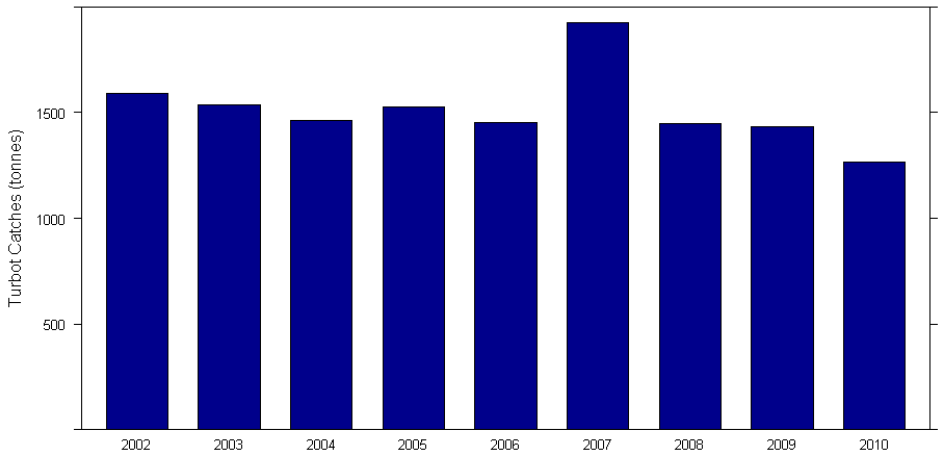

Figure 4.1.2 Time series of total Dutch turbot landings per year

Based on the proportions of landings per market category (step I) and the total amount of landings (Table 4.1.2), total landings per market category were calculated (Table 4.1.3). In some of the trips the proportional landings by market category are unknown (on average ~ 3%), and hence could not be included in this table.

Table 4.1.3 Turbot landings (kg) per year and market category

	Year								
Category	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	147112	116031	96515	81018	64098	76595	79745	102019	101233
2	108812	110416	71528	65192	66989	88739	96485	130847	113075
3	221685	162585	118106	163357	144933	193403	240323	236005	170184
4	485293	345299	413899	408166	394685	542784	399635	346249	259576
5	381642	459872	454289	475837	409005	602361	405519	343637	305981
6	194889	312771	266402	318954	332604	351658	195757	170913	165997

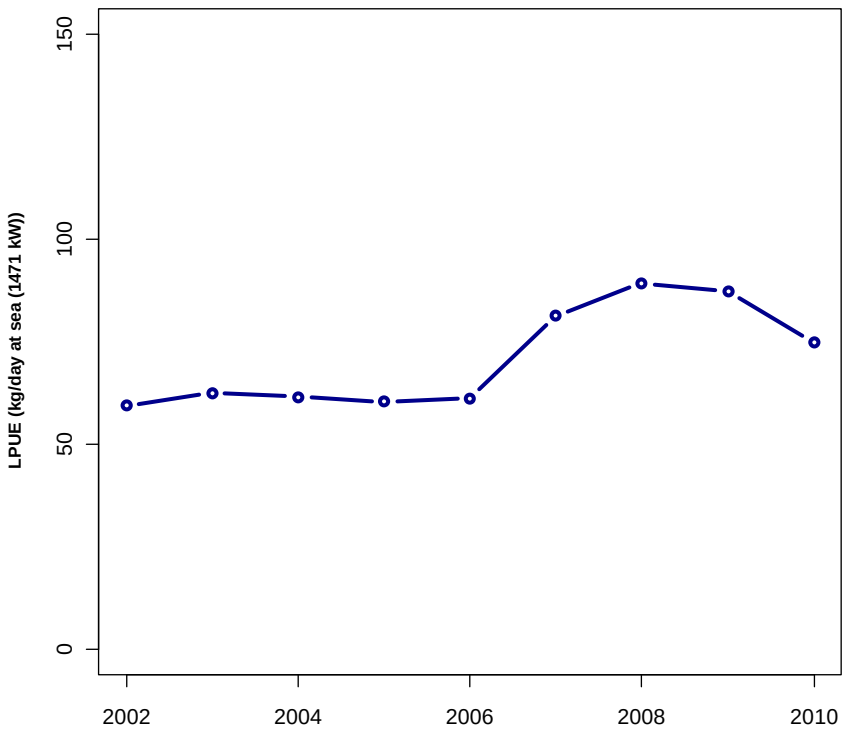

Figure 4.1.3 Corrected time series of turbot LPUE of the Dutch beam trawl fleet in ICES area IV.

4.1.3 STEP III-VI: LPUE per market category

To measure LPUE per market category, we first estimated the LPUE per ICES rectangle, year and market category. Subsequently, we have summed the LPUE's over the ICES rectangles per year and market category (Table 4.1.4). The proportionality of ages per market category (in step VI) is given in Table A.2 (Appendix A).

Table 4.1.4 LPUE per market category and year (kg turbot per day at sea)

	year								
Category	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	5.1	4.5	3.9	3.4	2.9	3.5	4.5	6.1	6.1
2	4.2	4.9	3.4	3.0	3.2	4.3	5.8	7.8	7.5
3	9.6	8.3	5.6	7.3	6.9	9.2	14.9	16.3	12.6
4	21.0	15.1	19.6	17.9	18.2	26.4	29.2	25.4	18.5
5	14.2	18.7	19.6	18.6	17.8	26.6	25.6	22.2	21.0
6	5.3	10.9	9.4	10.1	12.3	13.1	9.1	9.2	9.1
total	59.5	62.4	61.5	60.3	61.1	83.1	89.2	87.1	74.9

4.1.4 Step VII-VIII LPUE per age

The LPUE's per ICES rectangle and year are listed in the appendix (Table A.3). Table 4.1. lists the LPUE's per age and year and Figure 4.1. shows the LPUE per age and the distribution of LPUE's over the ages. The LPUE is mainly made up of ages 2-5 which contribute more than 85% of the total. The LPUE of older ages are very low or absent (Table 4.1.5). The corrected LPUE of the large Dutch beam trawl appears relatively stable in the period 2002-2006. Since 2006, there appears to have been an increase in LPUE, followed by a decline in 2008.

There is some cohort effect in the LPUE-at-age matrix, with the LPUE of younger ages (ages 3-7) being correlated along cohorts (Table 4.1.6 and Figure 4.1.5). For older ages, this correlation disappears, caused by the scarcity of data on older individuals. However, there seems to be a single cohort of older (> 10 yr old) fish that was caught between 2002 and 2006 (age 11 in 2002).

Table 4.1.5 LPUE per age and year between 2002 and 2010 (kg turbot per day at sea).

	Year								
age	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	1.65	2.06	2.66	1.26	3.82	0.88	2.41	0.78	2.66
2	12.78	23.32	24.61	21.05	18.61	40.96	27.91	14.90	22.11
3	27.78	13.88	21.84	23.13	24.82	20.18	31.36	32.08	14.40
4	7.95	13.94	4.74	9.78	7.32	13.4	10.31	24.51	14.69
5	5.45	3.90	5.30	1.56	3.46	3.60	10.93	7.31	10.91
6	1.86	2.43	1.09	2.45	1.01	2.53	3.18	3.58	5.14
7	0.66	1.44	0.83	0.13	1.28	0.43	2.14	1.67	2.40
8	0.84	0.48	0.28	0.41	0.31	0.61	0.22	1.11	1.01
9	0.13	0.66	0.11	0.15	0.03	0.00	0.63	0.12	0.80
10	0.05	0.14	0.00	0.14	0.27	0.22	0.00	0.95	0.27
11	0.21	0.00	0.00	0.05	0.04	0.14	0.06	0.00	0.48
12	0.05	0.08	0.00	0.09	0.09	0.05	0.06	0.10	0.00
13	0.03	0.00	0.06	0.00	0.00	0.04	0.00	0.00	0.00
14	0.00	0.03	0.00	0.10	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00

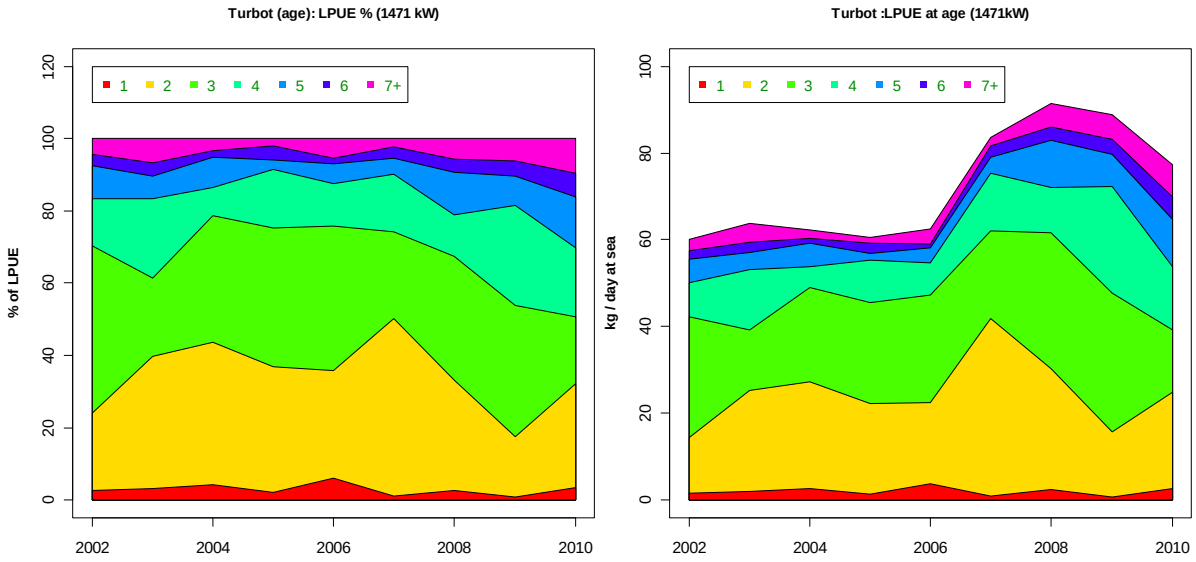

Figure 4.1.4 Time series of percentage of LPUE per age (left) and total LPUE per age (right) for turbot.

