Final Report NESPMAN

Improving the knowledge of the biology and the fisheries of the new species for management

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Summary

The NESPMAN (New Species for Management) project is meant to improve the knowledge of the biology and the fisheries of the new species for management. Apart from highly priced turbot, brill, striped red mullet and sea bass, these 12 species comprise also 3 gurnard species and 4 flatfishes. This report presents information for these 12 species that are becoming increasingly important for fisheries in NW Europe, partly due to the generally poor state of some of the main commercial fish species.

The information presented in this report is based on analyses of data from research vessel surveys, landings statistics, data from on board observers, market sampling programmes and from biological sampling. Some economical analyses have been carried out as well. Through this project a better insight is gained in aspects such as distribution of the species, length- and sometimes age-composition of the catches, growth and maturity, ageing, stock ID etc.

The results of the NESPMAN project will be presented at, and used by, the ICES Working Group on the Assessment of New Species (WGNEW) at its next meeting that is scheduled for October 2010. During this meeting the basis will be laid to formulate ICES advice on fisheries for the NEW species to the European Commission.

1 Introduction

The Memorandum of Understanding (MoU) signed between the European Community (EC) and the International Council for the Exploration of the Sea (ICES) in 2004 provided in its Annex I a list of species in the ICES fishing area for which recurring advice is requested by the Commission. In addition to the standard species for which advice has been requested within former agreements for many years (the main commercial species such as cod, plaice and herring), a list of species was added under a paragraph "New species".

In the following year, 2005, an ICES Working Group on the Assessment of New Species (WGNEW) was established to provide information on these new species. Two WGNEW meetings have since been held, in 2005 and 2007 (ICES 2006, and ICES 2007). The terms of reference for these meetings were to compile information on the biology and the fisheries on these species, to consider possibilities for fish stock assessments, to evaluate the status of the stocks as appropriate on the basis of existing information and develop a strategy that would further enable appropriate future assessments of these species.

The ICES working group considered the list of species and decided to add some species because they were thought to be of increasing commercial importance in (part of) the ICES area. The complete list of species that WGNEW is working on is as follows:

sea bass	*Dicentrarchus labrax*
striped red mullet	*Mullus surmuletus*
red gurnard	*Aspitrigla cuculus*
tub gurnard	*Trigla lucerna*
grey gurnard	*Eutrigla gurnardus*
John dory	Zeus faber
dab	*Limanda limanda*
flounder	*Platichthys flesus*
witch flounder	*Glyptocephalus cynoglossus*
lemon sole	*Microstomus kitt*
turbot	*Psetta maxima*
brill	*Scophthalmus rhombus*

During the two meetings of WGNEW, a lot of information on these species has been assembled. The members of WGNEW, however, were aware that many more data have been collected for several species but have not been analysed, or otoliths have been collected, but the ages have never been determined. Fisheries research institutes usually give priority to working on the major commercial species, and not to the new-comers as listed above. In its report (ICES 2007) WGNEW has identified the species/area combinations where more information was expected to be available from data that had not yet been analysed. The aim of the project NESPMAN – New Species for Management - was mainly to make these data available. WGNEW also proposed that some small scale sampling should be done to collect information in those cases where no sampling had been done before and data on length compositions of catches/landings, or on growth parameters for some of the species were completely lacking. Also this small scale sampling was incorporated in the proposal for the NESPMAN project.

The first objective of the NESPMAN project was to collate the available information on biological parameters, stock identity, and composition of catches and landings of the species dealt with by the ICES Working Group on the Assessment of New MoU Species (WGNEW). This is basic information when the state of a fish stock must be assessed.

Sources from which data have been compiled and analysed are:

<u>Survey data</u>: most recruit surveys with research vessels target one or more commercially important species, but most often data on all species (length and numbers) are being collected. As a standard, only the data of the target species have been analysed. Analysis of survey data for the NEW species provides information on e.g. the distribution of the species, nursery areas, length compositions, and trends in abundance.

<u>Fisheries data</u>: for most species, but not for all, data on landings are usually available. Sometimes some market sampling has been done in order to provide information on the length composition of the landings. In those cases where such information did not exist at all, some small scale sampling has been done. Where data on effort are relevant and not yet made available, such data have been extracted and analysed.

Discard data: in several countries on board sampling programmes have existed for some years. Also during on board sampling, data are as a standard collected on all species caught, but only data for the major species have been worked up. This report provides information from on board sampling for the NEW species.

Biological sampling: some sampling of the NEW species has over the years been done during certain research vessel surveys, but never in a systematic way. In a number of cases otoliths have been collected, and data on length, weight, sex and maturity have been recorded. Usually, however, the ages of these fish have not been determined, and the data are not analysed. This has been done under this project and results are presented here.

For some of the NEW species (e.g. red and tub gurnard) we do not know very much more than total landings and/or the time series data of abundance in research vessel surveys. In other cases much more information is available, but for none of the species analytical assessments seem possible. This is still due to a general lack of data: apart from landings data and research survey data no time series are available.

In the past an assessment has been attempted for North Sea turbot and brill (Boon & Delbare 2000), but since then, data collection has been irregular and an analytical assessment covering a longer period is not possible.

For sea bass more work on French data is underway. If these data were to be made available by the beginning of August, work could be carried out to combine the data into an international dataset and for preliminary assessments to be undertaken. The results could then be presented to the meeting of the ICES Assessment Working Group on New Species (WGNEW) which is scheduled to meet in October 2010.

This report of the NESPMAN project should be considered as a data-report, that in the first place is meant to be used by the ICES Working Group on the Assessment of New Species (WGNEW). The results of the analyses carried out under this project will be presented to WGNEW.

In a number of cases work started under this project, but is not yet completely finished. For example small scale sampling started in some cases with the intention to continue during 12 months, and not the whole year-cycle has yet been covered. Some of this work will be continued between the formal end date of the project (April 2010) and the next meeting of WGNEW (October 2010) in order to be able to present all results to WGNEW and have these included in the 2010 report of WGNEW.

2 WP1 - Analysis of survey data

2.1 IMARES[1]

2.1.1 Methods

Six species were selected for the analysis. These are tub gurnard (*Trigla lucerna*), grey gurnard (*Eutrigla gurnardus*), turbot (*Psetta maxima*), flounder (*Platichthys flesus*), brill (*Scophthalmus rhombus*), and witch flounder (*Glyptocephalus cynoglossus*).

Data from three surveys have been analysed: the ICES-coordinated International Bottom Trawl Survey (IBTS), the Dutch contribution to the Beam Trawl Survey (BTS) and the Dutch contribution to the Demersal Young Fish Survey (DFS). The IBTS has been rather stable in methods and in coverage over the whole range of years used in this analysis. The third quarter IBTS started in 1991 and has also been stable in coverage and methods. The (Dutch) BTS started in 1983. Initially, the survey was carried out by one vessel ("Isis") only and coverage was limited to the southeastern North Sea until 1995. In 1996 a second vessel ("Tridens") started to participate and the survey area was expanded to include the western and central North Sea. The DFS survey is carried out by three vessels since 1970, one vessel ("Stern") fishes the stations in the Wadden Sea, a second vessel ("Schollevaar") fishes in the SW Delta-area, a third vessel (mainly "Isis") covers the stations along the Dutch coast.

The survey period covered different time series, namely IBTS Q1: 1970-2009; IBTS Q3: 1991-2008; BTS Q3: 1985-2008; DFS Wadden Sea Q3: 1970-2008; DFS Coastal Zone Q3: 1970-2008; DFS Delta area Q3: 1970-2008.

For each species, an overview is given for each survey by quarter of the catches in a temporal (time series) and spatial (distribution maps) context. Also, the length-frequency distributions are given to indicate size cohorts within the different surveys.

The time series of each species show the mean abundance per year, for each survey by quarter. The annual mean abundance was calculated by first averaging the catches by ICES-rectangle by year, then for the whole North Sea by year, i.e. ICES-division IV.

The distribution maps of each species illustrate the mean catch per ICES-rectangle by survey and quarter. The mean catch per ICES rectangle was calculated by first averaging the catches by ICES-rectangle by year, then for the entire survey period. The distribution maps for the IBTS and BTS are shown for juveniles and adults separately. The length split used is indicated in Table 2.1.1

Table 2.1.1 Length split between juveniles and adults

Species		Length split	Reference
Tub gurnard	*Trigla lucerna*	<20 cm	Knijn et al. (1993) Atlas of North Sea Fishes. ICES CRR 194. 268pp.
Grey gurnard	*Eutrigla gurnardus*	<20 cm	Damm U (1987) Growth of grey gurnard (Eutrigla gurnardus) in the North Sea. ICES CM 1987/G:55. 10pp.
Turbot	*Psetta maxima*	<35 cm	Heessen, HJL (1999) By-catch species in the North Sea flatfish fishery (data on turbot and brill) preliminary assessment (DATUBRAS), Study 97/078. C028/99. 62pp.
Flounder	*Platichthys flesus*	<35 cm	www.fishbase.org
Brill	*Scophthalmus rhombus*	<29 cm	Heessen, HJL (1999) By-catch species in the North Sea flatfish fishery (data on turbot and brill) preliminary assessment (DATUBRAS), Study 97/078. C028/99. 62pp.
Witch flounder	*Glyptocephalus cynoglossus*	<25 cm	www.fishbase.org

The length frequency distribution of each species show the mean abundance (in percentage) per length class (1 cm below) for each survey by quarter. The length frequencies were calculated by first averaging the catches per

[1] Authors: Remment ter Hofstede, Henk Heessen & Ingeborg de Boois

length class by ICES-rectangle by year, then for the whole North Sea (i.e. ICES-division IV) by year, and finally for the annual means by length class were averaged by survey and quarter for the entire survey period.

2.1.2 Tub gurnard in IV

Time series of abundance (Figure 2.1.1 and 2.1.2)

IBTS-1 : During quarter 1 the abundance is quite low. No clear trend is to be seen, although numbers (of overwintering fish) seem to increase in the last five years of the time series.
IBTS-3 : This time series is relatively short, and the first year clearly is an outlier, possibly due to a wrong identification (grey gurnard identified as tub gurnard?). Slightly higher values occur during the last three years.
BTS-3: Although a clear peak in abundance in the late 1980s and early 1990s can be seen in Figure 2.1.1 and a much lower level since around 1995 this is not seen at all when the time series for the two vessels that carry out the survey is shown in Figure 2.1.2. The abundance in the stations covered by RV Isis gradually increased since 1985, but in the stations fished by RV Tridens numbers remain at a low level. The area covered by the survey has changed (see 2.1.1) and using all available data for the whole time series gives a misleading picture.
DFS-3: the numbers caught in the Demersal Fish Survey are usually quite low. Apart from a possible, minor, increase in the coastal zone no clear trend can be seen.

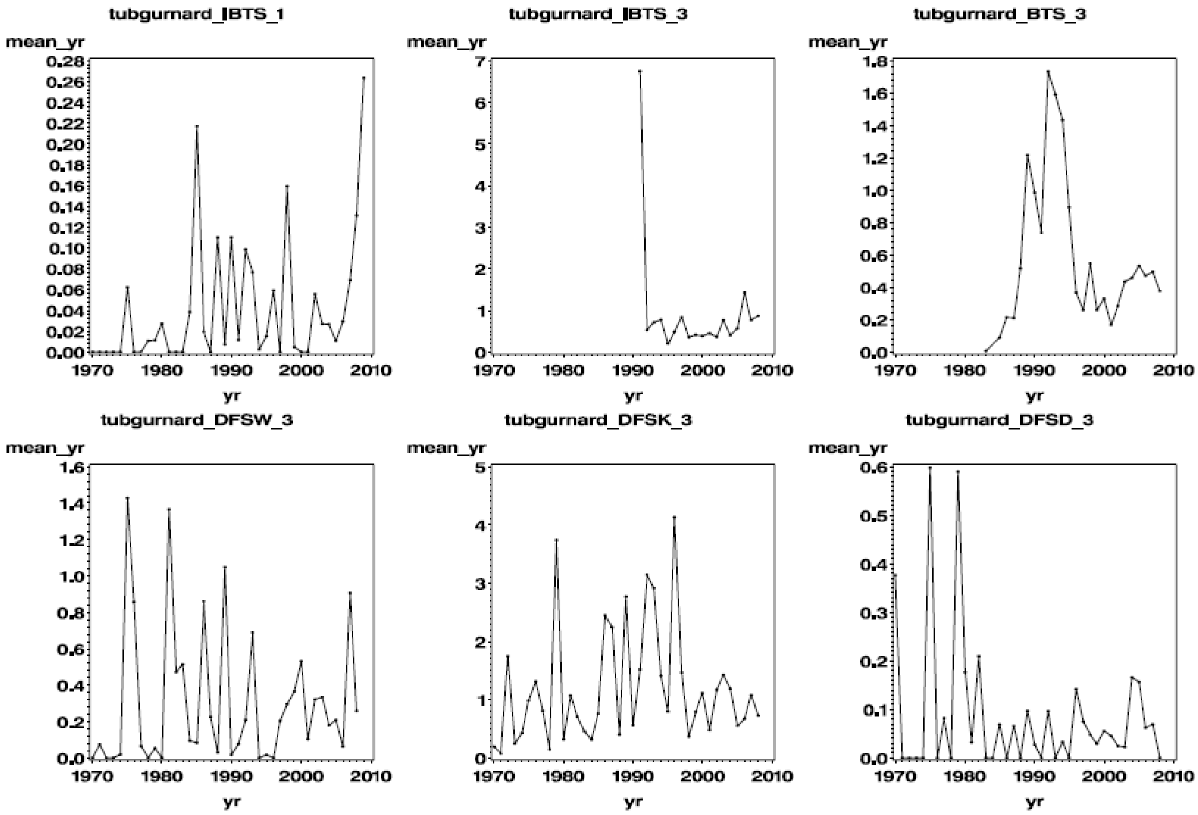


Figure 2.1.1 – Time series of abundance of tub gurnard by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

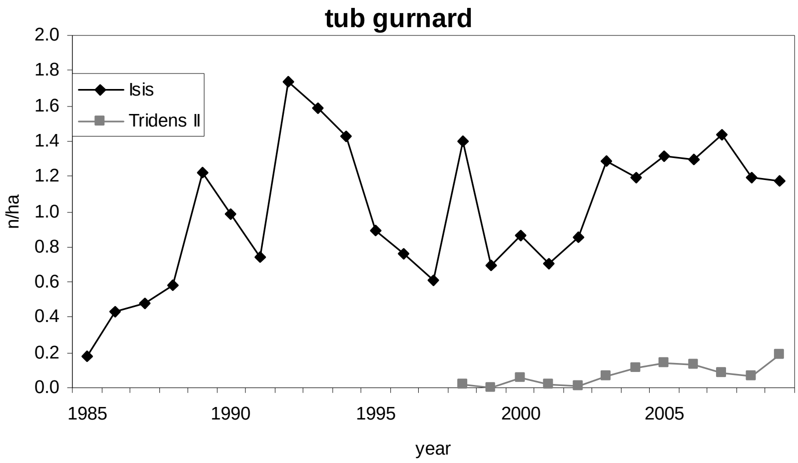


Figure 2.1.2 – Time series of abundance of tub gurnard in the BTS3 survey by vessel.

Conclusion: Tub gurnard is normally not present in the North Sea during winter, but enters the southern North Sea in spring, and leaves again in the autumn. The slight increase seen in IBTS1 may indicate an increase in the numbers of tub gurnard that remain in the North Sea in winter in recent years. This is similar to striped red mullet, another species that used to enter the North Sea in spring and leave in the autumn, but that now overwinters in the North Sea in increasing numbers. The most promising time series for tub gurnard seems to be from the Beam Trawl Surveys in quarter 3, and especially for the stations in the southeastern North Sea covered by RV Isis (Figure 2.1.2).

Length composition (Figure 2.1.3)

IBTS-1: Fish caught were in the range of 8 to 50 cm, with no clear modes indicating age-groups.
IBTS-3: The range is from about 12 to 50 cm, with a very clear peak at about 23 cm.
BTS-3: The range is from 5 to around 50 cm. Two very clear modes can be seen, around 10 cm, and around 25 cm.
DFS-3: Catches seem to be limited to small fish in the range of 4 to 20 cm. In the coastal area and in the Delta area also some fish in the range of 20 to 35 cm are caught.

Conclusion: BTS-3 probably provides the most complete picture of the annual length compositions.

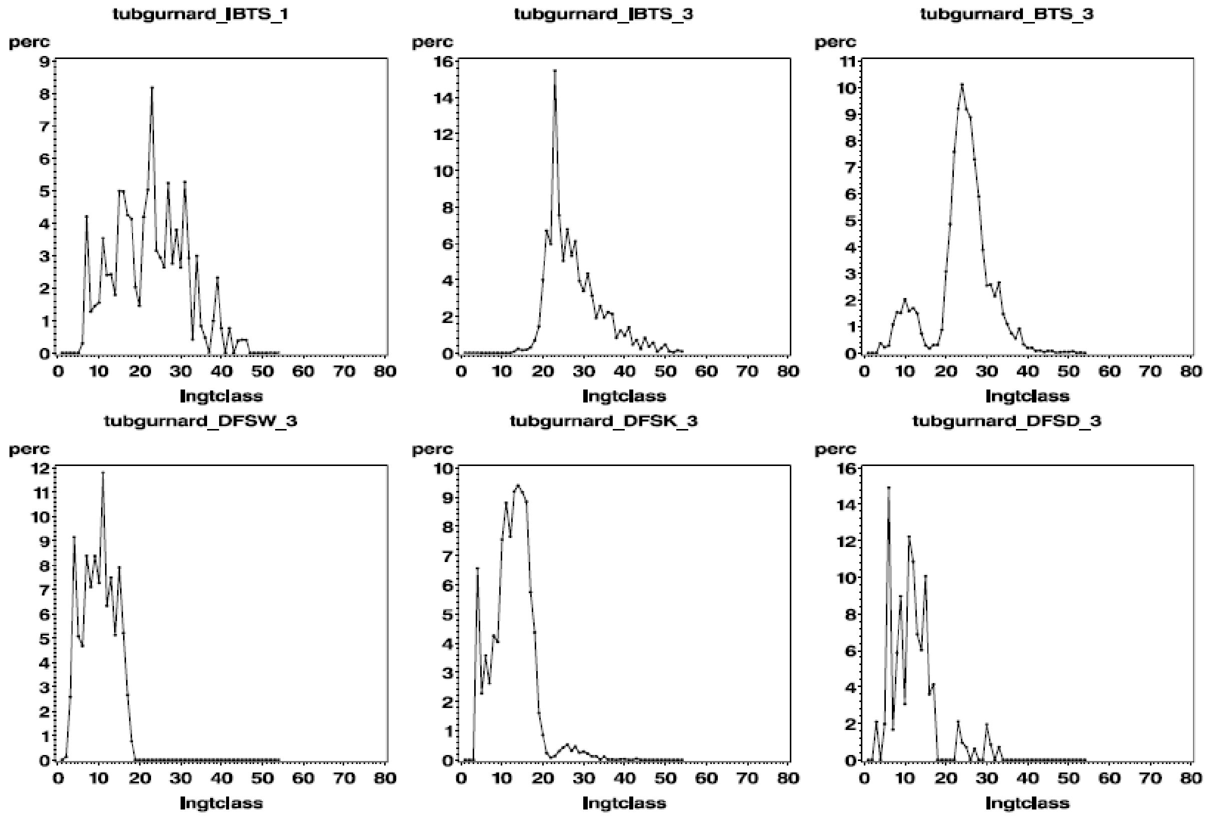


Figure 2.1.3 – Length frequency distribution of tub gurnard by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

Distribution (Figure 2.1.4 and 2.1.5)

IBTS-1: The numbers of tub gurnard caught in the first quarter IBTS are very low. The highest abundance can be seen near the northwestern and southwestern boundaries of the survey area.
IBTS-3: In the third quarter the abundance is much higher. There is a tendency that adults are more abundant towards the southeastern part of the North Sea. In juveniles no pattern is to be seen.
BTS-3: In this survey a very clear pattern can be seen, especially in the adult distribution. The abundance is higher (but numbers caught are still low) along the southeastern edge of the survey area. Juveniles show the same pattern but less clearly.
DFS-3: No clear pattern in shallow waters can be seen. In some years the highest catches are made in the Wadden Sea, in other years in the coastal zone.

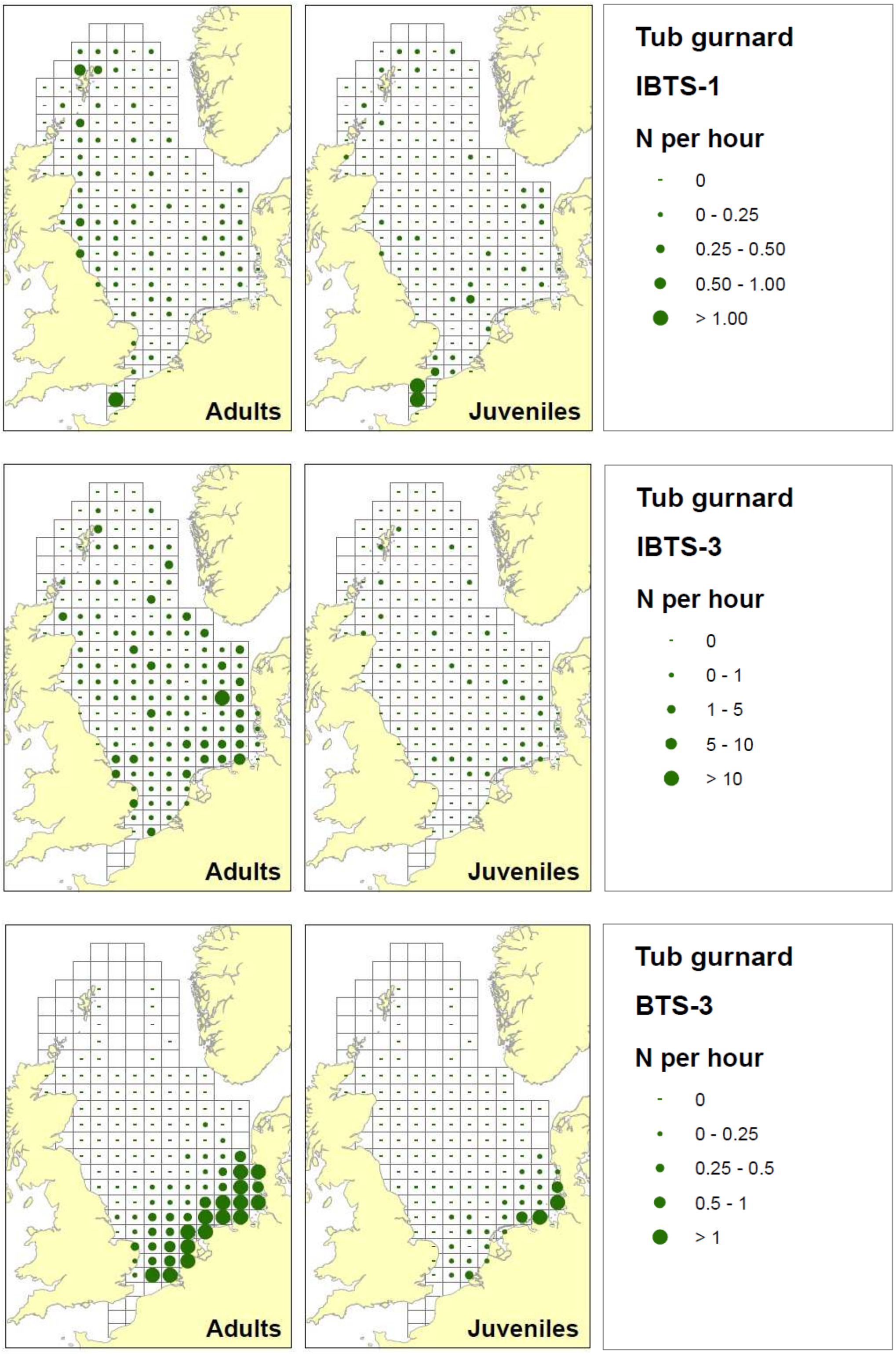


Figure 2.1.4 – Distribution of tub gurnard in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

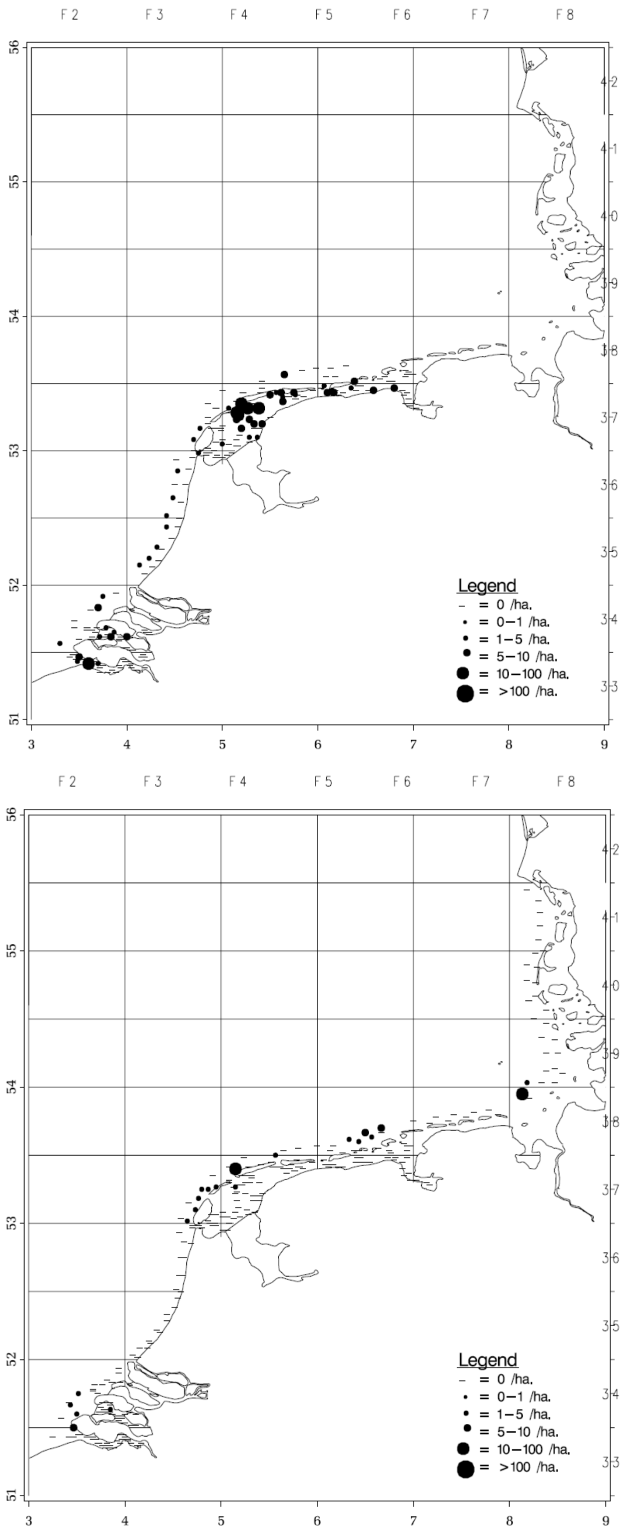


Figure 2.1.5 – Two examples of the distribution of tub gurnard in the DFS survey. Upper panel 1975, lower panel 1990.

2.1.3 Grey gurnard in IV

<u>Time series of abundance</u> (Figure 2.1.6)

IBTS-1 : From 1970 to 1980 the abundance is quite low. In 1981 a sudden peak appears, followed by a gradual increase from the late 1980s. Since around 2000 the abundance fluctuates at a high level.
IBTS-3: Abundance shows an increase from the beginning of the time series in 1991 until around 2000.
BTS-3: Compared to the IBTS the abundance seen in the BTS is at a much lower level. A similar increase between 1990 and 2000 can be seen.
DFS-3: Catches in shallow waters are low, especially in the estuaries. In the coastal zone catches were at a comparatively higher level from 1970 to 1990, and have remained small since then.

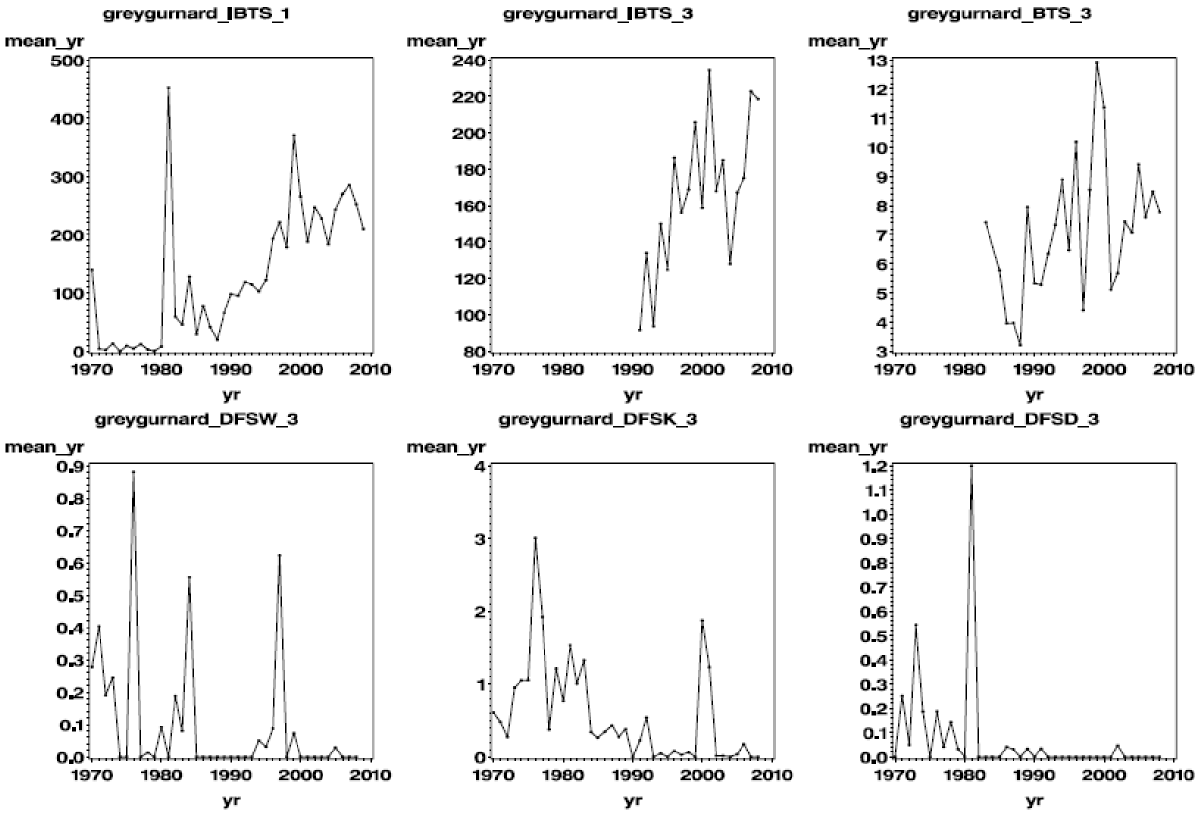


Figure 2.1.6 – Time series of abundance of grey gurnard by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

<u>Length composition</u> (Figure 2.1.7)

IBTS-1, IBTS-3 and BTS-3 all show rather similar length compositions from just below 10 to 40 or 45 cm and a peak around 20cm. The catches in the Demersal Fish Survey represent the smaller fish in the range 5 to 20 cm.