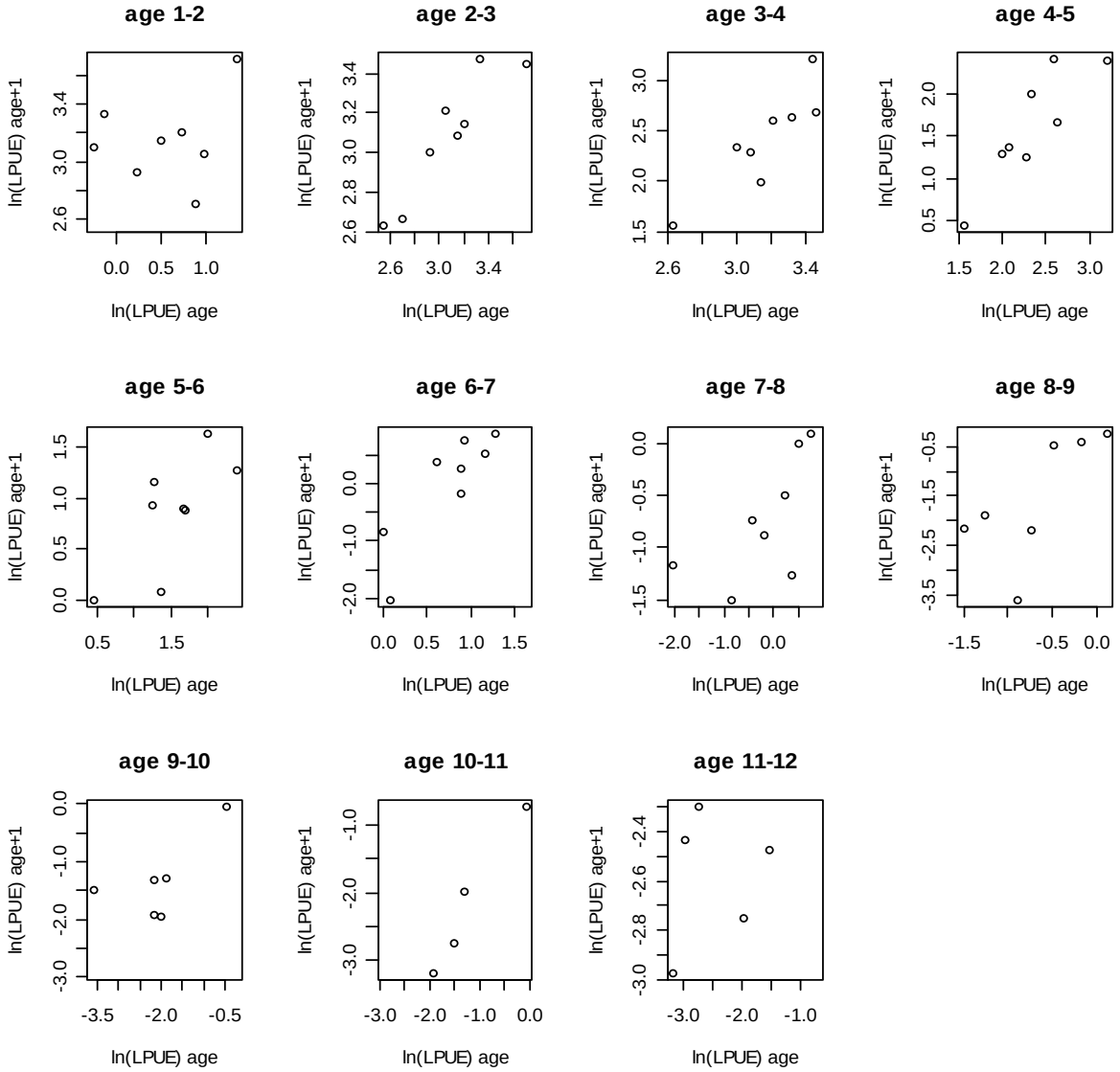

Figure 4.1.5 Correlation between turbot log LPUE for successive ages within a year class.

Table 4.1.6 Correlation statistics and p-value for turbot LPUE for successive ages within a year class. Number within brackets indicates degrees of freedom. Grey rows indicate significant correlations.

Age	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
R	0.22	0.92	0.90	0.88	0.74	0.86	0.66	0.69	0.69	0.98	0.2
p	0.59(6)	<0.01(6)	<0.01(6)	<0.01(6)	0.03(6)	<0.01(6)	0.08(6)	0.08(5)	0.14(4)	0.02(2)	0.76(3)

4.2 Brill

For brill we follow the same procedure as for turbot.

4.2.1 Step I: Proportions of landings per trip and market category

The landings per market category, trip and year are used to estimate the proportions per category. For brill, there are 3 market categories, ranging from 1 to 3 (Table 3.2.1). The auctions use an additional category for larger animals, but these are very rare. As for turbot, we exclude this market category from the following analyses, because this market category has not sufficiently been sampled at the auctions, resulting in lack of information on the ages within this market category (Table B.4). The catches of the market category 0 are therefore proportionally divided over the other 3 categories.

4.2.2 Step II: Effort and landings per ICES rectangle

Effort

Trends in effort for the Dutch beam trawl fleet fishing in area IV are the same for brill as for turbot (Figure 4.2.1). Trends in effort of the vessels that caught brill show that in some trips brill was not caught (Figure 4.2.1). The number of trips in which no brill was caught is larger than the number of trips in which no turbot was caught. This results in the red line in Figure 4.2.1 being lower than the red line in Figure 4.1.1. For 1.9% of the trips, no power could be allocated to the vessel. These were given the average power of the other vessels.

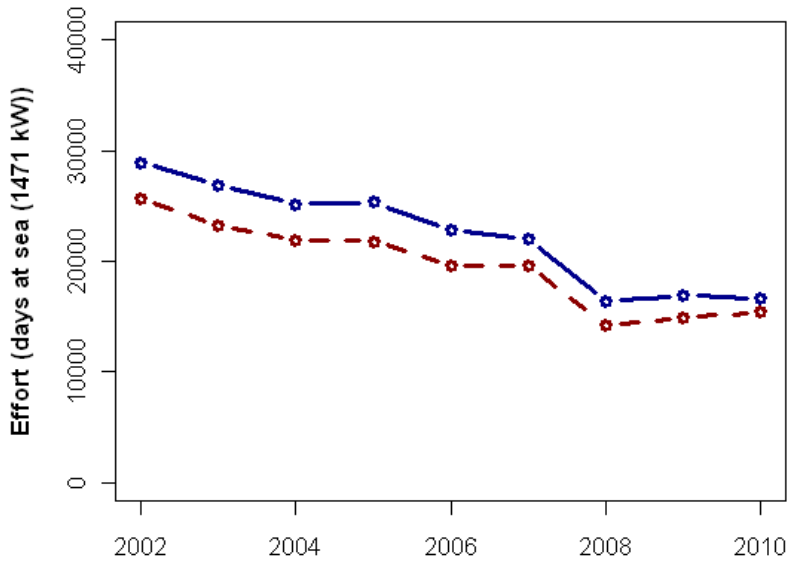

Figure 4.2.1 Time series of effort (days at sea per 1471 kW vessel) by the total Dutch beam trawl fleet (blue solid line) or the Dutch Beam trawl fleet that landed brill (red dashed line).

Landings

Brill landings per ICES rectangle and year for the Dutch beamtrawl fleet are listed in Table B.1 (Appendix B). The total landings per year are listed in and shown in (Table 4.2.1 and Figure 4.2.2). The landings per trip, ICES rectangle and year are divided over the market categories by multiplying the landings with the proportions in the proportions table (not shown). In Table 4.2.2 we show the total landings per year

and market category. Because for some trips information on the distribution over the market categories was lacking, there is a small loss of recorded landings and effort in this table (average ~ 4%).

Table 4.2.1 Brill landings (kg) per year in the North Sea for the Dutch beam trawl fleet > 221 kW

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Landings	817423	831961	699578	645762	666506	775154	593458	717255	952534

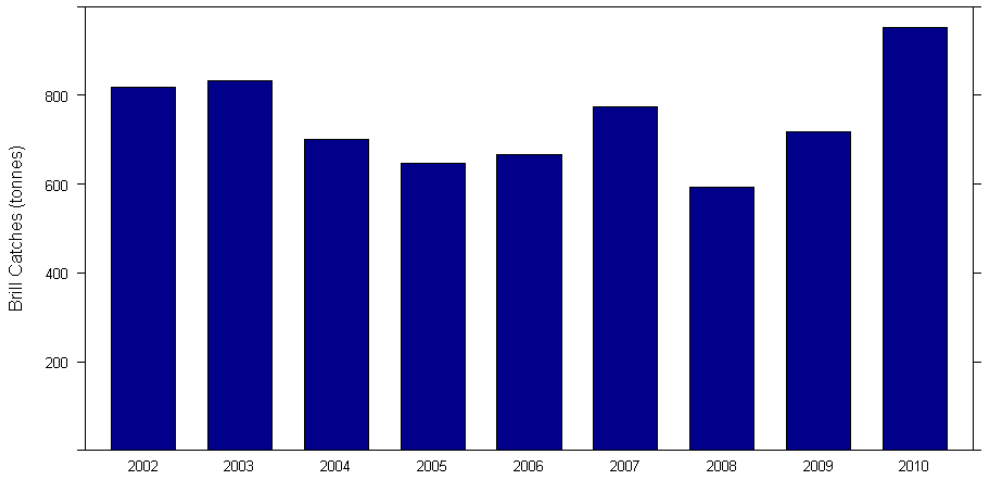

Figure 4.2.2 Time series of brill landings by beam trawl vessels >221 kW in the North Sea

Table 4.2.2 Brill landings per market category

	Year								
Category	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	275942	238896	264315	285915	254500	323290	324218	326859	519828
2	411618	469038	324899	274813	272266	359102	212189	263181	236084
3	86939	105960	87553	79082	120735	66679	45004	90754	89923

4.2.3 STEP III-VI: LPUE per market category

The LPUE per ICES rectangle, year and market category are listed in Table B.3 (Appendix B). The LPUE's per market category and year are listed in Table 4.2.3 . The proportionality of ages per market category (in step VI) is given in Table B.2 (Appendix B).

Table 4.2.3 Brill LPUE's per market category and year (kg per day at sea).

	Year								
Category	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	8.9	8.1	9.8	11.6	10.5	13.6	18.2	18.1	26.1
2	12.0	16.7	15.1	11.7	11.5	15.5	12.6	14.8	15.1
3	2.5	3.9	3.4	2.9	4.4	3.1	2.6	4.7	5.5
total	23.36	28.75	28.33	26.28	26.44	32.20	33.42	37.70	46.79

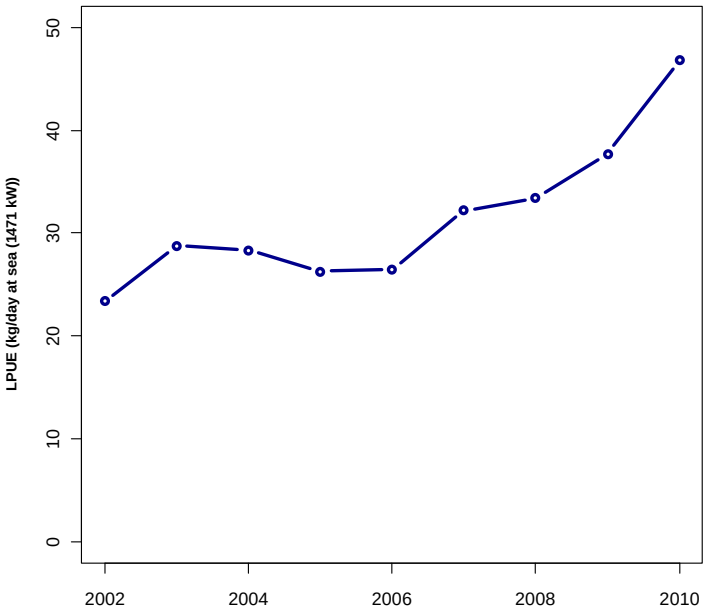

Figure 4.2.3 Corrected time series of brill LPUE of the Dutch beam trawl fleet in ICES area IV.

4.2.4 STEP VII-VIII: LPUE per age

The LPUE per ICES rectangle are listed in the appendix (Table B.3). In Table 4.2.4 the LPUE's per age and year and in Figure 4.1.4, the LPUE per age and the distribution of LPUE's over the ages are shown. The LPUE is mainly made up of ages 1-3 which contribute more than 85% of the total. As for turbot, the LPUE's of older ages are very low or absent. The corrected age-structured LPUE data shows an increase in the period 2002-2010. This increase is mainly caused by an increase in the younger ages (ages 2-4). Correlations between the log of LPUE for successive years within age classes are shown in Figure 4.2.5 and Table 4.2.5. These correlations are all positive, but only significant for the ages 2-6 (Table 4.2.5). For the other ages, there was not enough data available. In addition, ages older than 8 are scarce.

Table 4.2.4 Brill LPUE per age (kg per day at sea)

age	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
0	0.00	0.00	0.07	0.00	0.00	0.00	0.01	0.03	0.00
1	3.31	6.02	5.86	2.82	5.08	4.17	3.64	6.68	9.06
2	10.3	15.88	13.72	13.89	10.91	20.77	14.07	14.02	22.01
3	7.77	3.88	6.66	7.39	7.84	5.12	13.82	11.89	7.37
4	0.99	2.07	1.12	1.55	2.22	1.48	1.38	4.37	6.45
5	0.62	0.36	0.66	0.32	0.32	0.54	0.4	0.5	1.74
6	0.33	0.21	0.17	0.25	0.06	0.06	0.1	0.11	0.00
7	0.00	0.24	0.04	0.00	0.00	0.06	0.00	0.11	0.15
8	0.03	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.02	0.00	0.06	0.00	0.00	0.00	0.00	0.00
10	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00

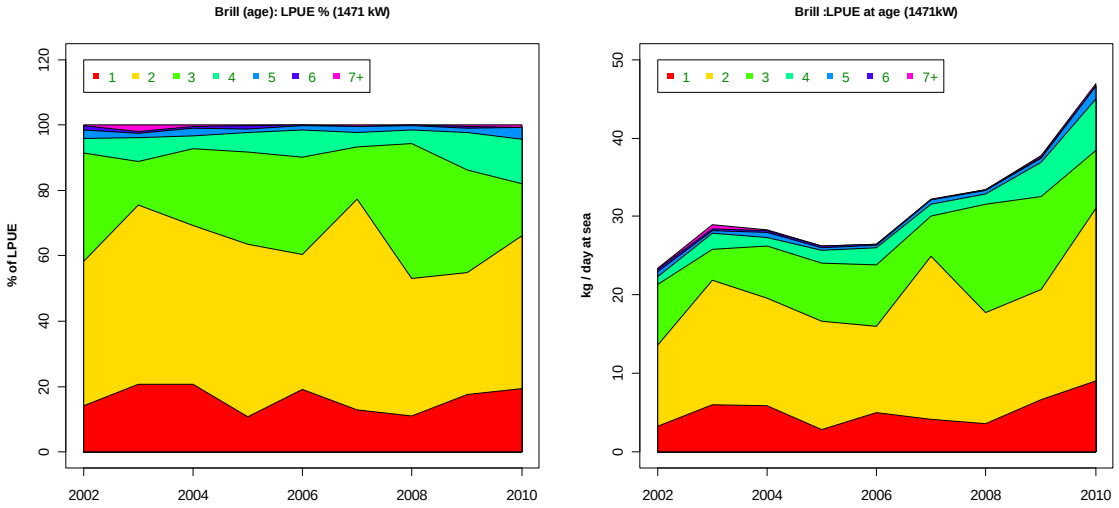

Figure 4.2.4 Time series of percentage of LPUE per age (left) and total LPUE per age (right).

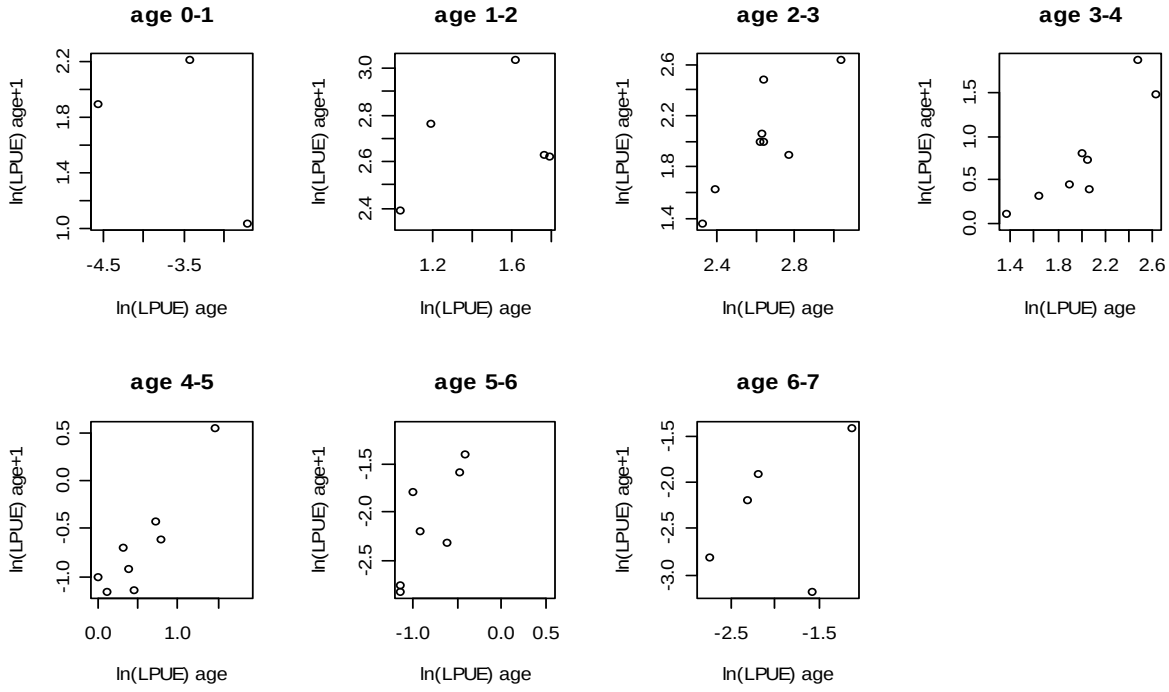

Figure 4.2.5 Correlation between log of brill LPUE for successive years within an age class.

Table 4.2.5 Correlation statistics and p-value for turbot LPUE for successive ages within a year class. Number within brackets indicates degrees of freedom.