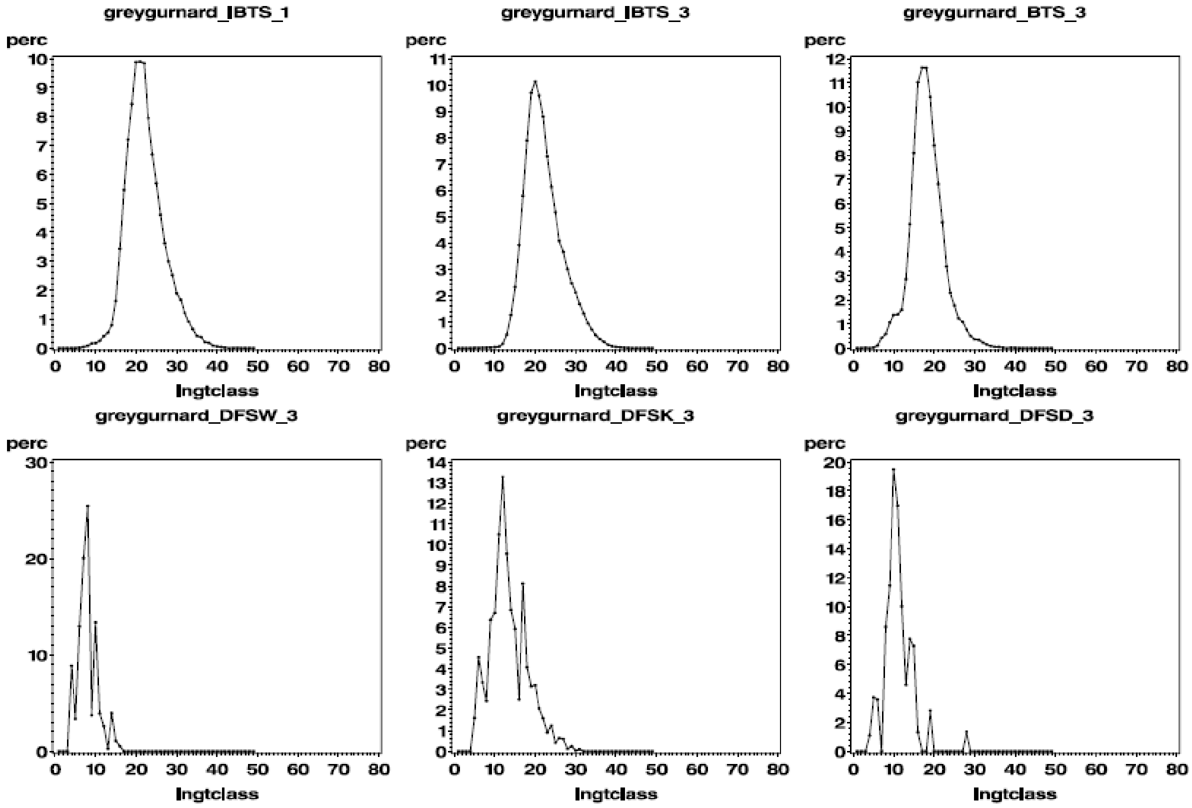


Figure 2.1.7 – Length frequency distribution of grey gurnard by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

Distribution (Figures 2.1.8 and 2.1.9)

The highest abundance in IBTS-1 is in the central western and north western North Sea. The distribution of adults and juveniles is broadly similar. In summer time (IBTS-3) grey gurnard is spread more widely to occupy also the eastern and southeastern North Sea. Again, the distribution of juveniles and adults are very similar.
In BTS-3 the highest abundance can be seen in a broad band spanning from the English coast to the coast of Jutland. Juveniles seem more abundant than adults. A clear patch of juveniles occurs in the northwestern part of the survey area.
In the DFS-3 survey the occurrence of small grey gurnards is quite variable. In some years small amounts are being caught, in other years the species is almost absent.

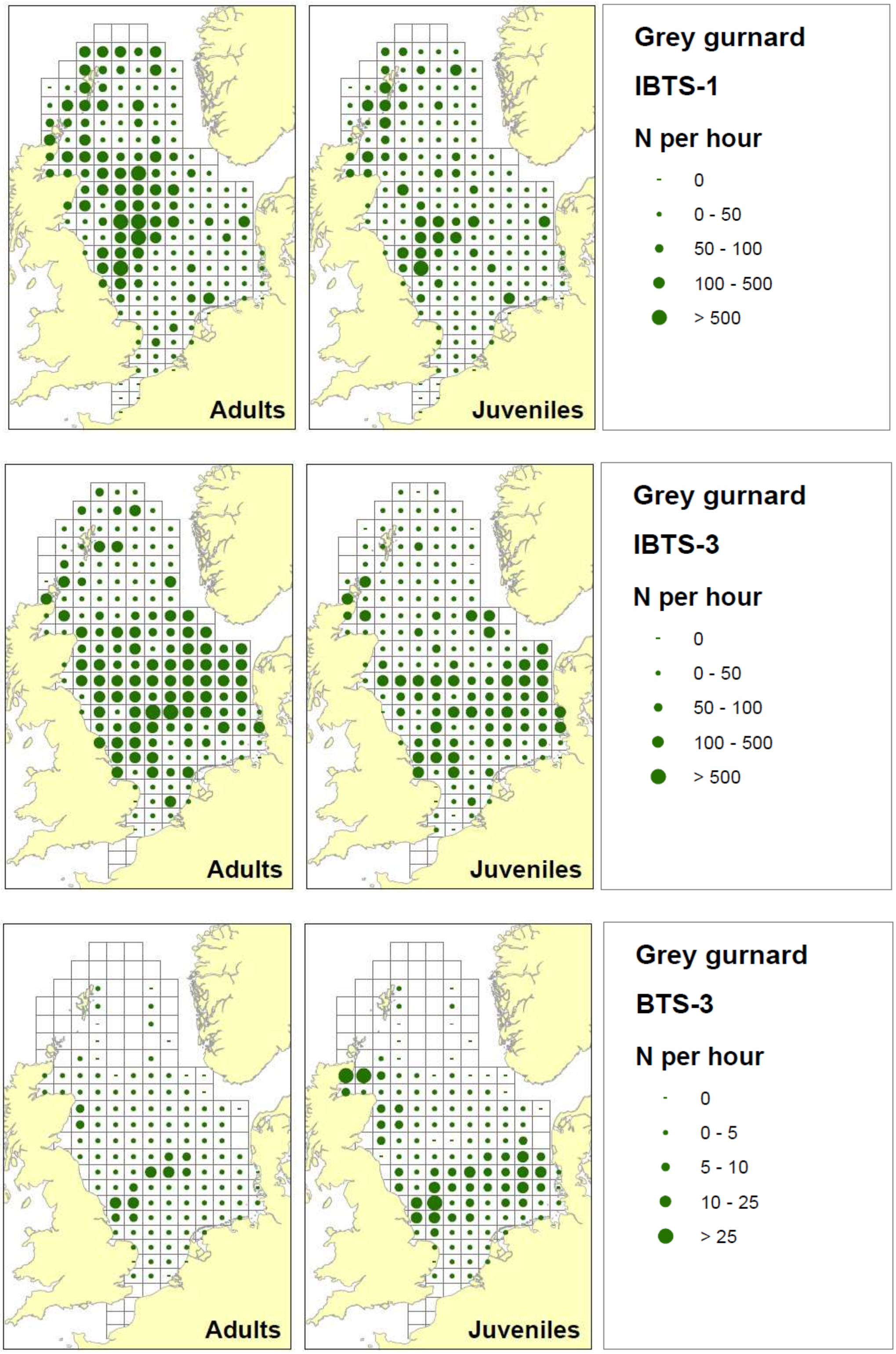


Figure 2.1.8 – Distribution of grey gurnard in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

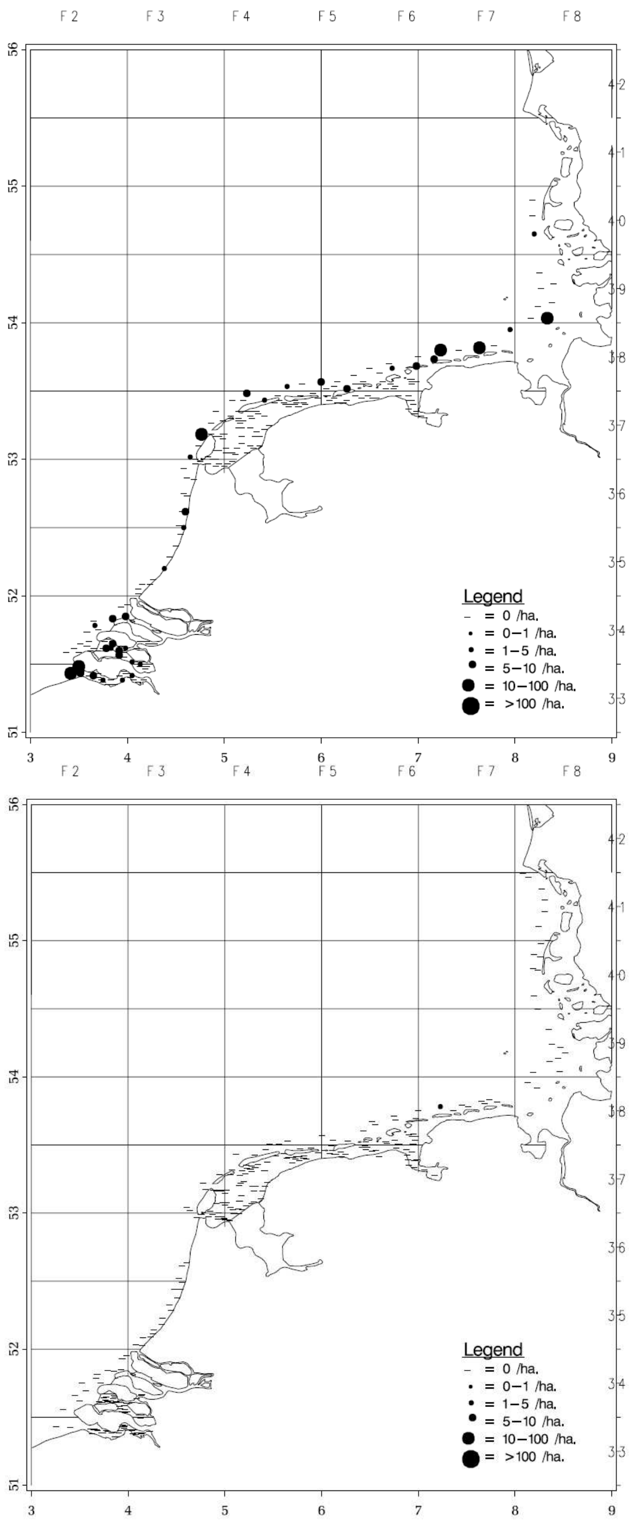


Figure 2.1.9 – Two examples of the distribution of grey gurnard in the DFS survey. Upper panel 1981, lower panel 2004.

2.1.4 Flounder in IV

<u>Time series of abundance</u> (Figure 2.1.10 and 2.1.11)

IBTS-1: The pattern is not very clear. Catches fluctuate and are possibly at a higher level during the most recent years.
IBTS-3: No clear pattern. A low abundance during quarter 3, with one peak in 1998.
BTS-3: No clear pattern. A low abundance. When the abundance for the stations of the two vessels that carry out the survey are taken into account (Figure 2.1.11) it is clear that only the abundance for stations fished by RV Isis are meaningful. The time series, however, does not show a clear pttern.
DFS-3: The pattern in the time series is not clear. The abundance is highest in the Wadden Sea and the Delta estuary.

Conclusion: a year class signal might be seen in the Wadden Sea and in the Delta estuary. Adults are best represented in the quarter 1 IBTS which is around the time that flounder spawns in the open sea. In quarter 3 most fish is found in shallow and less saline coastal waters. There does not seem to be a relation between the DFS catches in the Wadden Sea (Figure 2.1.10) and the BTS-3 catches in the southeastern North Sea (Figure 2.1.11).

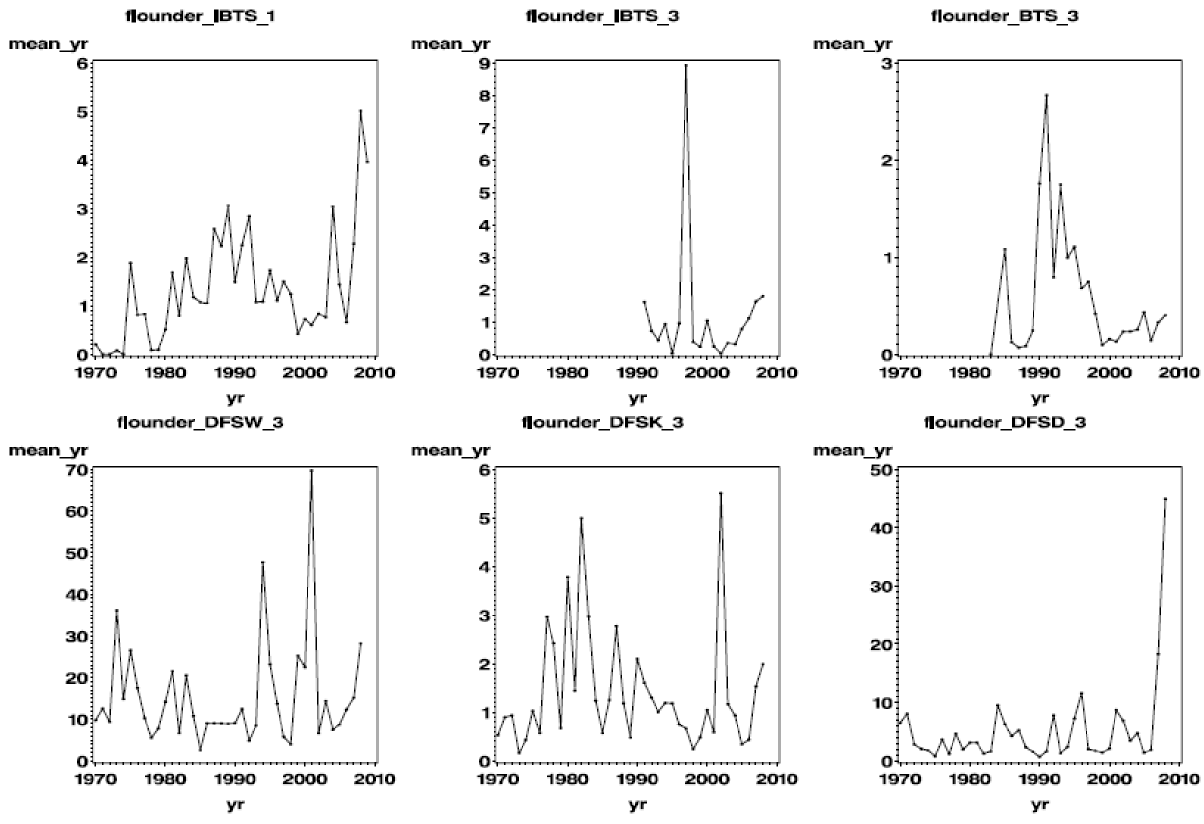


Figure 2.1.10 – Time series of abundance of flounder by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

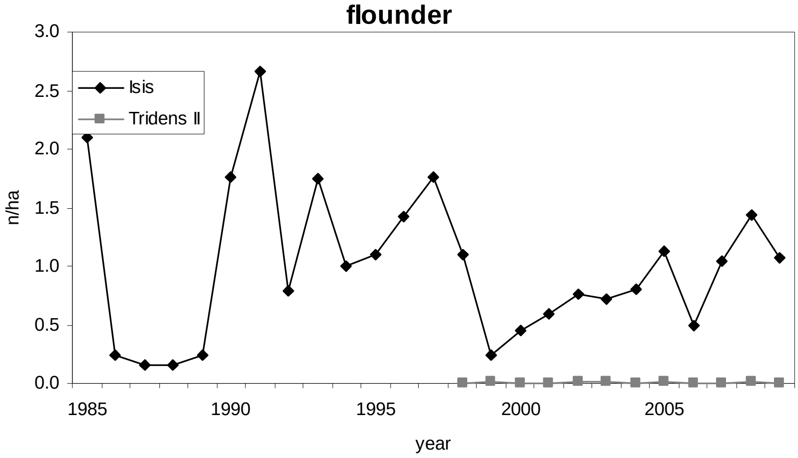


Figure 2.1.11 – Time series of abundance of flounder in the BTS-3 survey by vessel.