Age	0-1	1-2	2-3	3-4	4-5	5-6	6-7
r	0.62	0.57	0.84	0.89	0.92	0.78	0.37
p	0.58(1)	0.13(6)	<0.01(6)	<0.01(6)	<0.01(6)	0.04(5)	0.53(3)

5 New data

Alternative data sources could be used if more information is needed on the age structure of the population to be used in age structured stock assessments such as being used for other commercially important flatfish species. To obtain additional information to estimate the age composition of the population and or to estimate a reliable CPUE, we will discuss a number of options:

1. Industry survey
2. Egg survey
3. Expansion of the market (auction) sampling
4. Expansion of BTS survey
5. Expansion of discard sampling

5.1 Industry survey

An industry survey is a survey with a scientific set-up, but carried out with commercial vessels in close cooperation with the fishing industry. Such a survey can provide large amounts of data in a relatively short time. In addition, at present, the Dutch fishing industry, the Ministry of EL&I and IMARES are setting up an industry survey for sole and plaice. If they succeed, it will be relatively easy to include other flatfish species such as turbot and brill in this survey. However, it is unclear if the data resulting from this sampling will be sufficient to trace the changes in the age composition, because the number of catches are low for turbot and brill..

Advantages	Disadvantages
• If an industry survey for plaice and sole is set up, then the effort and costs to include sampling of other species like turbot and brill are relatively low.	• If an industry survey for plaice and sole is not set up, then the costs are high. • Observers are desired on board to obtain independent data, which is costly. • Catchability of the commercial fishery increase over the years (Technology Creep) and differs per vessel making standardizations of LPUE more difficult. • The numbers of turbot and brill caught per vessel are low, because turbot and brill are usually not targeted specifically.

5.2 Egg survey

An egg survey provides an estimate of the number of eggs produced by the spawning stock, which is an indicator of the state of the stock. There are two options to use an egg survey for turbot and brill data collection. The first is to design a new survey. As a first step in designing this survey, the survey ‘sound in the sea’ (Dutch: ‘geluid in zee’), can be used to find the best time to collect egg samples for turbot and brill. This survey is a year round egg survey, but has been executed only once (in 2010). However, it will be costly to set up a new survey targeting turbot or brill eggs while determining the difference between eggs of turbot and brill is difficult because the size ranges of the eggs of the two species overlap.
The second option is to use the egg survey that is already going on for mackerel eggs. However, there are not many turbot and brill eggs caught in this survey, because the area covered and the sampling time of the survey are not optimal.

Advantages	Disadvantages
• If the mackerel eggs survey is used the effort and costs to include eggs of other species like turbot and brill are relatively low. • Provides independent data • Time series of egg production can be used directly as a proxy for spawning stock biomass without the use of a stock assessment stock status	• Costly to set up a new survey, and survey needs to run for a considerably amount of time to be used in an assessment model • The mackerel egg survey does not catch many turbot and brill eggs • Turbot and brill eggs are hard to distinguish from each other owing to an overlap in their size range.

5.3 Expansion of BTS survey

The surveys carried out by IMARES targeting flatfish (BTS, SNS, DFS) do not catch many turbot and brill (BTS:200 turbot and 200 brill per year (Isis + Tridens), resulting in approximately 3 individuals per hour). Additional BTS hauls could be done to estimate a reliable survey CPUE. The catchability of large fishes in the BTS is very low. Thus, to get a better fisheries-independent age structure for the older animals from the BTS survey is costly because survey effort would have to be increased substantially.

Advantages	Disadvantages
• Provides independent data • Easy to set-up	• Costly • Many additional hauls are needed to collect enough data (especially older individuals).

5.4 Expansion of the market (auction) sampling

To get a better estimate of the age distribution the market sampling program could be extended. The analyse described in this study primarily used this type of data. At present, the aim of the market sampling program is to sample a minimum of 720 turbots and brill per year for age determination. To compare, for plaice and sole the aim is to sample 3600 and 3000 individuals respectively. The extension of the market sampling program should be aimed especially at sampling the older animals, because this is where the age structure of the data deteriorates because of low sample size. If 500 additional individuals are sampled, the age structure in the older ages would increase substantially. The costs for sampling an additional 500 turbot individuals is approximately 29080,- euro, resulting from:

500 turbots with average weight 4 kg, loss in sales price after sampling		12000,-
Auction costs		500,-
Hours IMARES visiting auction	10 visits * 4 hours *2 persons= 16 * 73,-	5840,-
Hours IMARES processing sample	1 session * 20 hours * 2 persons = 8 *73,-	2920,-
Hours IMARES age-reading & preparation	1 session * 80 hours *1 person= 16 * 73,-	5840,-
Hours IMARES database check & import	1 session * 10 hours * 1 person= 2 * 73,-	730,-
		29080,-

Advantages	Disadvantages
• Improves the estimate of the age distribution (length/weight/ sex), especially if older fish are sampled (> 5 year) • Relatively inexpensive, especially if measurements and otholith removals are executed on the auction	• Fisheries dependent • Only improves age structure estimates of landings and LPUE/CPUE, no information on spatial patterns/targeting.

5.5 Expansion of discard sampling

IMARES executes a discard sampling program. The data collected by this program on turbot and brill can be used. However, in the discard sampling turbot and brill are not always measured and the numbers of turbot and brill in the discards is probably too low to significantly contribute to more reliable estimates of CPUE's or age distributions.

Advantages	Disadvantages
• Relatively easy to join in the existing discard sampling program	• At present, turbot and brill are not measured • Numbers of discards of turbot and brill are low • Data are not independent if observers are absent

6 Conclusions

LPUE of turbot and brill per age class can be estimated with present data for the period 2002-2010. The sampling programs that allow estimating the age-structured LPUE are still running. The LPUE series for turbot and brill are covered by the Dutch beam trawl fleet > 221 kW for the whole North Sea , being an important fishing fleet for these species. By applying the methods of Quirijns (2010) the LPUE is partly corrected for targeting behaviour by accounting for spatial redistribution of fishing effort on the level of the ICES statistical rectangle. Finally, the age-segregation of the LPUE allows incorporating it in age-structured stock assessments.

The corrected LPUE series indicate an increase in commercial LPUE for both species during the period 2002-2006. For turbot, the LPUE stays stable in the first five years, increases between 2006 and 2008, and decreases afterwards. The increase in brill LPUE is larger, and occurs throughout the study period.

Compared to other commercially important flatfish species relatively few brill and turbot market samples are taken. This reduces the ability to track the cohorts in the LPUE series of the older ages which is a prerequisite for reliable stock assessment estimates. Also, the time series currently spans only 9 years. Collection of additional data may therefore be desirable. Expanding the BTS survey will provide industry independent data and would therefore give easily interpretable results. The option of an industry survey is also a good option if the survey is already being executed for sole and plaice. However, both options are costly. Therefore, the option of increasing the samples of turbot and brill at the auction is relatively easy and relatively inexpensive and therefore at present the most promising.

In Table the category 11 stocks are listed. The methods used for this document will not per definition be applicable for all category 11 species. For dab, flounder, lemon sole and tub gurnard, samples at the auctions are taken to collect biological data. . For these species it may be possible to raise the data in a similar way as was done in this report to estimate the age composition of the stock. For other species (witch flounder, horse mackerel, silver smelt, red mullet and squid) there is no market sampling. For these species, other methods will have to be developed.

7 Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 57846-2009-AQ-NLD-RvA). This certificate is valid until 15 December 2012. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

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Quirijns, F. J. 2010. Landings and Effort data of sole and plaice in the North Sea Sea (WD WGNSSK 2007). Wageningen IMARES.

Quirijns F.J., Poos J.J., Rijnsdorp AD (2008) Standardizing commercial CPUE data in monitoring stock dynamics: Accounting for targeting behaviour in mixed fisheries. Fisheries Research89:1-8

Justification

Report number: C109/11
Project Number: 4308101020

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

Approved: Niels Hintzen MSc
Junior researcher

Signature:

Date: the 26th of September 2011

Approved: dr. ir. T.P. Bult
Head Fisheries Department

Signature:

Date: the 26th of September 2011

Appendix A. Turbot

Table A.1 Turbot landings per rectangle. Rectangles with less than 10 000 kg over all years are summed in the row labelled "other".