Length composition (Figure 2.1.12)

IBTS-1: The size range is from 10 to 50 cm, with one peak around 30 cm.
IBTS-3: The peak is again at 30 cm but a small percentage of 0-group can be seen of about 10 cm.
BTS-3: Broadly similar to IBTS-3 with possibly a small mode at 20 cm representing 1-group fish.
DFS-3: In the Wadden Sea and the Delta estuary two size classes (year-classes) can clearly be distinguished, 0-group and 1-group, with modes at around 10 and 20 cm. In the Wadden Sea the contribution of 0-group seems to be highest. The catches in the coastal area are smaller and no distinction between year classes can be made.

Conclusion: As an indication of year class strength, the DFS catches in the Wadden Sea and Delta estuary might be used. The catches of the IBTS-1 would provide a good picture of the adult component of the stock.

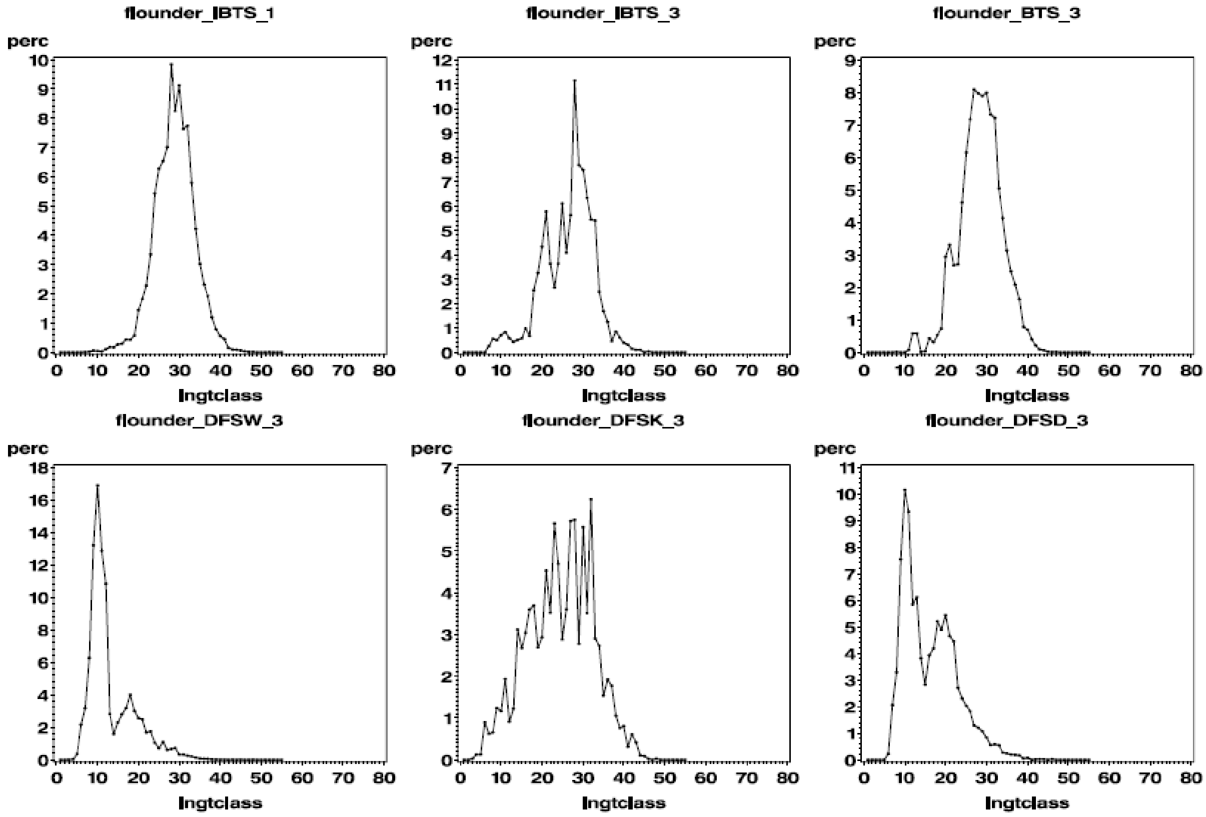


Figure 2.1.12 – Length frequency distribution of flounder by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

Distribution (Figures 2.1.13 and 2.1.14)

IBTS-1: During quarter 1 flounder are widely distributed over the North Sea, with a slightly higher abundance in the southeastern North Sea. Juveniles are also widespread, and are only found in small numbers.
IBTS-3: In the third quarter the abundance is lower, with only some coastal areas with a higher abundance.
BTS-3: In the beam trawl survey in quarter 3 adults are mainly found in shallow coastal parts of the southeastern North Sea. Juveniles have a similar distribution but occur in lower numbers.
DFS-3: Juvenile flounder are especially abundant in the Wadden Sea and the shallow southeastern Delta.

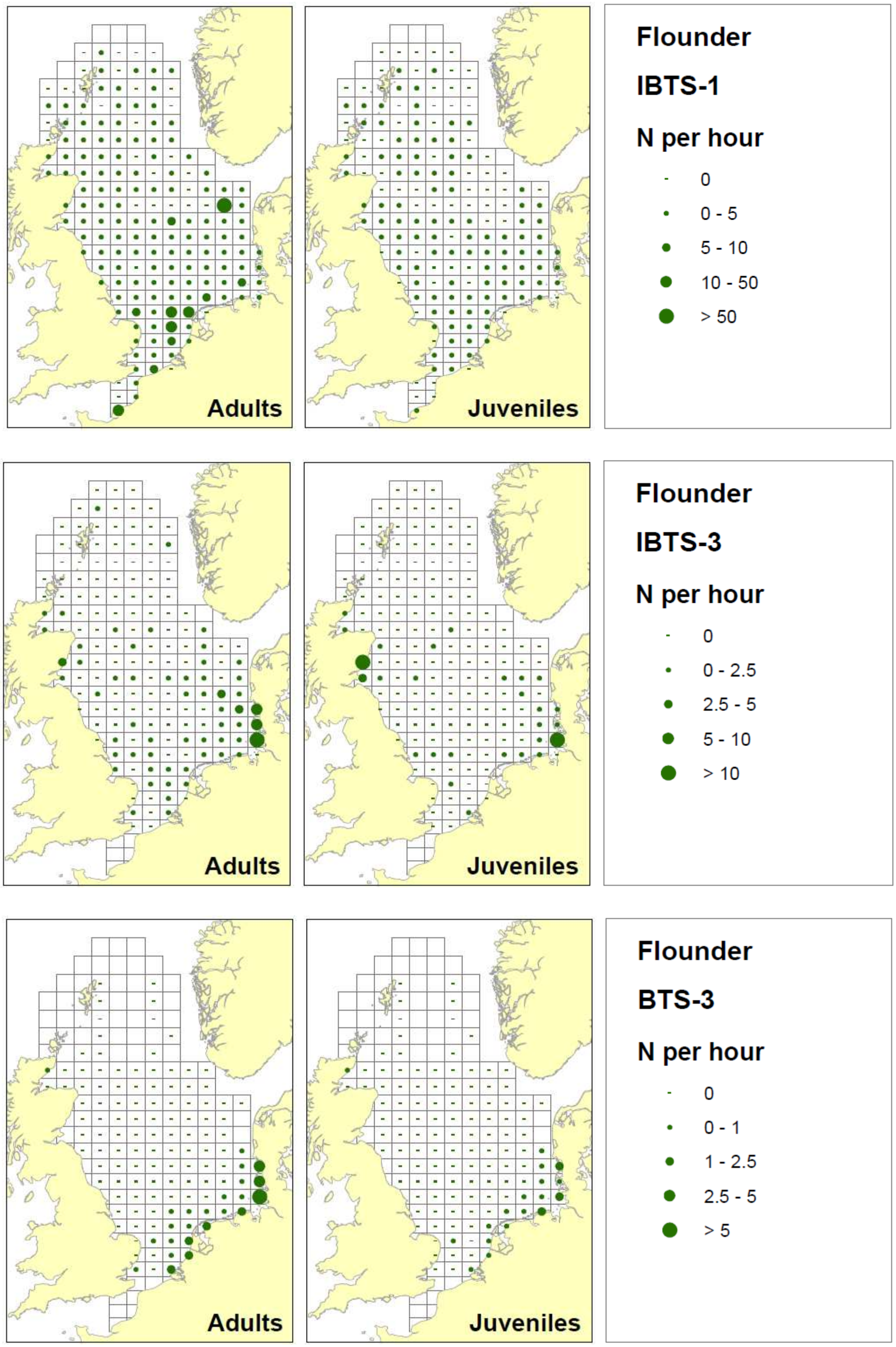


Figure 2.1.13 – Distribution of flounder in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

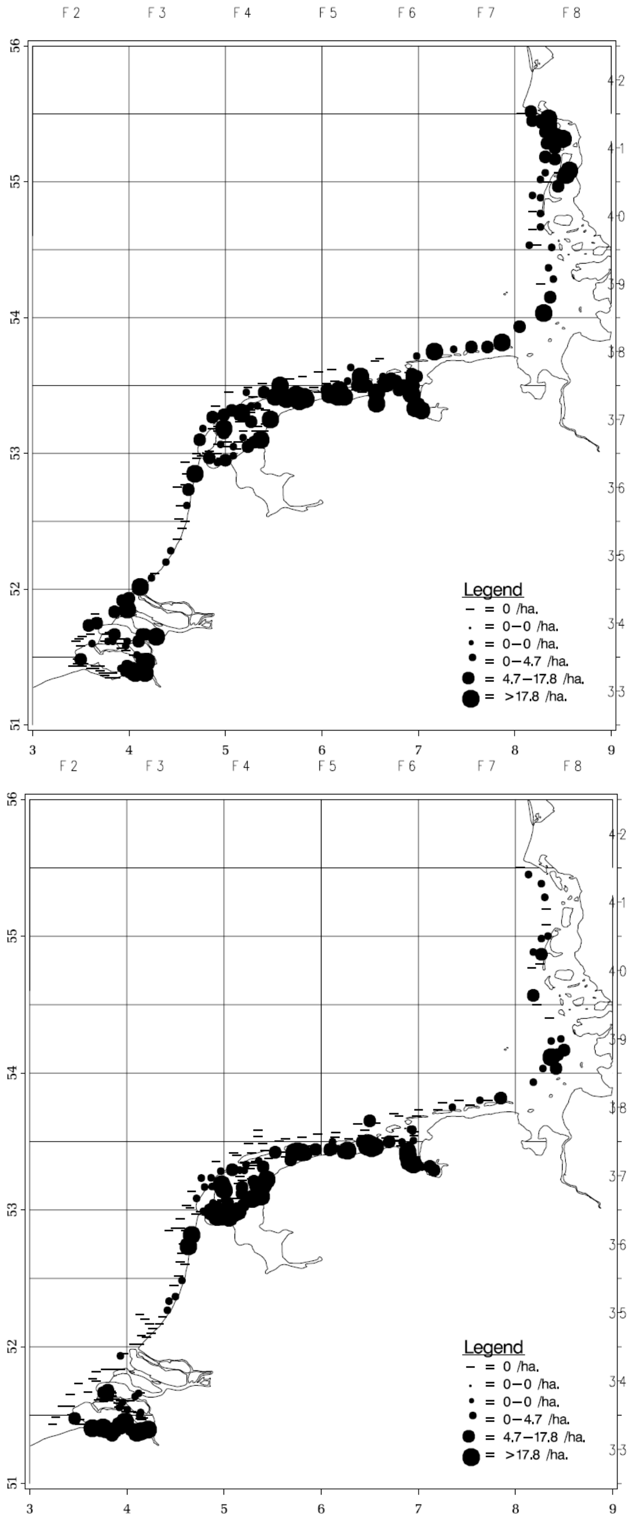


Figure 2.1.14 – Two examples of the distribution of flounder in the DFS survey. Upper panel 1980, lower panel 2007.

2.1.5 Witch flounder in IV

Time series of abundance (Figure 2.1.15)

IBTS-1: The abundance of witch flounder has been fluctuating. A “maximum” was reached around 1995, and the abundance seems to have decreased since.
IBTS-3: No pattern can be detected in the abundance time series.
BTS-3: In this time series the change in survey coverage in 1996 is reflected. Only since that year part of the distribution area of witch flounder has been included. No clear trend is visible since 1996.
DFS-3: Witch flounder does not occur in the southern North Sea.

Conclusion: As a time series the catches of witch flounder during the IBTS seem most promising, and especially for the IBTS-1 since more stations are usually fished in quarter 1, and the time series is longer.

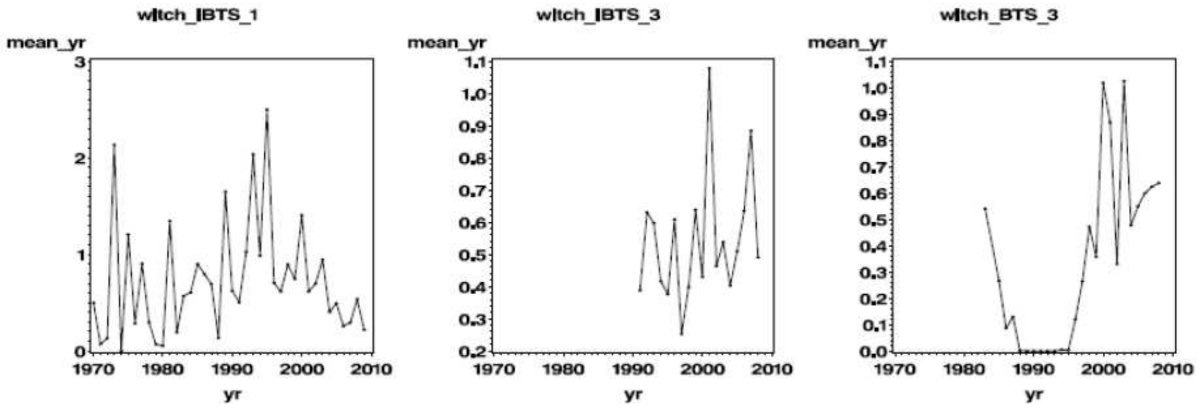


Figure 2.1.15 – Time series of abundance of witch flounder by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

Length composition (Figure 2.1.16)

Both IBTS-1, IBTS-3 and BTS-3 catch the whole size range of witch flounder from just below 10 cm to around 50 cm. The peak in the length range in both IBTS surveys is around 35 cm, in the BTS it is around 30 cm.

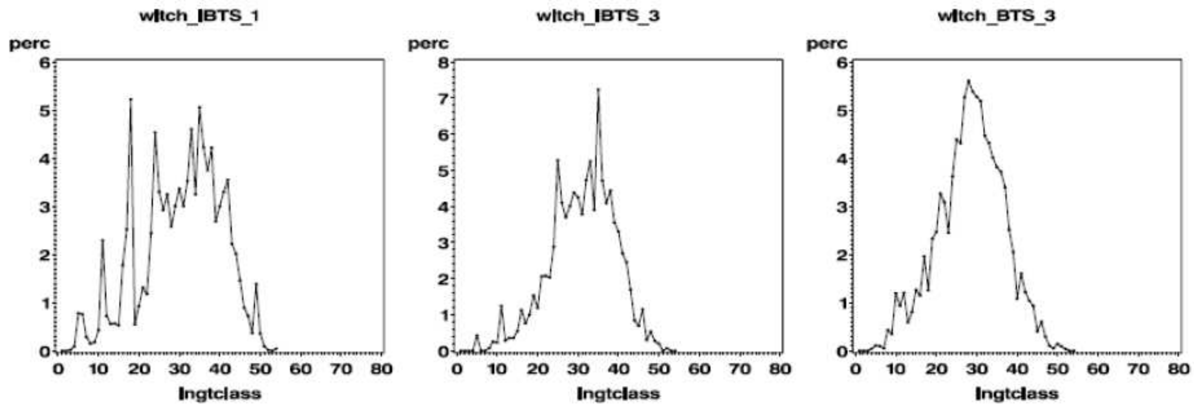


Figure 2.1.16 – Length frequency distribution of witch flounder by survey. From left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008).

Distribution (Figure 2.1.17)

IBTS-1 and IBTS-3: Witch flounder is a species that occurs in the deeper waters of the northern North Sea. There does not seem to be a significant difference in the distribution in winter and in summer. Whereas a tendency seems to exist for adults to occur mainly in offshore waters (certainly in IBTS-3) the juveniles may be more abundant towards the edges of the survey area.

The third quarter Beam Trawl Survey (BTS-3) just covers the southern range of witch flounder. Also in these data no obvious difference exists between adult and juvenile distribution.

Some specimens of witch flounder have incidentally been reported for the Demersal Fish Survey (DFS-3) but these catches are believed to stem from wrong identification of the species.

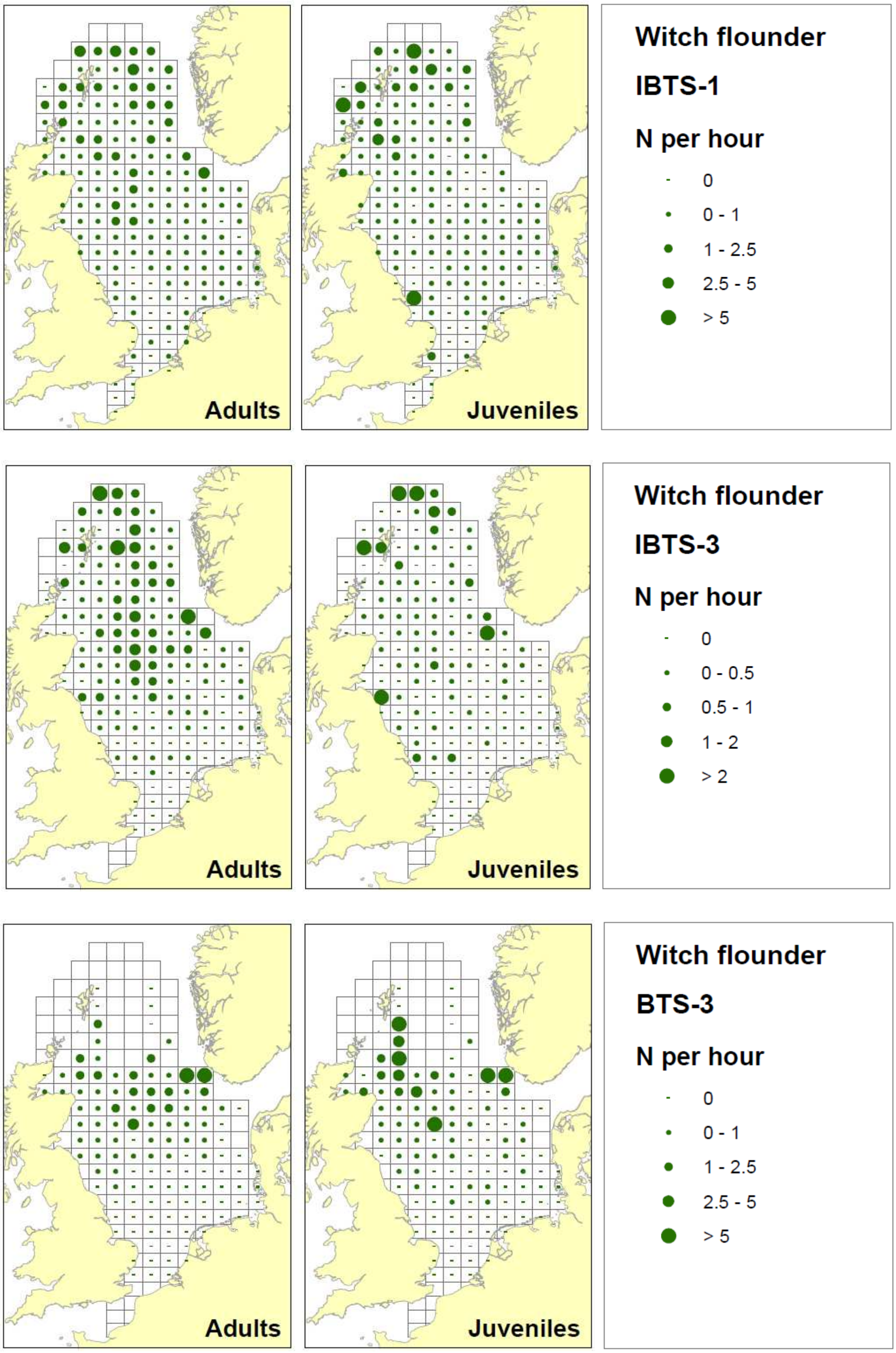


Figure 2.1.17 – Distribution of witch flounder in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

2.1.6 Turbot in IV

Time series of abundance (Figure 2.1.18)

IBTS-1: An increase can be seen from the late 1970s up to 1990, followed by a decrease to around 2000, which is then followed by another increase.
IBTS-3: The last part of the former graph is mirrored in the data for the quarter 3 IBTS.
BTS-3: The time series for the combined BTS data is misleading. Due to the specific distribution and the coverage by two vessels the time series for these vessels should be considered separately (Figure 2.1.19). The catches by RV Tridens in the central and western North Sea are almost zero. The time series for RV Isis, covering the southeastern North Sea, shows an abundance at approximately the same level since 1990.
DFS-3: The time series do not show a clear pattern. but only occasional peaks.

Conclusion: the time series from IBTS-1 and BTS-3 (RV Isis only) probably provide the most reliable information.

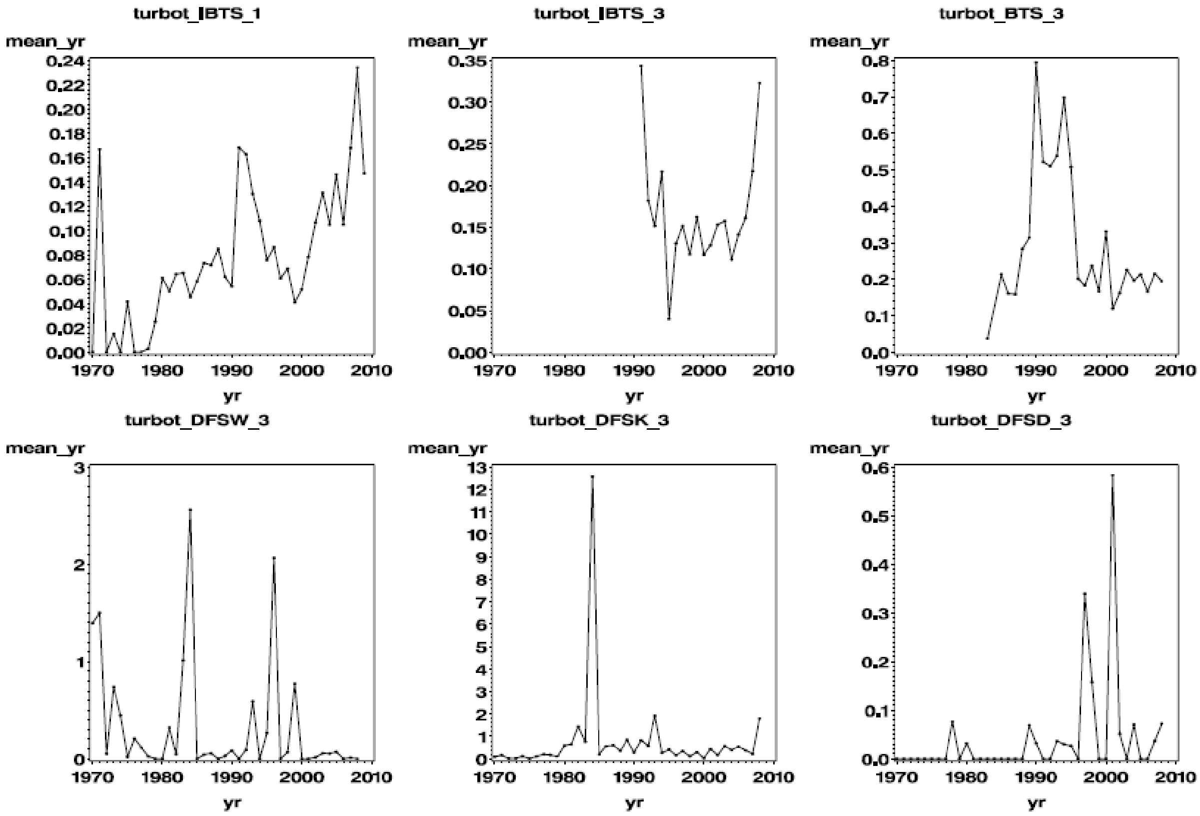


Figure 2.1.18 – Time series of abundance of turbot by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

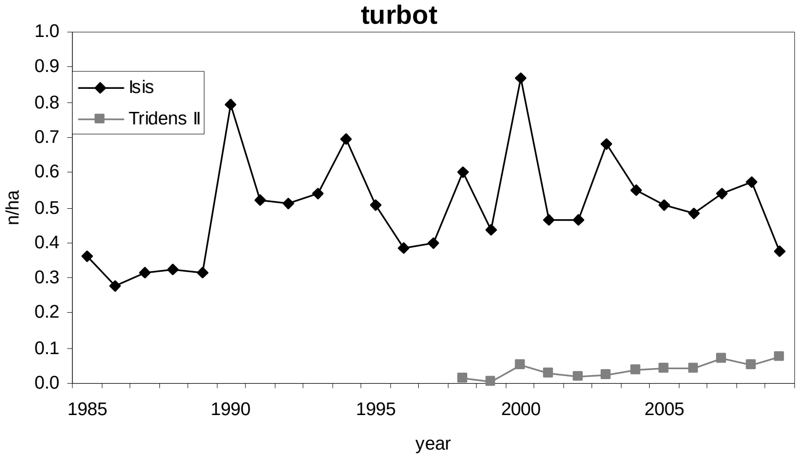


Figure 2.1.19 – Time series of abundance of turbot in the BTS3 survey by vessel

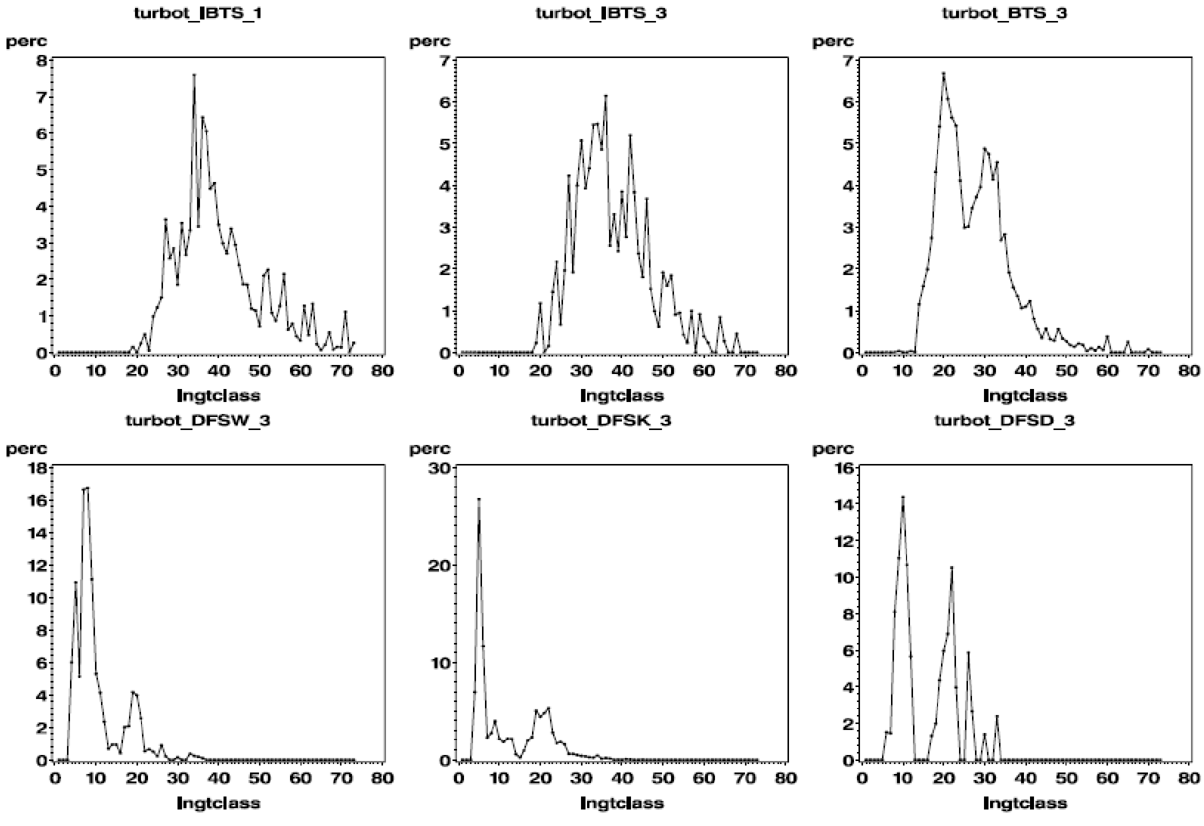


Figure 2.1.20 – Length frequency distribution of turbot by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

Length composition (Figure 2.1.20)

IBTS-1: The length range is from 20 to around 70 cm, with a peak at about 35 cm.
IBTS-3: Very similar to IBTS-1.
BTS-3: Most fish caught is between 12 and 40 cm in length. Two modes can be seen, one around 20 and the other one around 35 cm.
DFS-3: In shallow waters the specimens caught are clearly smaller than in the open sea. Catches consist probably mostly of 0-group fish (mode around 8-9 cm) and 1-group fish (mode around 20 cm).

Distribution (Figure 2.1.21 and 2.1.22)

IBTS-1: Turbot occurs widely distributed over the North Sea, with slightly higher abundance in the south-eastern North Sea. As brill, turbot is usually found in small numbers.
IBTS-3: The distribution pattern in IBTS1 and IBTS3 are broadly similar. In the eastern North Sea the abundance seems slightly higher. No obvious difference between adults and juveniles can be seen.
BTS-3: In the beam trawl survey there is a clear different pattern in juveniles, with higher numbers caught in the shallow continental zone in the south-east. There is no indication why the pattern in the juvenile distibution between the IBTS3 and BTS3 is so markedly different.
DFS-3: 0-group turbot (and brill) occur in very shallow water, and are found in all areas covered by the Demersal Fish Survey, Wadden Sea, southwestern Delta and coastal waters.