	Year								
Rectangle	2002	2003	2004	2005	2006	2007	2008	2009	2010
31F1	2170	3432	2295	2070	1308	3055	1915	2630	5415
31F2	44610	59290	57827	48507	51282	73748	65288	71290	72394
31F3	585	1360	3895	825	1035	1550	500	20	288
32F1	2640	3840	2320	945	390	2050	1442	1228	1464
32F2	79661	86408	74368	74779	70714	119651	84200	87235	75263
32F3	47222	40476	40002	52494	37720	63373	53573	29412	26272
33F2	25932	29511	24192	35842	30910	41298	42168	53236	39324
33F3	84196	80721	69813	103018	80832	95753	87354	77368	60147
33F4	6615	7128	5658	15272	7461	10609	6566	6447	4255
34F2	43944	43348	29793	37085	42490	59070	56924	61362	49466
34F3	81264	82868	66499	86815	72805	77088	71325	72039	59935
34F4	36493	49614	38199	49238	42724	55443	38358	41865	31637
35F1	1203	1870	1420	1170	1611	2934	1459	1399	2182
35F2	63126	46788	43650	34706	59464	66005	55364	84448	57871
35F3	80147	71173	77805	85471	81796	116258	79331	82914	56723
35F4	46298	41414	32009	43665	33170	42535	32498	25610	15747
36F0	6402	2143	2488	1981	2424	785	1174	1172	2083
36F1	14957	7616	7956	3603	6346	4372	2911	5616	4683
36F2	23396	20471	16992	19302	24438	34305	18568	35087	24509
36F3	41923	33997	38390	42592	36419	68864	40027	51973	51206
36F4	84339	84191	87460	85863	65582	131844	69737	80994	44324
36F5	51705	43419	44834	46763	40318	58597	33252	20094	21288
36F6	5905	1520	8190	7087	4074	4550	1430	3616	3307
36F7	1280	920	3810	2766	1990	2211	1311	1655	4236
37F0	13270	6768	5677	3746	6070	4164	1467	3439	4038
37F1	26780	17914	17931	14950	17160	16283	4890	6259	8660
37F2	24696	29889	19850	17310	9493	27013	12211	16944	14913
37F3	17288	19093	13520	7051	7748	13983	9814	16636	11904
37F4	53471	45830	34215	31955	20570	64676	34009	45215	36436
37F5	71052	69496	75352	74974	71344	108740	67245	78444	86459
37F6	128680	119058	181243	158663	151448	189517	94323	90619	94854
37F7	82146	97332	151592	130752	141968	137071	165621	82774	63960
38F0	3390	4745	1550	1860	855	2925	424	0	62
38F2	5040	11475	11915	4030	3015	7838	4145	2612	429
38F3	2858	3403	941	865	800	1425	2600	447	620
38F4	14002	18882	3300	5895	1875	10022	8631	3779	2912
38F5	31332	37783	21372	17493	21270	24618	39796	25980	28319
38F6	69173	55642	48227	60406	61800	76011	61889	53041	78788
38F7	5555	2180	825	2065	4317	3924	9315	1574	560
39F2	1435	5490	1890	2145	1170	150	0	709	500
39F3	4870	7489	2930	3150	4440	765	3125	2575	1450
39F4	6485	7925	1340	4500	1640	100	2249	2140	2795
39F5	14113	11914	4310	5855	2542	2940	4332	5545	2500
39F6	50455	42296	19811	30425	30370	22292	24569	27850	38332
39F7	32328	17060	15740	18360	14925	12503	6260	3835	4090
40F3	1830	1670	1770	920	2595	120	100	2907	824
40F4	3957	12676	8920	5650	5138	600	6674	2553	6739
40F5	2482	2994	2115	1675	1520	653	3099	650	1629
40F6	12741	12715	4376	8505	13728	8536	10021	17042	26466
40F7	4255	4645	1115	7350	8394	19252	3610	7563	13129
41F5	610	1280	1670	855	4588	1865	1890	6296	2235
41F6	6101	3330	5727	1890	9348	3470	160	7540	3727
41F7	0	600	365	650	2410	2241	20	1325	5520
42F4	560	2380	720	1930	4911	510	530	0	0
42F6	1790	1185	1961	1040	4125	2775	818	7113	1739
43F7	0	690	814	1345	3536	6484	4633	5843	3253
44F4	1440	0	6510	1960	2525	2350	5295	2595	0
other	18040	15550	11390	14993	17284	12700	6796	3804	2836

Table A.2 Proportionality of ages per market category. Note that the ages 16-17 are absent, because no fishes of these ages were sampled.

Category 1

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	18
2002	0	0	0.005	0.153	0.365	0.217	0.069	0.116	0.016	0.011	0.042	0	0.005	0	0	0
2003	0	0	0	0.215	0.221	0.195	0.200	0.062	0.082	0.015	0	0.010	0	0	0	0
2004	0	0	0	0.159	0.420	0.159	0.145	0.072	0.029	0	0	0	0.014	0	0	0
2005	0	0	0	0.197	0.242	0.364	0.030	0.061	0.045	0.015	0.015	0	0	0.030	0	0
2006	0	0	0	0.116	0.261	0.246	0.275	0.058	0	0	0.014	0.014	0	0	0.014	0
2007	0	0	0	0.179	0.218	0.333	0.051	0.128	0	0.038	0.038	0	0	0	0	0.013
2008	0	0	0.028	0.113	0.282	0.169	0.296	0.028	0.056	0	0.014	0.014	0	0	0	0
2009	0	0	0	0.173	0.154	0.231	0.212	0.135	0.019	0.077	0	0	0	0	0	0
2010	0	0	0	0.059	0.250	0.250	0.147	0.103	0.118	0.044	0.029	0	0	0	0	0

Category 2

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	18
2002	0	0	0.129	0.353	0.368	0.095	0.030	0.025	0	0	NA	NA	NA	NA	NA	NA
2003	0	0	0.049	0.545	0.175	0.138	0.053	0.012	0.028	0	0	0	0	0	0	0
2004	0	0	0.068	0.392	0.473	0.014	0.054	0	0	0	0	0	0	0	0	0
2005	0	0	0.051	0.592	0.112	0.224	0.010	0.010	0	0	0	0	0	0	0	0
2006	0	0	0.078	0.400	0.374	0.052	0.070	0.017	0.009	0	0	0	0	0	0	0
2007	0	0	0.017	0.537	0.281	0.124	0.017	0.008	0	0.008	0	0	0.008	0	0	0
2008	0	0	0.123	0.189	0.410	0.139	0.107	0.016	0.016	0	0	0	0	0	0	0
2009	0	0	0.038	0.487	0.231	0.205	0.026	0	0	0	0	0.013	0	0	0	0
2010	0	0	0	0.220	0.370	0.230	0.080	0.05	0.010	0	0.040	0	0	0	0	0

Category 3

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	18
2002	0	0.010	0.593	0.255	0.109	0.020	0.007	0.007	0	0	0	0	0	0	0	0
2003	0	0.006	0.329	0.541	0.070	0.041	0.006	0	0	0.003	0	0	0	0.003	0	0
2004	0	0.043	0.647	0.158	0.129	0.007	0.014	0	0	0	0	0	0	0	0	0
2005	0	0.038	0.532	0.405	0.006	0.019	0	0	0	0	0	0	0	0	0	0
2006	0	0	0.416	0.409	0.148	0.007	0	0	0	0.013	0	0.007	0	0	0	0
2007	0	0.028	0.348	0.481	0.072	0.050	0.006	0	0	0.006	0	0.006	0	0	0	0.006
2008	0	0.034	0.358	0.338	0.230	0.034	0	0	0.007	0	0	0	0	0	0	0
2009	0	0	0.302	0.488	0.151	0.035	0.012	0	0	0.012	0	0	0	0	0	0
2010	0	0.010	0.162	0.429	0.305	0.067	0.029	0	0	0	0	0	0	0	0	0

Category 4

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	18
2002	0	0.148	0.692	0.115	0.028	0.005	0.005	0.002	0.002	0	0	0.002	0	0	0	0
2003	0	0.172	0.444	0.259	0.079	0.023	0.010	0	0.010	0	0	0.003	0	0	0	0
2004	0	0.268	0.595	0.059	0.059	0.020	0	0	0	0	0	0	0	0	0	0
2005	0	0.140	0.675	0.140	0.010	0.020	0	0.010	0	0	0	0.005	0	0	0	0
2006	0.005	0.181	0.693	0.085	0.015	0	0.010	0.005	0	0.005	0	0	0	0	0	0
2007	0	0.364	0.442	0.147	0.037	0.009	0	0	0	0	0	0	0	0	0	0
2008	0	0.256	0.569	0.069	0.075	0.019	0.006	0	0.006	0	0	0	0	0	0	0
2009	0	0.068	0.545	0.330	0.034	0	0	0.011	0	0.011	0	0	0	0	0	0
2010	0	0.259	0.370	0.259	0.093	0	0.019	0	0	0	0	0	0	0	0	0

Category 5

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	18
2002	0.047	0.419	0.438	0.057	0.031	0.005	0	0.002	0	0	0	0	0	0	0	0
2003	0.034	0.642	0.192	0.096	0.013	0.010	0.003	0.008	0	0.003	0	0	0	0	0	0
2004	0.044	0.624	0.288	0.035	0.009	0	0	0	0	0	0	0	0	0	0	0
2005	0.020	0.535	0.335	0.095	0.010	0	0	0	0	0.005	0	0	0	0	0	0
2006	0.041	0.423	0.434	0.077	0.010	0.005	0.005	0	0	0.005	0	0	0	0	0	0
2007	0.005	0.728	0.180	0.074	0	0.005	0.005	0.005	0	0	0	0	0	0	0	0
2008	0.019	0.561	0.293	0.051	0.057	0.019	0	0	0	0	0	0	0	0	0	0
2009	0	0.322	0.489	0.133	0.056	0	0	0	0	0	0	0	0	0	0	0
2010	0.064	0.486	0.239	0.110	0.046	0.046	0.009	0	0	0	0	0	0	0	0	0

Table A.2 continued. Proportionality of ages per market category

Category 6

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	18
2002	0.184	0.679	0.132	0.003	0	0	0.003	0	0	0	0	0	0	0	0	0
2003	0.131	0.799	0.056	0.008	0.003	0	0.003	0	0	0	0	0	0	0	0	0
2004	0.190	0.730	0.074	0.005	0	0	0	0	0	0	0	0	0	0	0	0
2005	0.087	0.821	0.077	0.010	0	0.005	0	0	0	0	0	0	0	0	0	0
2006	0.245	0.635	0.115	0	0.005	0	0	0	0	0	0	0	0	0	0	0
2007	0.058	0.894	0.034	0.014	0	0	0	0	0	0	0	0	0	0	0	0
2008	0.210	0.611	0.115	0.038	0.019	0.006	0	0	0	0	0	0	0	0	0	0
2009	0.084	0.651	0.229	0.036	0	0	0	0	0	0	0	0	0	0	0	0
2010	0.144	0.766	0.054	0.018	0.009	0.009	0	0	0	0	0	0	0	0	0	0

Table A.3 Turbot LPUEs per ICES rectangle and year. Shaded rows contain no missing values and are used in age structured LPUE calculations.