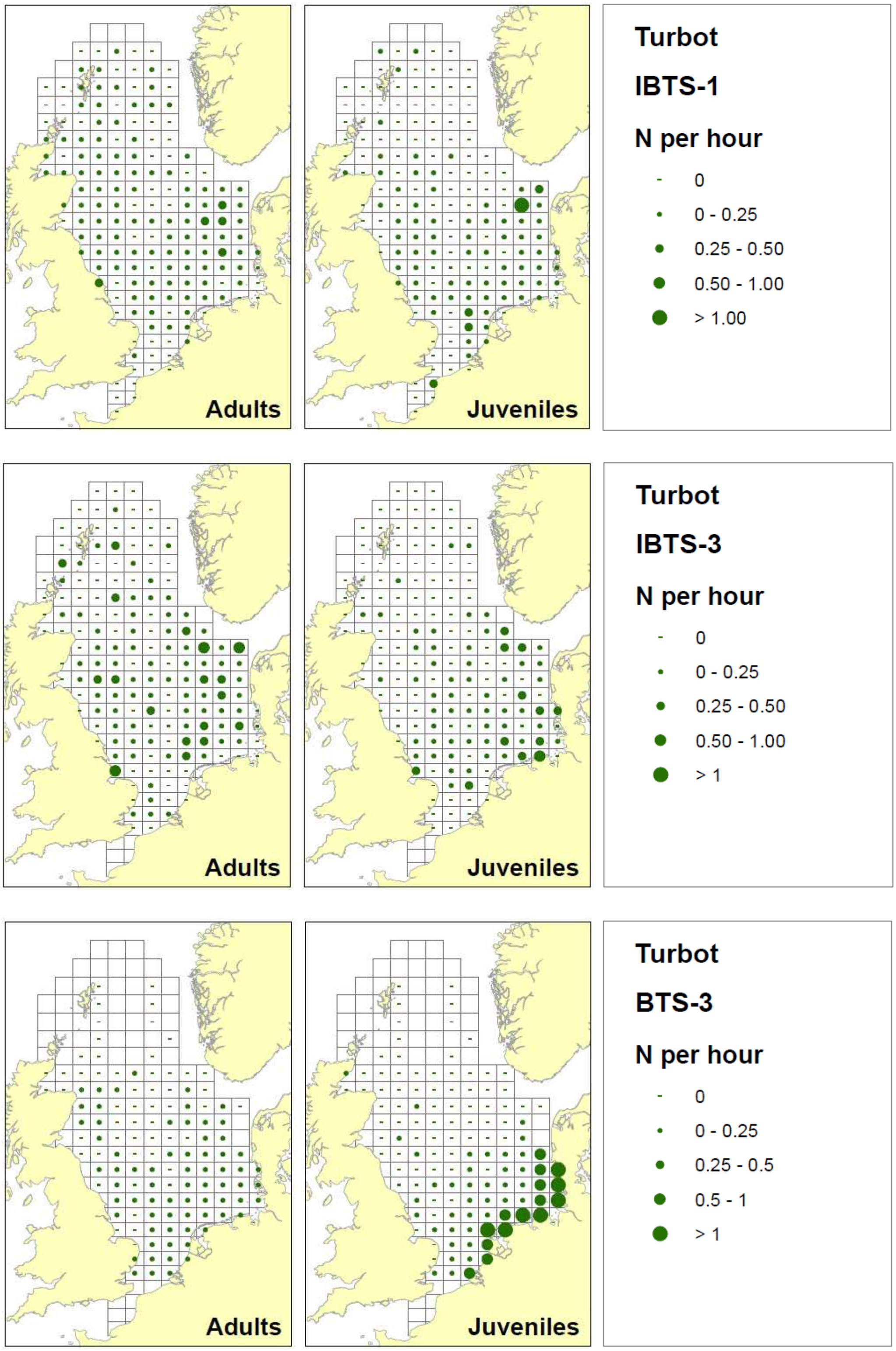
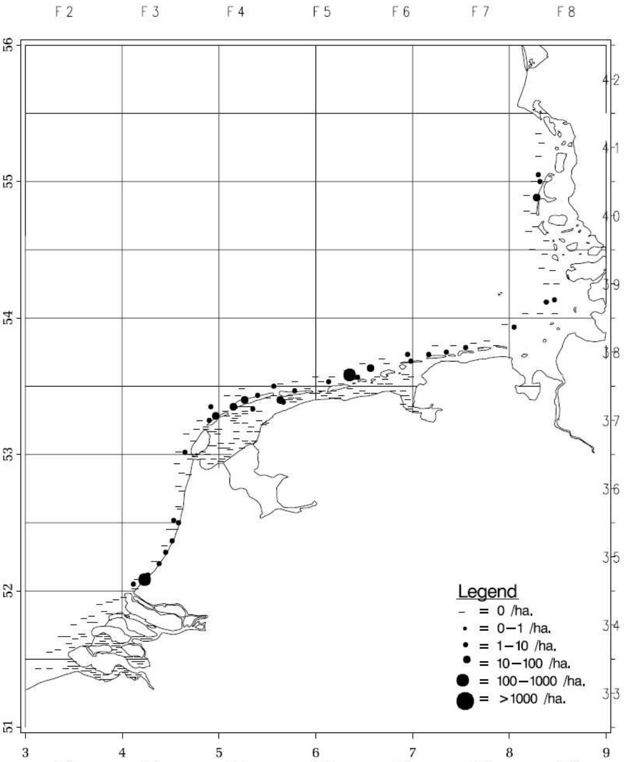


Figure 2.1.21 – Distribution of turbot in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).



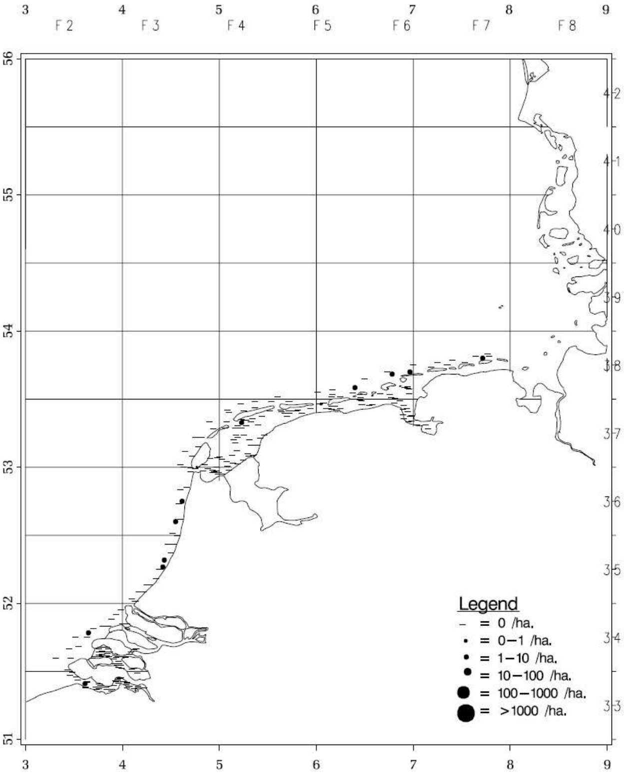


Figure 2.1.22 – Two examples of the distribution of turbot in the DFS survey. Upper panel 1984, lower panel 2002.

2.1.7 Brill in IV

<u>Time series of abundance</u> (Figure 2.1.23 and 2.1.24)

IBTS-1: The abundance of brill is rather low, but is increasing since the beginning of the time series. A peak is visible in the early 1990s.
IBTS-3: The pattern broadly mirrors the pattern seen in IBTS-1.
BTS-3: The time series for the combined BTS data is misleading. Due to the specific distribution and the coverage by two vessels the time series for these vessels should be considered separately (Figure 2.1.24). The catches by RV Tridens in the central and western North Sea are very insignificant. The time series for RV Isis, covering the southeastern North Sea, shows an abundance that increases between 1985 and 1992, decreases for some years and more or less stabilises the last 13 years.
DFS-3: In shallow waters the pattern in the time series seems rather similar in the three areas. The good and poor years can be seen in all three series. No trend can be distinguished.

Conclusion: as time series probably the IBTS-1 and the BTS-3 (RV Isis only) provide the best information.

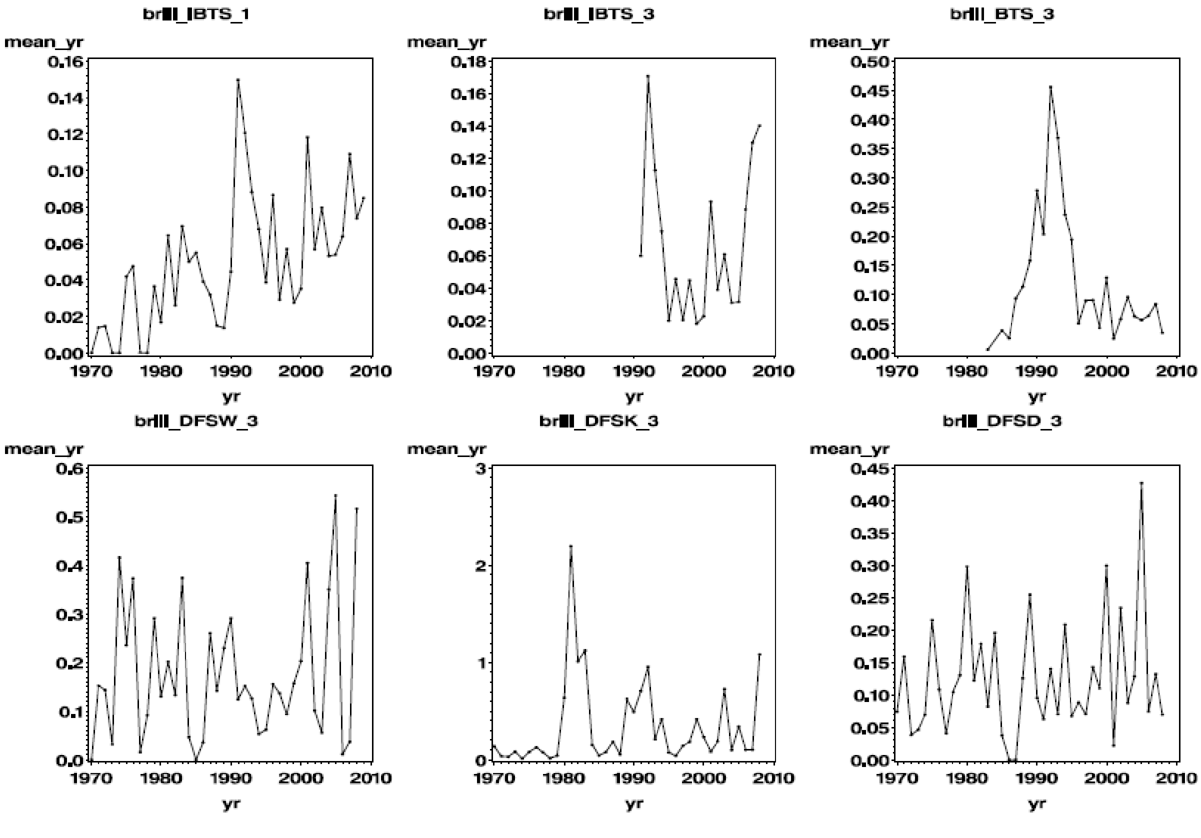


Figure 2.1.23 – Time series of abundance of brill by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

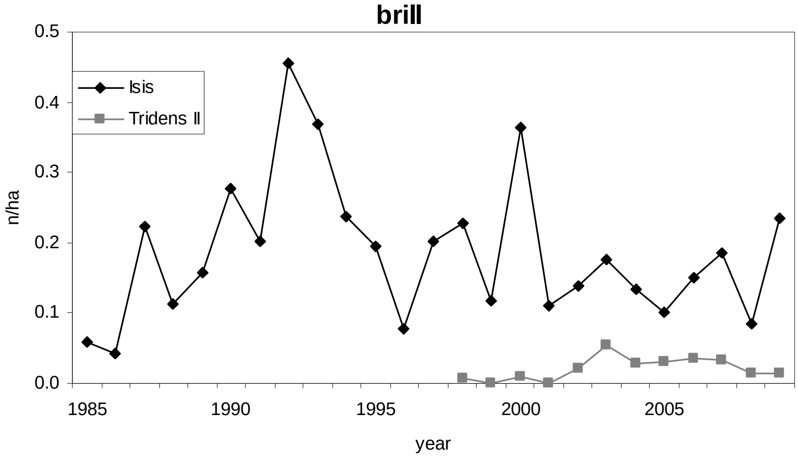


Figure 2.1.24 – Time series of abundance of brill in the BTS3 survey by vessel.

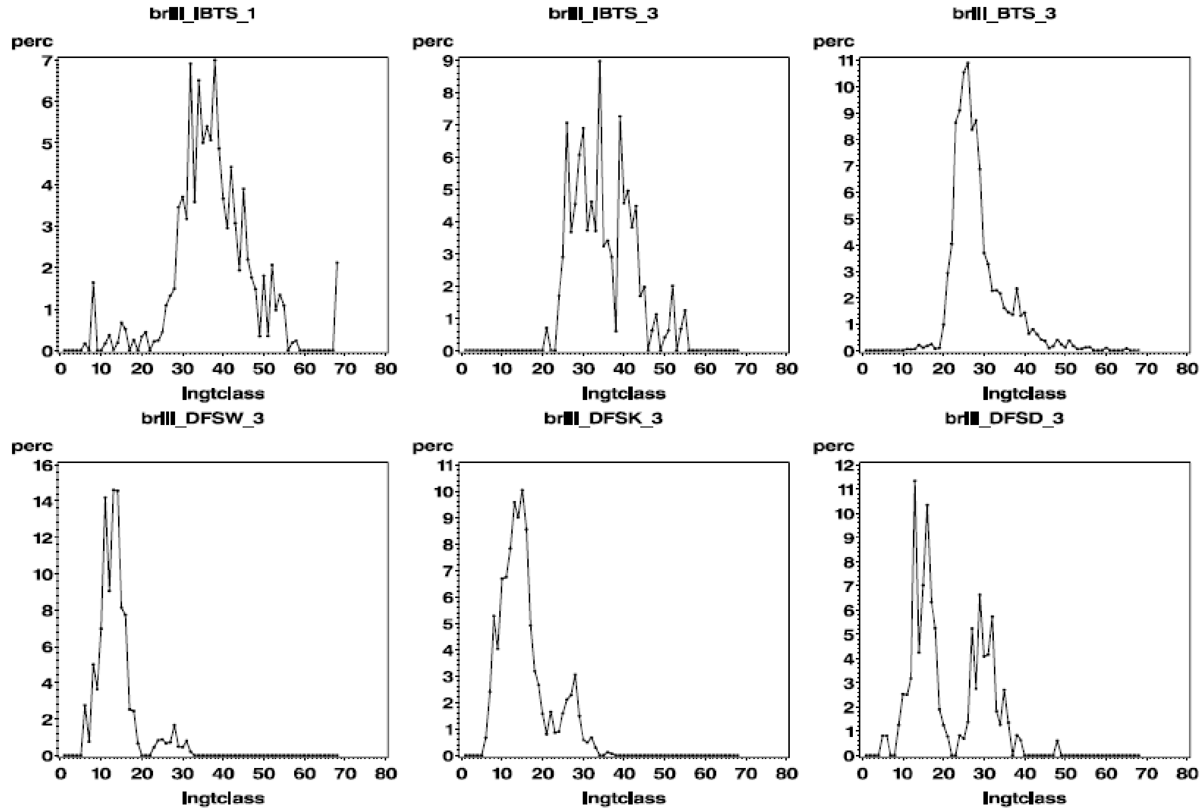


Figure 2.1.25 – Length frequency distribution of brill by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

Length composition (Figure 2.1.25)

IBTS-1: The main catches are for brill in the size range from 20 to 60 cm. Some smaller fish are caught in the range 10 to 20 cm. The peak is at approximately 30-40 cm.
IBTS-3: This length composition is similar to IBTS-1 but fish smaller than 20 cm are missing.
BTS-3: Catches mainly consist of fish in the size range from 20-30 cm.
DFS-3: In the three shallow areas to size-groups can be distinguished: from about 8 to 20 cm and from 20 to 35 cm, probably representing 1- and 2-group fish.

Distribution (Figures 2.1.26 and 2.1.27)

IBTS-1: Brill are found in small numbers only, and have a southerly distibution, although single specimens are found in the northernmost stations of the survey. No difference is apparent between adult and juvenile distribution.
IBTS-3: In the third quarter IBTS slightly higher abunances are observed in coastal waters.
BTS-3: In the beam trawl survey the distribution pattern is more outspoken. Adults are found in the southeastern half of the North Sea. Broadly the juveniles have the same distribution but here higher numbers are clearly found in the shallow parts of the German Bight. It is not clear what exactly causes the different patterns of juvenile distribution between the IBTS3 and BTS3 surveys.
DFS-3: O-group brill are known to occur in extremely shallow water, even in the surf-zone. Also in the DFS young brill are widely distributed over the stations in the Wadden Sea, the SW Delta and the coastal area. The areas with the highest abundance change slightly from year to year.

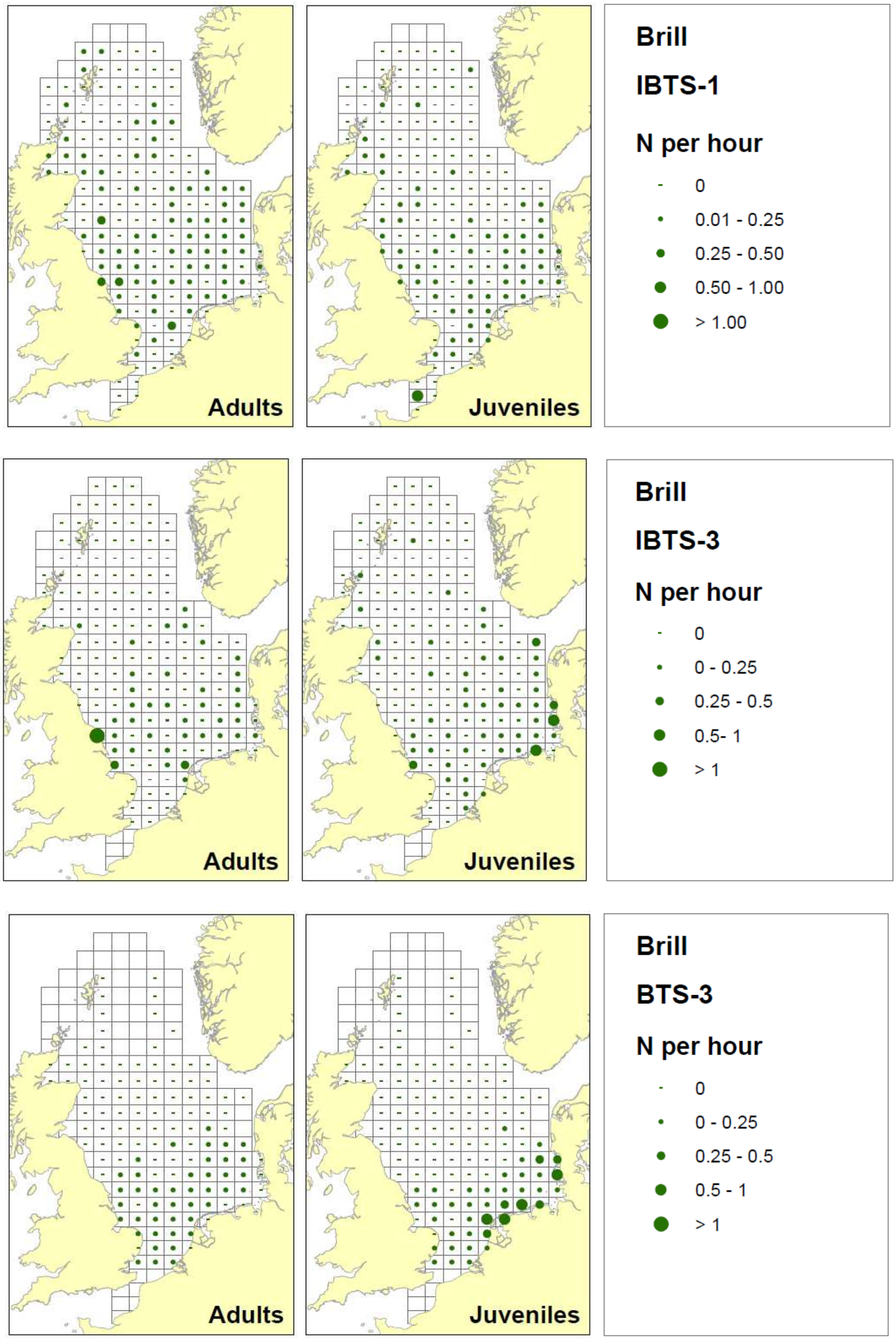


Figure 2.1.26 – Distribution of brill in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

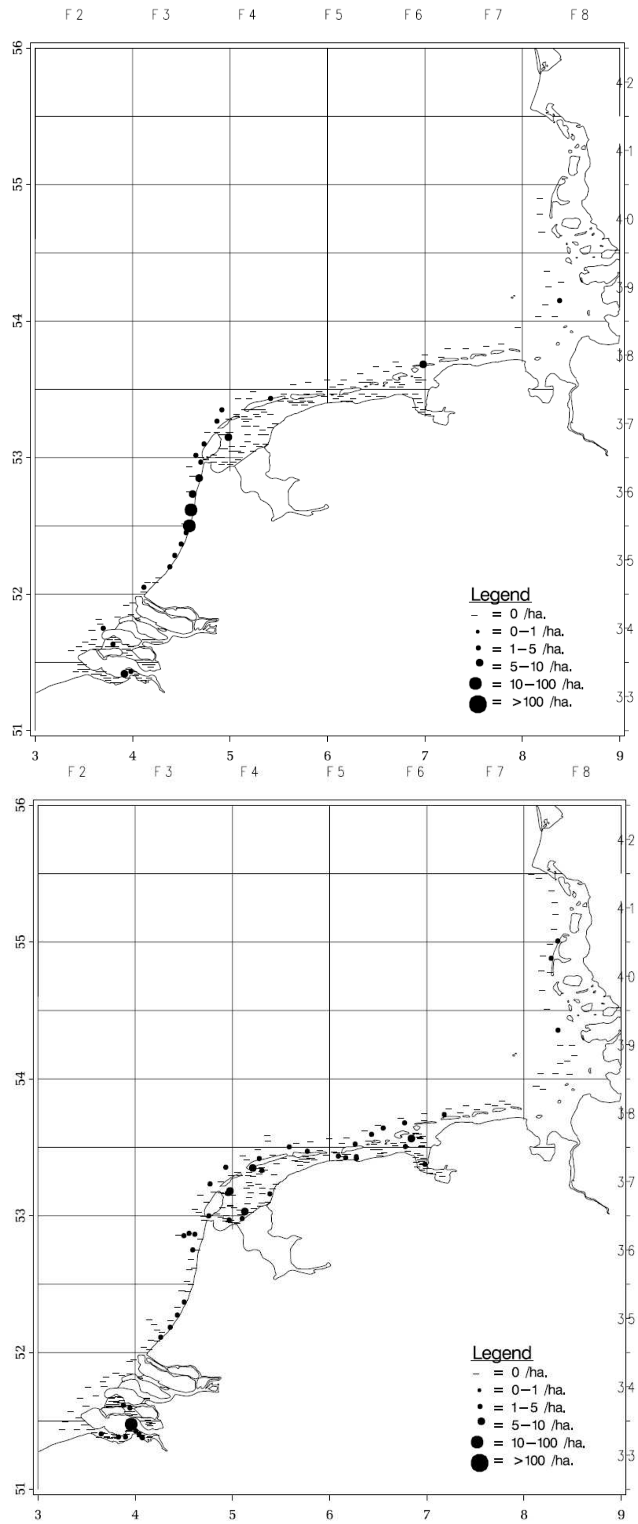


Figure 2.1.27 – Two examples of the distribution of brill in the DFS survey. Upper panel 1981, lower panel 2005.

2.2 CEFAS[2]

2.2.1 Lemon sole in the Irish Sea, Bristol Channel, VIIe, VIId and North Sea

The abundance of lemon sole and dab was investigated for four Cefas surveys that are commonly used to provide tuning indices for other commercial species. These surveys are: the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E); eastern Channel Beam Trawl survey (BTS7d), the western Channel (VIIe) (Carhelmar) Beam Trawl survey, and the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl survey (NWGFS). Together these surveys cover much of the area around the UK coast.

A full description of each survey series will not be given here, but briefly, the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E) has taken place in August since 1992, on the RV Cirolana (1992-2002) and the RV Cefas Endeavour (2003-2009). The survey uses a GOV trawl and fishing takes place in ICES Divisions IVa, b & c. The survey is part of the ICES coordinated International Bottom Trawl Survey in the North Sea. The eastern Channel Beam Trawl survey (BTS7d) has taken place annually in July since 1990, on the RV Corystes (1990-2007) and the RV Cefas Endeavour (2008-2009). The survey is primarily a sole and plaice survey, using a 4m beam trawl and fishing in ICES Divisions VIId and IVc. The western Channel (VIIe) (Carhelmar) Beam Trawl Survey has taken place annually in October since 1989. This survey takes place on a commercial beam trawler (the Carhelmar), using two 4 m beam trawls, primarily for sole and plaice. However, in 2002, 2003 and 2004, the survey was undertaken on the RV Corystes, using a single 4 m beam only. The Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl Survey (NWGFS) has taken place annually in September since 1989, on the RV Corystes (1989-2008) and the RV Cefas Endeavour (2009). The survey is primarily a juvenile sole and plaice survey, using a 4m beam trawl and fishing in ICES Divisions VIIa, f and g.

For each survey series, data were extracted on the number of dab and lemon sole caught per length group by prime station, along with information on the prime station position and the distance covered during the tow. First, for each survey year, the total number of fish caught in all valid tows was calculated and the number of valid tows fished and the distance covered by the valid tows was determined. For the three beam trawl surveys an index of abundance was calculated as the number of fish caught per metre beam (number of valid stations * beam length) per nautical mile (total distance covered). For the North Sea (IBTS3E) survey, the index of abundance was calculated as the number of fish caught per nautical mile. Next, the abundance at length was calculated for each survey and the mean length of fish in each survey was calculated. Finally, the abundance at each station was calculated and plotted using the ArcGIS programme.

Annual indices of lemon sole abundance for each survey series are given in Table 2.2.1 and Figure 2.2.1. For lemon sole in the eastern Channel, abundance has been variable with a large peak observed in 1995 and smaller peaks in 2002, 2004 and 2008. In the Carhelmar survey lemon sole abundance was initially relatively high but decreased in the early 1990's until the early 2000's. This was followed by an increase to 2004, but abundance then decreased again. However, abundance increased again in 2008 and 2009. In the Irish Sea/Bristol Channel, lemon sole abundance steadily increased from the beginning of the time series to 2003, since when it has declined. In the North Sea, lemon sole abundance has generally increased through the time series.

Mean length of lemon sole in each survey year and a mean length for each survey series is given in Table 2.2.2. For lemon sole, mean length was relatively consistent through each survey series. However, the series average mean length of lemon sole caught in the Carhelmar survey (~31 cm TL), was notably higher than that of the other three surveys (~20 cm, 22 cm and 23 cm).

Abundance at length is given for lemon sole by survey year in Figures 2.2.2 - 2.2.5, and abundance by station and survey is given in Figures 2.2.6 - 2.2.9.

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2 Author: Sarah Walmsley

2.2.2 Dab in the Irish Sea, Bristol Channel, VIIe, VIId and North Sea

Annual indices of dab abundance for each survey series are given in Table 2.2..1 and Figure 2.2.10. Dab abundance in the eastern Channel (BTS7D) appears to be relatively stable through the time series, though a peak in abundance was seen in 1994, after which it declined to 1998. In 2007, abundance was the second lowest of the survey series, but increased in 2008 and 2009. In the Carhelmar survey, abundance was relatively stable at the beginning of the survey series, but a large increase in abundance can be seen between 2000 and 2002, followed by a large decline in the following years, down to historical levels. In the Irish Sea/Bristol Channel survey (NWGFS), there has been an overall increase in dab abundance through the time series. In the North Sea (IBTS3E), abundance was relatively stable at the beginning of the time series, followed by a decline to the lowest observed level in 1990. In 1991, abundance was at the series high. Since that time, abundance has been relatively stable until 2009 when it declined again. In all surveys, dab abundance is significantly higher than that of lemon sole.

Mean length of dab in each survey year and a mean length for each survey series is given in Table 2.2.2. Mean length has remained relatively consistent throughout the survey series. Overall, mean lengths for dab in the North Sea and Carhelmar surveys were similar, and higher than the eastern Channel and Irish Sea/Bristol Channel surveys.

Abundance at length is given for dab by survey in Figures 2.2.11 - 2.2.14, and abundance by station and survey is given in Figures 2.2.15 - 2.2.18.

Table 2.2.1 - Indices of dab and lemon sole abundance in 4 Cefas surveys: the eastern Channel Beam Trawl survey (BTS7d), the western Channel (VIIe) (Carhelmar) Beam Trawl survey, the Irish Sea/Bristol Channel (VIIa, f, g) Beam trawl survey (NWGFS) and the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E). Abundance for the three beam trawl survey is given as number of fish per m beam per nm and abundance for the groundfish survey is given as number of fish per nm.

	Dab				Lemon sole			
Year	BTS7d	Carhelmar	NWGFS	IBTS3E	BTS7d	Carhelmar	NWGFS	IBTS3E
1988							0.0015	
1989		0.0175				0.0009	0.0019	
1990	0.0227	0.0089			0.0033	0.0011	0.0011	
1991	0.0317	0.0098	0.0815		0.0020	0.0014	0.0016	
1992	0.0367	0.0045	0.0767	128.43	0.0011	0.0003	0.0013	4.71
1993	0.0134	0.0053	0.0637	110.51	0.0039	0.0004	0.0025	4.18
1994	0.0436	0.0151	0.0968	124.71	0.0062	0.0004	0.0028	4.72
1995	0.0178	0.0113	0.0874	142.27	0.0074	0.0007	0.0031	8.72
1996	0.0215	0.0098	0.0731	164.91	0.0042	0.0006	0.0027	9.63
1997	0.0214	0.0099	0.1112	244.44	0.0031	0.0005	0.0027	6.94
1998	0.0102	0.0081	0.1232	138.14	0.0019	0.0006	0.0026	6.22
1999	0.0170	0.0100	0.1744	216.30	0.0027	0.0003	0.0022	8.23
2000	0.0143	0.0055	0.1773	86.17	0.0022	0.0004	0.0027	8.40
2001	0.0241	0.0232	0.1522	338.39	0.0033	0.0007	0.0029	9.63
2002	0.0217	0.0374	0.1019	253.84	0.0047	0.0012	0.0039	8.50
2003	0.0333	0.0254	0.1823	328.41	0.0050	0.0006	0.0052	10.92
2004	0.0207	0.0115	0.1764	265.49	0.0026	0.0021	0.0043	9.72
2005	0.0219	0.0089	0.1374	338.78	0.0061	0.0005	0.0027	12.06
2006	0.0315	0.0165	0.1329	286.86	0.0022	0.0007	0.0031	9.43
2007	0.0123	0.0057	0.1111	332.73	0.0018	0.0004	0.0039	15.73
2008	0.0197	0.0064	0.1238	322.52	0.0045	0.0014	0.0024	9.18
2009	0.0331	0.0085	0.1324	215.72	0.0022	0.0014	0.0021	10.93

Table 2.2.2 - Mean length (mm) of dab and lemon sole in four Cefas survey series: the eastern Channel Beam Trawl Survey (BTS7d), the western Channel (VIIe) (Carhelmar) Beam Trawl Survey, the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl Survey (NWGFS) and the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E).