	Year								
Rectangle	2002	2003	2004	2005	2006	2007	2008	2009	2010
31F1	22.55	71.81	42.91	33.39	26.71	50.71	51.79	54.26	68.4
31F2	31.13	43.85	41.99	34.26	36.04	66.2	57.2	61.41	70.51
31F3	14.34	59.29	50.08	45.44	28.47	24.1	29.4	10.7	0
31F4	NA	NA	NA	NA	NA	NA	NA	NA	NA
31F6	NA	NA	0	NA	NA	NA	NA	NA	NA
32F0	NA	NA	NA	1.97	NA	NA	NA	NA	NA
32F1	43.71	44.62	37.94	25.3	22.17	39.54	59.41	48.75	56.87
32F2	35.08	38.18	40.3	35.65	40.49	60.88	58.64	57.01	57.4
32F3	44.09	51.81	42.48	58.78	48.46	86.37	70.08	67.78	65.15
32F4	75.42	130.16	44.02	101.22	65.43	38.82	35.86	NA	0
32F5	NA	13.35	NA	NA	NA	NA	NA	NA	NA
33F0	NA	NA	NA	NA	NA	NA	NA	NA	31.39
33F1	43.59	39.71	NA	22.83	22.56	NA	NA	83.72	NA
33F2	36.75	38.04	30.53	39.51	43.71	60.88	76.98	68.92	57.04
33F3	36.31	43.22	33.42	46.16	47.61	63.15	67.25	65.96	48.64
33F4	44.33	44.35	40.39	73.89	69.37	74.97	62.34	69.11	38.88
33F5	36.48	NA	NA	39.71	NA	NA	NA	NA	NA
33F6	NA	NA	NA	NA	NA	NA	NA	NA	NA
34F0	NA	21.92	NA	NA	NA	NA	NA	NA	NA
34F1	30.31	16.86	19.87	48.4	0	NA	NA	NA	19.2
34F2	33.77	28.78	25.84	30.37	34.84	50.26	58.02	44.64	36.86
34F3	43.57	49.64	42.86	46.97	49.02	64.48	77.77	77.55	54.92
34F4	45.25	50.82	45.45	60.6	54.37	66.5	66.51	85.57	51.15
34F5	22.07	NA	48.37	83.18	43.3	72.73	NA	159.73	0
34F6	34.93	NA	18.23	NA	NA	NA	NA	NA	NA
34F7	NA	NA	NA	NA	NA	NA	NA	NA	NA
35F0	29.4	42.66	14.71	NA	NA	NA	22.43	NA	0
35F1	11.64	14.77	13.32	11.43	17.78	32.72	22.26	23.02	22.33
35F2	42.49	39.21	36.77	39.46	58.78	75.87	81.32	84.27	72.29
35F3	58.56	61.35	54.95	63.4	73.24	86.09	99.17	93.05	73.05
35F4	54.49	54.99	52.93	61.53	52.66	69.82	77.61	77.42	55.44
35F5	51.02	53.64	59.11	76.85	63.13	88.82	62.7	86.36	52.95
35F6	96.24	174.55	0	NA	100.47	NA	158.18	NA	NA
36F0	41.54	31.98	25.63	27.88	29.76	34.27	38.72	35.79	34.86
36F1	32.36	22.82	21.27	15	24.71	27.53	25.99	28.19	23.92
36F2	47.75	48.81	35.25	44.3	65.56	87.66	83.53	91.12	75.24
36F3	70.44	62.4	65.97	69.51	83.02	141.27	128.62	101.88	85.86
36F4	61.74	60.72	66.3	65.73	63.76	108.23	83.03	79.27	65.05
36F5	58.09	62.29	75.56	78.9	82.77	95.35	82.15	78.5	73.77
36F6	81.19	64.25	120.04	101.16	132.26	88.64	73.93	99.54	107.28
36F7	125.31	90.26	169.46	161.95	211.99	110.78	118.2	116.1	154.94
36F8	NA	147.77	NA	NA	NA	NA	NA	NA	NA
37F0	45.86	40.94	34.69	28.6	35.35	49.52	39.92	48.2	46.71
37F1	37.07	32.51	32.16	28.63	33.93	50.57	46.49	42.07	40.81
37F2	56.92	45.48	47.14	41.25	61.92	88.05	110.77	106.42	70.87
37F3	65.78	65.36	70.96	58.39	77.12	127.78	153.6	159.31	92.12
37F4	80.61	86.82	89.35	86.61	97.56	158.31	163.8	145.7	110.21
37F5	87.1	91.89	98.71	94.63	88.76	115.06	113.71	122.12	104
37F6	90.54	116.23	134.98	106.42	111.18	119.19	118.58	100.62	125.3
37F7	115.2	205.72	195.08	168.45	218.25	194.67	170.33	144.21	145.17
37F8	175.46	NA	NA	NA	NA	NA	61.22	NA	195.35
38F9	113.1	39.81	88.75	82.95	NA	28.44	NA	NA	NA
38F0	56.26	66.16	45.6	44.46	41.87	63.88	31.56	0	19.16
38F1	46.42	31.61	17.88	41.04	32.73	15.44	72.41	NA	37.79
38F2	52.82	41.62	44.84	33.82	54.5	89.3	69.07	70.73	30.96
38F3	47.15	49.76	51.44	42.23	36	92.27	103.72	72.24	35.81
38F4	91.18	87.78	108.02	86.65	67.66	113.61	150.84	113.65	76.53
38F5	96.62	110.01	103.12	95.26	87.85	120.66	137.31	119.03	137.54

Table A.3 continued. Turbot LPUEs per ICES rectangle and year. Shaded rows contain no missing values and are used in age structured LPUE calculations.

	Year								
Rectangle	2002	2003	2004	2005	2006	2007	2008	2009	2010
38F6	98.2	112.87	133.21	110.63	97.9	132.77	164.61	146.66	161.55
38F7	145.44	191.26	132.07	119.54	121.61	171.66	159.58	155.06	115.54
38F8	102.36	NA	NA	NA	NA	122.78	NA	NA	NA
39F0	52.4	NA	NA	14.18	6.72	NA	NA	NA	NA
39F1	8.28	42.55	34.57	16.19	66.93	55.08	0	NA	NA
39F2	35.99	42.87	23.57	29.09	25.79	50.71	NA	44.78	53.34
39F3	56.52	41.74	36.31	45.97	42.59	67.16	71.27	60.96	47.55
39F4	62.21	48.71	37.52	57.07	35.83	56.29	77.1	85.98	63.1
39F5	85.7	86.64	89.09	74.96	55.59	90.12	112.77	132.8	107.58
39F6	106.05	113.97	146.48	131.11	98.3	134.24	163.18	169.58	194.45
39F7	155.48	147.32	208.2	195.2	169.73	150.91	264.74	235.54	255.3
39F8	123.71	NA	NA	NA	32.43	NA	NA	NA	NA
40F0	NA	NA	NA	4.62	NA	0	NA	NA	NA
40F1	NA	NA	21.65	16.27	NA	NA	NA	NA	NA
40F2	38.51	36.92	20.77	33.64	19.52	28.71	NA	224.3	NA
40F3	55.4	62.13	41.47	40.98	53.9	0	46.28	90.46	58.64
40F4	73.99	55.98	50.96	63.1	52.43	59.43	79.28	67	64.4
40F5	92.88	56.35	68.66	77.33	46.75	62.05	80.15	82.18	67.55
40F6	109.83	83.22	78.31	100.94	77.88	125.46	179.41	177.89	218.14
40F7	114.8	157.29	123.1	135.43	127.43	112.87	243.87	243.35	238.3
41F1	NA	NA	NA	9.41	NA	NA	NA	NA	NA
41F3	NA	41.69	5.6	29.13	16.67	31.58	NA	NA	NA
41F4	19.31	85.47	47.71	31.47	32.34	17.31	202.93	NA	67.99
41F5	40.92	48.46	89.56	43.01	75.56	74.44	81.95	144.89	61.64
41F6	79.97	78.92	49.74	48.45	52.44	75.55	188.24	245.23	130.69
41F7	NA	279.83	2.4	60.28	61.99	69.39	19.59	220.69	227.49
42F1	NA	NA	NA	NA	NA	NA	NA	NA	NA
42F2	73.93	15.77	NA	NA	70.5	0	NA	NA	NA
42F3	33.18	54.89	33.57	44.84	59.19	62.38	38.4	NA	NA
42F4	54.37	77.99	89.02	52.39	52.85	29.96	34	NA	NA
42F5	83.23	120.67	49.37	4.05	54.45	144.6	NA	143.8	180.17
42F6	89.51	58.98	45.28	40.11	62.98	57.95	94.48	170.79	73.23
42F7	NA	0	8.02	14.37	28.48	38.44	106.3	72.25	49.67
42F8	NA	NA	0	NA	NA	NA	NA	NA	0
43F2	84.82	0	NA	NA	NA	NA	NA	NA	NA
43F3	48.39	40.65	26	51.27	62.21	36.75	NA	NA	NA
43F4	62.87	4.48	34.64	50.01	51.59	43.37	0	98.82	157.75
43F5	89.22	97.56	76.79	56.09	55.35	56.62	79.16	178.82	NA
43F6	54.53	55.4	23.23	36.72	27.1	70.54	67.77	294.86	36.92
43F7	NA	16.1	14.55	11.76	28.19	52.9	101.99	160.74	80.19
44F2	69.4	67.01	121.23	106.57	140.11	NA	NA	NA	NA
44F3	101.88	52.03	71.32	108.75	90.39	82.49	NA	NA	NA
44F4	62.3	NA	88.21	82.37	91.58	107.63	136.04	138.52	NA
44F5	134.33	NA	NA	142.45	108.47	71.66	123.79	142.75	NA
44F6	50.75	NA	NA	NA	NA	NA	NA	NA	NA
45F2	NA	96.86	0	98.32	NA	NA	NA	NA	NA
45F3	NA	NA	122.63	132.27	91.55	NA	211.27	NA	NA
45F4	NA	NA	NA	NA	NA	196.14	NA	NA	NA
45F5	NA	NA	NA	NA	0	NA	NA	NA	NA
49F4	NA	NA	NA	32.96	NA	NA	NA	NA	NA
49F5	NA	NA	NA	65.93	NA	NA	NA	NA	NA
52F3	NA	NA	NA	42.23	NA	NA	NA	NA	NA
32F7	NA	NA	NA	NA	NA	NA	NA	NA	NA
35F7	NA	NA	NA	NA	NA	NA	NA	NA	NA
40F8	NA	NA	NA	NA	NA	NA	NA	NA	NA
43F8	NA	NA	0	NA	NA	NA	NA	NA	NA
50F6	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table A.4 Turbot market sampling. Numbers per market category per year. Notice that several years are missing because no market sampling was done in those years.

	Market category								
Year	+	0	1	2	3	4	5	6	Total
1981		135	30	36	36	40			277
1982			280	288	313	300			1181
1983		10	363	332	415	415			1535
1984			309	354	419	427			1509
1985			290	362	418	429			1499
1986			231	301	350	358			1240
1987			72	104	121	126			423
1988			87	93	107	111			398
1989			72	73	94	119	119		477
1990			102	98	131	135	133		599
1998			38	69	94	131	122		454
2002			189	201	302	400	422	365	1879
2003		15	195	246	316	390	386	373	1921
2004	11		69	74	139	205	226	189	913
2005	7	1	66	98	158	200	200	195	925
2006	8		69	114	149	199	196	192	927
2007	12		78	121	181	217	217	207	1033
2008	9		71	122	148	160	157	157	824
2009	9		52	78	86	88	90	83	486
2010	10		68	100	105	107	109	111	610

Appendix B. Brill

Table B.1 Brill landings per rectangle. Rectangles with less than 10 000 kg over all years are summed in the row labelled "other".

	Year								
Rectangle	2002	2003	2004	2005	2006	2007	2008	2009	2010
31F1	3090	3840	2510	1950	1441	2705	1204	1985	5495
31F2	56521	61650	45152	32434	41952	38889	33581	44577	64082
32F1	3280	4790	2670	1030	360	2064	1269	1192	1859
32F2	99530	95780	75024	61619	62349	90031	62517	76225	91471
32F3	37062	30756	30446	25416	26282	38267	33046	22130	30530
33F2	31219	40024	30546	33382	30940	43100	41433	58512	72001
33F3	73524	72396	57857	67130	58156	70521	51244	67856	93684
33F4	4255	4825	3551	4495	3754	4693	2959	4330	4252
34F2	48429	47136	34530	35608	41444	48832	43738	52608	81516
34F3	64957	68288	47502	47253	46476	43670	37499	55685	75349
34F4	18282	25991	20138	18845	18098	20125	13278	18628	23952
35F1	7170	3855	4909	6118	5655	5030	3428	2932	7676
35F2	38133	31389	27695	21025	27592	25632	19444	33859	45686
35F3	39067	36428	35858	27011	26362	25598	19542	31958	28574
35F4	21039	16104	14232	12306	8502	10790	6496	8716	9078
36F0	4722	1880	1760	2497	1699	360	284	457	1478
36F1	7831	4552	4353	3039	4306	2945	1556	2641	5107
36F2	12630	9442	11297	9147	11171	14622	6172	12861	20529
36F3	19299	15692	17843	15150	12094	18775	10496	16782	30518
36F4	27836	29653	29233	23002	17969	25887	14919	19239	16942
36F5	19594	16929	11218	11630	10658	11006	7694	5852	7759
37F0	9440	6480	5635	3917	5318	2789	935	2419	3553
37F1	15088	8920	12411	10338	13727	9514	2576	5264	9184
37F2	9792	10622	9381	5975	4912	9756	3445	6516	8308
37F3	7236	10363	7423	4013	4109	5622	2657	6451	6995
37F4	19615	18006	12673	14358	8465	17526	9094	14879	17539
37F5	25708	27641	28396	27311	26695	30217	21608	26650	36762
37F6	24334	33102	34758	31963	36884	51767	28261	26539	34634
37F7	10229	17417	23775	18028	24109	21362	26093	12567	15936
38F4	4797	8998	1515	3530	1015	4410	3457	2512	1897
38F5	9475	18038	9253	9000	10241	9834	16028	11091	14511
38F6	15701	17403	14472	20189	25035	33192	27855	23081	35077
39F5	2619	4076	1350	2063	740	1495	1744	1791	880
39F6	7207	10793	6215	10630	15796	10278	14270	12627	19559
39F7	3798	2495	2600	2850	4445	2689	4340	997	1355
40F4	45	1090	2701	2105	1114	260	1790	279	1309
40F6	2022	2375	1359	3100	6127	2890	4228	7918	11148
40F7	305	585	130	1593	1955	4678	1950	2913	4964
41F6	200	880	1663	645	2257	669	40	3738	1282
other	12342	11277	15544	14067	16302	12664	11288	9998	10103

Table B.2 Proportionality of ages per market category. Note that the ages 11-13 are absent, because no fishes of these ages were sampled.

Category 1

	Age												
Year	0	1	2	3	4	5	6	7	8	9	10	14	15
2002	0	0	0.172	0.651	0.088	0.06	0.025	0	0.004	0	0	0.002	0
2003	0	0.009	0.397	0.327	0.203	0.022	0.022	0.015	0	0.002	0.002	0	0.002
2004	0	0	0.319	0.515	0.094	0.047	0.017	0.004	0.004	0	0	0	0
2005	0	0.016	0.328	0.503	0.104	0.027	0.016	0	0	0.005	0	0	0
2006	0	0.006	0.194	0.594	0.176	0.024	0.006	0	0	0	0	0	0
2007	0	0.004	0.610	0.259	0.088	0.031	0.004	0.004	0	0	0	0	0
2008	0	0	0.310	0.617	0.054	0.019	0	0	0	0	0	0	0
2009	0	0.012	0.270	0.503	0.190	0.012	0.006	0.006	0	0	0	0	0
2010	0	0	0.438	0.267	0.233	0.057	0	0.006	0	0	0	0	0

Category 2

	Age												
	0	1	2	3	4	5	6	7	8	9	10	14	15
2002	0	0.151	0.652	0.163	0.018	0.008	0.009	0	0	0	0	0	0
2003	0	0.196	0.684	0.073	0.025	0.011	0.002	0.007	0	0	0.002	0	0
2004	0.004	0.215	0.649	0.105	0.013	0.013	0	0	0	0	0	0	0
2005	0	0.123	0.719	0.123	0.030	0	0.005	0	0	0	0	0	0
2006	0	0.215	0.618	0.129	0.032	0.005	0	0	0	0	0	0	0
2007	0	0.178	0.700	0.097	0.016	0.008	0	0	0	0	0	0	0
2008	0	0.156	0.598	0.203	0.031	0.004	0.008	0	0	0	0	0	0
2009	0	0.259	0.494	0.167	0.062	0.019	0	0	0	0	0	0	0
2010	0	0.333	0.606	0.022	0.022	0.017	0	0	0	0	0	0	0

Category 3

	Age												
	0	1	2	3	4	5	6	7	8	9	10	14	15
2002	0	0.600	0.388	0.012	0	0	0	0	0	0	0	0	0
2003	0	0.681	0.312	0.002	0.002	0.002	0	0	0	0	0	0	0
2004	0	0.761	0.234	0.005	0	0	0	0	0	0	0	0	0
2005	0	0.404	0.559	0.037	0	0	0	0	0	0	0	0	0
2006	0	0.580	0.398	0.023	0	0	0	0	0	0	0	0	0
2007	0	0.436	0.525	0.029	0.010	0	0	0	0	0	0	0	0
2008	0.004	0.641	0.339	0.012	0.004	0	0	0	0	0	0	0	0
2009	0.007	0.551	0.381	0.061	0	0	0	0	0	0	0	0	0
2010	0	0.727	0.256	0.012	0.006	0	0	0	0	0	0	0	0

Table B.3 Brill LPUEs per ICES rectangle and year. Shaded rows contain no missing values and are used in age structured LPUE calculations.

	Year								
Rectangle	2002	2003	2004	2005	2006	2007	2008	2009	2010
31F1	32.71	67.74	48.06	34.58	26.37	47.39	30.4	47.96	72.46
31F2	39.77	46.81	35.14	24.25	29.07	39.33	31.71	41.31	62.88
31F3	8.56	42.95	24.83	16.47	18.02	22.59	42.97	43.08	0
31F4	NA	NA	NA	NA	NA	NA	NA	NA	NA
31F6	NA	NA	0	NA	NA	NA	NA	NA	NA
32F0	NA	NA	NA	1.97	NA	NA	NA	NA	NA
32F1	52.16	57.16	45.08	24.89	18.09	40.58	52.22	41.61	64.84
32F2	41.97	42.72	40.57	30.32	35.54	46.15	44.37	49.93	71.72
32F3	34.77	38.63	32.16	28.63	34.62	51.29	40.26	49.09	88.49
32F4	45.04	49.84	34.65	49.85	26.11	32.98	17.64	NA	0
32F5	NA	23.37	NA	NA	NA	NA	NA	NA	NA
33F0	NA	NA	NA	NA	NA	NA	NA	NA	10.46
33F1	68.73	40.71	NA	60.61	44.54	NA	NA	66.98	NA
33F2	44.09	51.73	37.86	36.88	41.84	63.51	77.09	75.15	105.68
33F3	31.66	39.21	28.31	30.01	34.17	44.74	39.92	59.07	79.32
33F4	27.83	30.76	28.94	22.48	33.51	32.24	24.71	43.14	42.34
33F5	33.05	NA	NA	52.95	NA	NA	NA	NA	NA
34F0	NA	27.08	NA	NA	NA	NA	NA	NA	NA
34F1	34.22	24.22	32.56	83.37	0	NA	NA	NA	138.76
34F2	35.84	32.06	30.12	28.41	32.99	41.36	44.15	39.82	59.45
34F3	34.99	40.63	30.89	24.98	29.99	34.75	40.06	59.62	66.24
34F4	22.61	24.78	24.08	22.22	22.52	22.51	21.88	38.45	42
34F5	19.01	NA	9.26	8.21	0	25.45	NA	42.59	0
34F6	0	NA	36.46	NA	NA	NA	NA	NA	NA
34F7	NA	NA	NA	NA	NA	NA	NA	NA	NA
35F0	38.13	17.65	7.35	NA	NA	NA	0	NA	0
35F1	36.15	31.16	46.82	57.29	59.37	45.21	54.32	39.37	71.08
35F2	27.77	28.02	24.2	26.15	29.58	32.9	32.84	37.57	63.11
35F3	29.26	30.49	24.63	20.56	23.25	19.84	25.18	38.28	41.27
35F4	25.38	20.56	23.67	17.33	13.72	17	16.46	25.69	27.8
35F5	20.91	10.06	17.27	13.73	18.74	22.96	10.07	25.84	15.3
35F6	23.26	8.73	0	NA	43.06	NA	77.72	NA	NA
36F0	28.37	29.18	25.14	25.6	22.78	10.75	8.76	13.88	23.86
36F1	18.67	14.83	15.76	15.93	14.96	20.62	16.65	16.72	29.08
36F2	26.14	22.79	23.22	22.02	28.71	34.82	30.79	33.85	60.99
36F3	31.56	28.72	29.55	23.15	25.4	38.57	33.71	31.57	49.81
36F4	20.93	21.27	21.77	18.15	17.89	20.81	17.17	18.96	24.96
36F5	20.62	23.77	18.71	19.99	22.19	17.93	20.48	21.41	24.58
36F6	14.51	18.26	23.58	18.48	29.21	25.69	31.96	26.26	36.09
36F7	25.73	18.94	24.19	19.55	37.77	31.1	18.79	21.84	39.3
36F8	NA	42.22	NA	NA	NA	NA	NA	NA	NA
37F0	31.41	34.87	34.26	29.87	34.17	27.47	24.95	33.44	43.92
37F1	21.45	16.65	22.59	20.75	27.45	30.07	20.81	31.55	46.84
37F2	20.33	16.28	23.38	17.06	32.14	33.84	30.8	38.7	41.93
37F3	29.49	34.67	36.09	28.77	37.85	49.69	39.91	60.33	53.91
37F4	29.6	34.72	33	36.42	38.59	42.83	44.56	44.16	50.36
37F5	29.48	35.49	35.29	33.41	32.24	32.28	37.02	41.05	43.54
37F6	16.78	32.31	26.48	22.49	27.51	32.67	34.18	29.35	45.41
37F7	14.89	36.08	29.46	23.49	37.3	31.39	29.07	22.62	35.57
37F8	0	NA	NA	NA	NA	NA	61.22	NA	21.71
38F9	33.27	26.54	36.26	31.2	NA	34.13	NA	NA	NA
38F0	36.17	38.25	31.18	20.63	24.24	34.46	20.24	0	27.74
38F1	19.73	14.73	2.4	24.76	7.14	5.66	0	NA	0
38F2	4.82	2.43	2.66	0	0.61	4.93	0	5.48	4.75
38F3	10.12	17.73	15.67	10.54	10.61	7.14	4.72	0	12.69
38F4	31.63	40.38	49.88	50.02	33.61	51.46	59.14	74.67	62.84
38F5	29.56	50.82	43.15	46.34	39.86	49.25	53.52	51.06	72.84

Table B.3 continued. Brill LPUEs per ICES rectangle and year. Shaded rows contain no missing values and are used in age structured LPUE calculations.

	Year								
Rectangle	2002	2003	2004	2005	2006	2007	2008	2009	2010
38F6	20.15	34.15	38.66	37.38	38.39	55.74	69.59	59.12	70.48
38F7	14.43	33.81	36.23	26.66	31.6	63.63	43.47	25.28	73.86
38F8	40.74	NA	NA	NA	NA	24.56	NA	NA	NA
39F0	0	NA	NA	0	58.01	NA	NA	NA	NA
39F1	49.66	1.19	13.45	10.4	0	16.32	0	NA	NA
39F2	4.04	0.14	8.94	5.67	10.24	0	NA	3.2	0
39F3	1.09	1.61	10.69	8.35	6.12	3.59	1.69	1.56	3.20
39F4	1.68	8.52	9.73	22.59	3.16	22.52	5.27	8.96	9.56
39F5	17.26	30.32	33.07	29.52	15.85	47.25	43.99	44.63	36.11
39F6	15.92	27.93	45.15	47.11	47.16	58.04	85.83	71.91	89.01
39F7	16.84	22.55	37.33	33.08	50.64	33.95	185.92	67.33	87.61
39F8	61.86	NA	NA	NA	0	NA	NA	NA	NA
40F0	NA	NA	NA	60.58	NA	70.46	NA	NA	NA
40F1	NA	NA	64.95	0	NA	NA	NA	NA	NA
40F2	6.06	0	7.8	9.58	0	57.41	NA	56.07	NA
40F3	1.12	0	20.51	23.69	17.4	0	0	9.58	2.27
40F4	0.54	4.61	16.56	23.61	8.98	21.6	19.4	7.74	11.62
40F5	4.27	5.8	21.5	34.81	14.06	18.44	8.97	5.81	36.16
40F6	18.22	15.13	25.77	37.18	36.12	41.43	78.72	92.89	96.72
40F7	8.47	19.79	14.71	28.06	27.77	28.06	163.38	100.78	106.07
41F1	NA	NA	NA	0	NA	NA	NA	NA	NA
41F3	NA	4.49	0	0	0	0	NA	NA	NA
41F4	0	2.46	32.37	5.65	6.87	1.62	75.79	NA	0
41F5	0	2.45	11.24	15.35	13.57	18.8	28.32	13.12	20.1
41F6	2.48	19.63	15.36	16.08	8.88	14.35	47.06	108.01	46.62
41F7	NA	55.97	2	17.28	9.41	12.81	0	129.08	128.39
42F1	NA	NA	NA	NA	NA	NA	NA	NA	NA
42F3	0	0	0	0	1.88	8.32	0	NA	NA
42F4	0	0	0	5.03	8.39	8.94	12.91	NA	NA
42F5	4.48	1.14	15.42	0	3.81	25.96	NA	32.12	20.49
42F6	2.04	9.23	8.56	14.01	7.01	8.52	3.98	9.52	31.59
42F7	NA	0	0	2.31	1.75	7.54	6.53	27.05	32.31
42F8	NA	NA	0	NA	NA	NA	NA	NA	0
43F2	0	0	NA	NA	NA	NA	NA	NA	NA
43F3	1.06	0	0	9.78	2.67	8.18	NA	NA	NA
43F4	1.13	0	5.01	13.45	11.09	9.99	0	82.35	0
43F5	1.9	0	8.97	14.34	27.88	9.29	18.41	235.29	NA
43F6	2.24	0	1.43	5.23	5.79	0.38	8.07	0	0
43F7	NA	2.86	2.8	3.24	2.72	3.84	12.79	28.49	20.21
44F2	0	0.32	0	10.21	12.36	NA	NA	NA	NA
44F3	3.91	1.63	8.43	17.23	22.38	11.44	NA	NA	NA
44F4	0.47	NA	11.87	23.7	20.07	14.13	51.11	141.75	NA
44F5	5.97	NA	NA	25.39	74.95	17.2	65.21	181.96	NA
45F2	NA	0	0	14.83	NA	NA	NA	NA	NA
45F3	NA	NA	14.37	46.4	94.97	NA	137.32	NA	NA
45F4	NA	NA	NA	NA	NA	37.52	NA	NA	NA
49F4	NA	NA	NA	13.73	NA	NA	NA	NA	NA
49F5	NA	NA	NA	27.47	NA	NA	NA	NA	NA
52F3	NA	NA	NA	25.38	NA	NA	NA	NA	NA
32F7	NA	NA	NA	NA	NA	NA	NA	NA	NA
33F6	NA	NA	NA	NA	NA	NA	NA	NA	NA
35F7	NA	NA	NA	NA	NA	NA	NA	NA	NA
40F8	NA	NA	NA	NA	NA	NA	NA	NA	NA
42F2	0	0	NA	NA	0	0	NA	NA	NA
43F8	NA	NA	0	NA	NA	NA	NA	NA	NA
44F6	0	NA	NA	NA	NA	NA	NA	NA	NA
45F5	NA	NA	NA	NA	0	NA	NA	NA	NA
50F6	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table B.4 Brill market sampling. Number of individuals per market category per year. Note that several years are missing because no market sampling was done in those years.

	Market category				
Year	+	0	1	2	3	Total
1981		141	9	10		160
1982		364	95	100		559
1983		810	225	276		1311
1984		119	466	522	433	1540
1985		482	371	331		1184
1986		542	397	432		1371
1987		128	93	159		380
1988		128	80	110		318
1989		82	118	158		358
1990			167	274		441
1998			155	222		377
2002			571	663	402	1636
2003		70	459	561	480	1570
2004	10		235	228	218	691
2005	14	3	183	203	161	564
2006	40		165	186	176	567
2007	46		228	247	204	725
2008	53		261	256	251	821
2009	63		163	162	147	535
2010	56		176	180	172	584