	Dab					Lemon sole			
	BTS7d	Carhelmar	NWGFS	IBTS3E		BTS7d	Carhelmar	NWGFS	IBTS3E
1989		191					318	229	
1990	161	210				267	302	201	
1991	164	201	146			283	324	226	
1992	168	202	157	172		265	336	234	260
1993	170	188	135	169		186	323	188	254
1994	101	144	130	170		201	293	194	245
1995	143	174	142	167		202	305	202	240
1996	153	158	142	162		204	316	217	242
1997	147	165	143	160		250	322	218	239
1998	181	181	139	164		236	318	216	231
1999	128	120	128	158		179	327	209	233
2000	144	171	134	165		218	325	190	232
2001	123	110	145	158		206	311	216	225
2002	142	138	145	167		207	276	206	226
2003	107	151	139	160		232	317	207	221
2004	153	128	140	166		210	276	205	226
2005	160	102	142	169		239	311	195	225
2006	108	139	147	158		212	303	189	222
2007	154	181	148	171		185	318	187	225
2008	155	198	150	176		231	280	182	221
2009	149	158	149	179		239	302	202	227
Series Mean	146	162	142	166		223	310	205	233

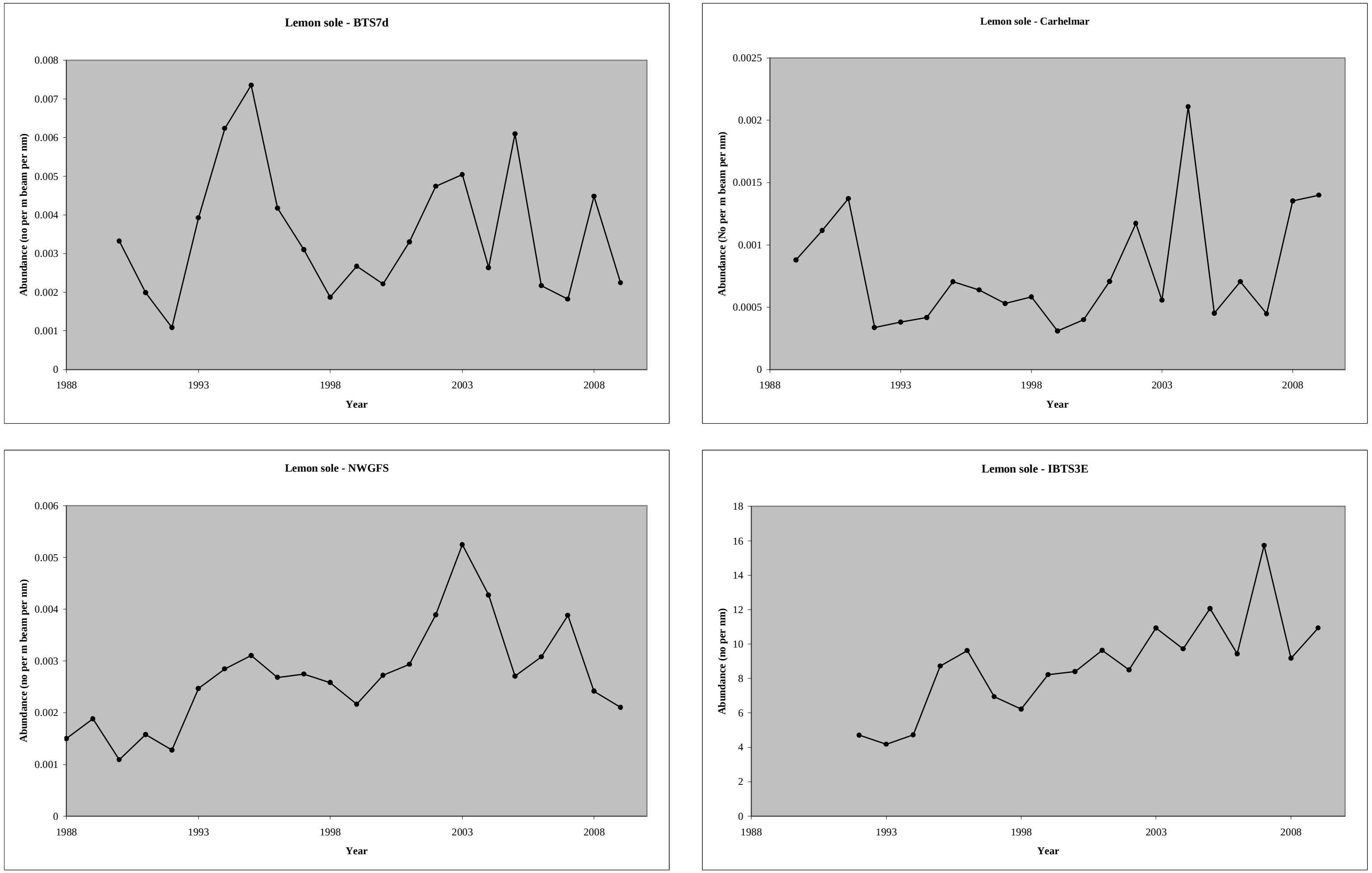


Figure 2.2.1 - Indices of abundance of lemon sole caught in 4 Cefas surveys: the eastern Channel Beam Trawl survey (BTS7d), the western Channel (VIIe) (Carhelmar) Beam Trawl survey, the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl survey (NWGFS) and the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E). Abundances are given as number of fish per m beam per nm for the beam trawl surveys and as number of fish per nm for the groundfish survey.

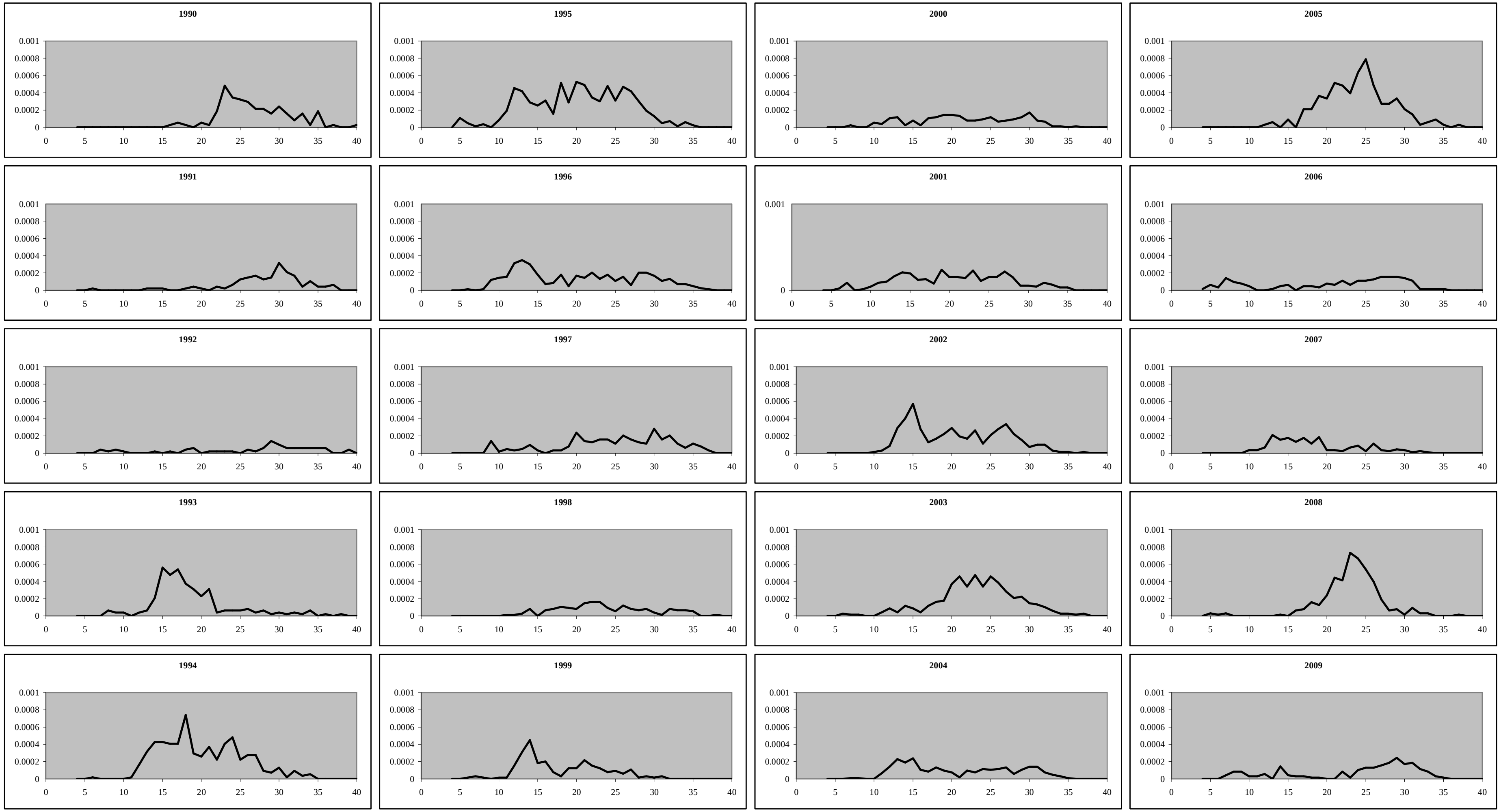


Figure 2.2.2 - Abundance (no per m beam per nm) by length (cm) of lemon sole caught annually in the eastern Channel beam trawl survey, between 1990 and 2009.

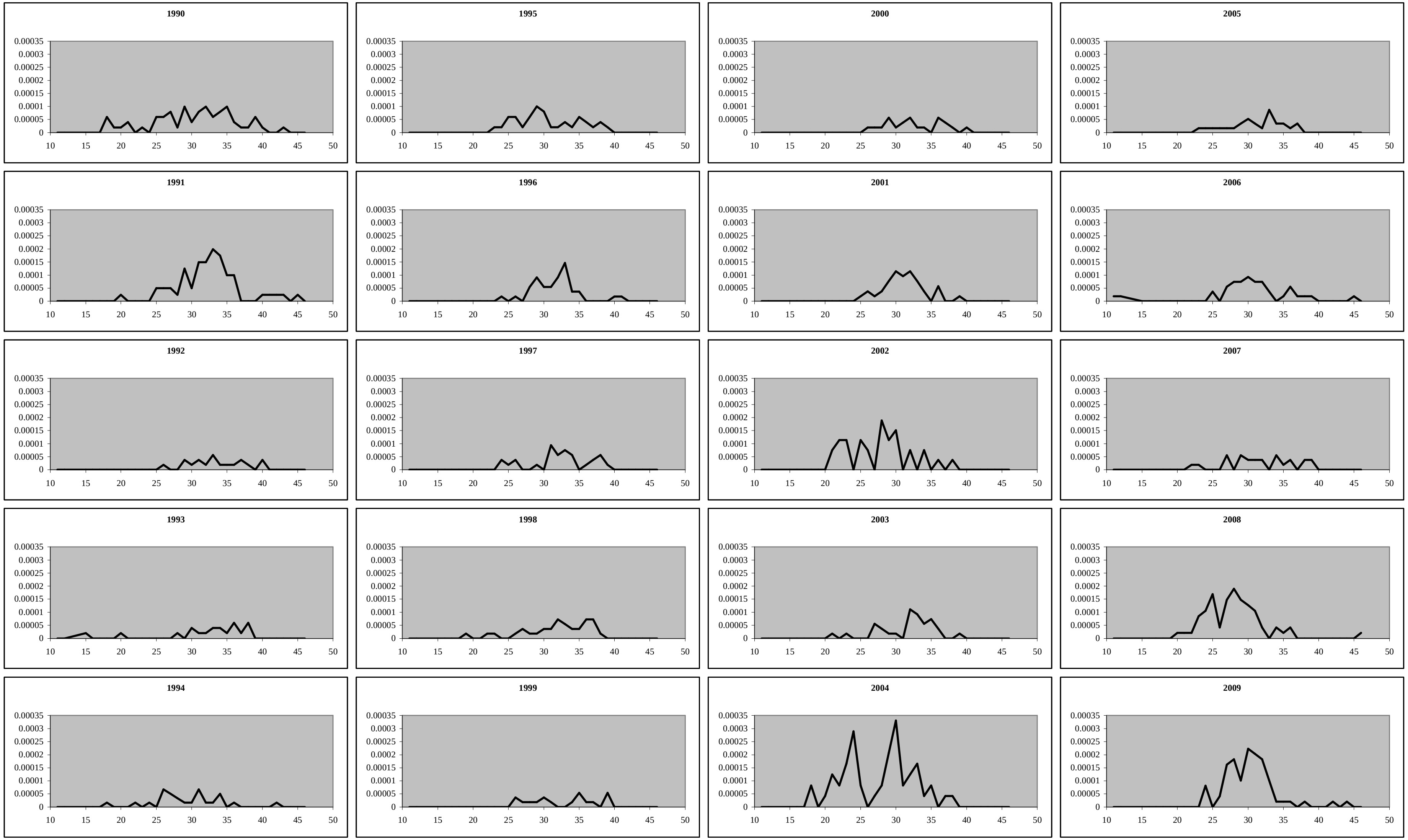


Figure 2.2.3 - Abundance (no per m beam per nm) by length (cm) of lemon sole caught annually in the Carhelmar survey, between 1990 and 2009.

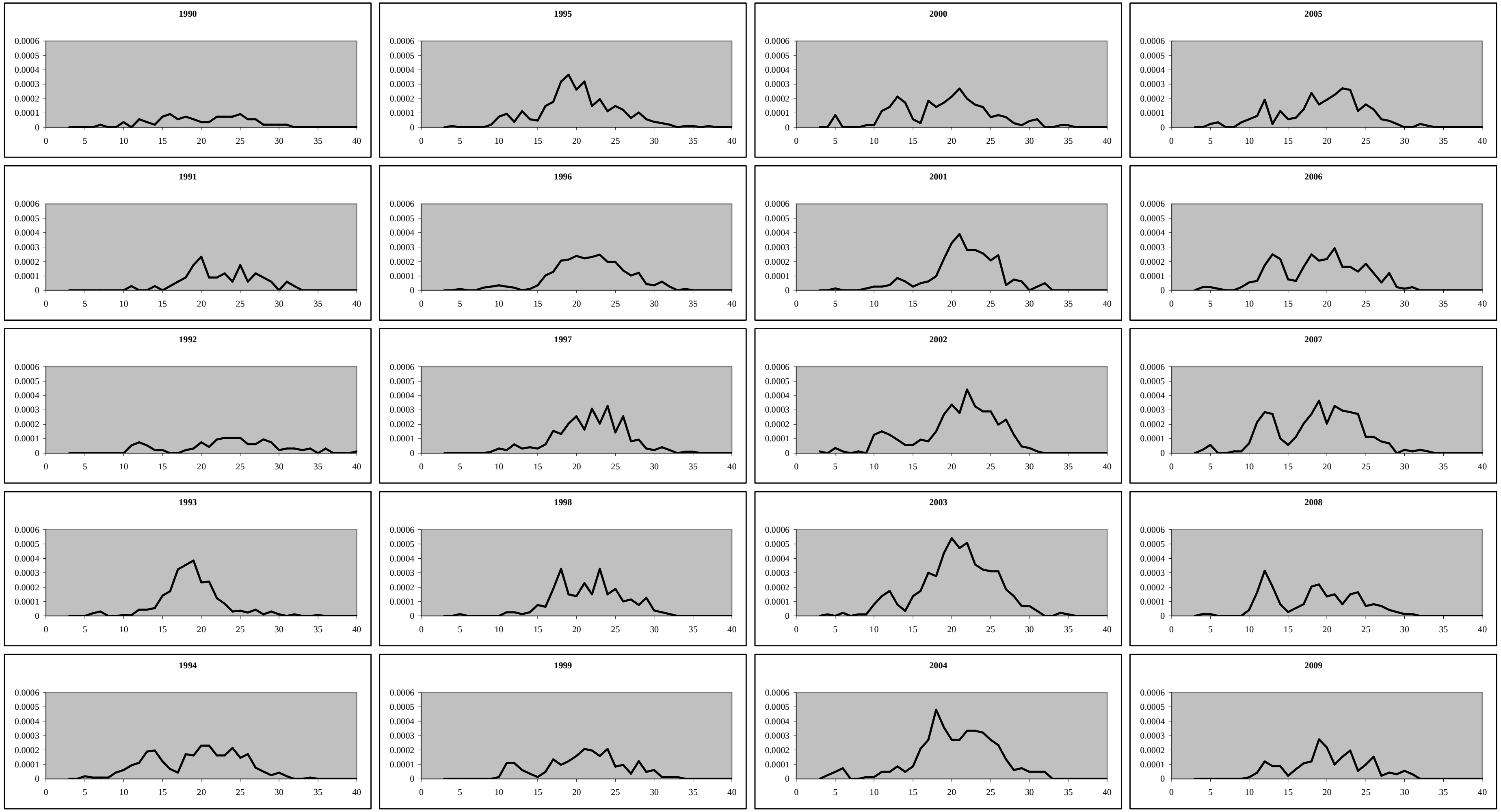


Figure 2.2.4 - Abundance (no per m beam per nm) by length (cm) of lemon sole caught annually in the Irish Sea/Bristol Channel beam trawl survey, between 1991 and 2009.

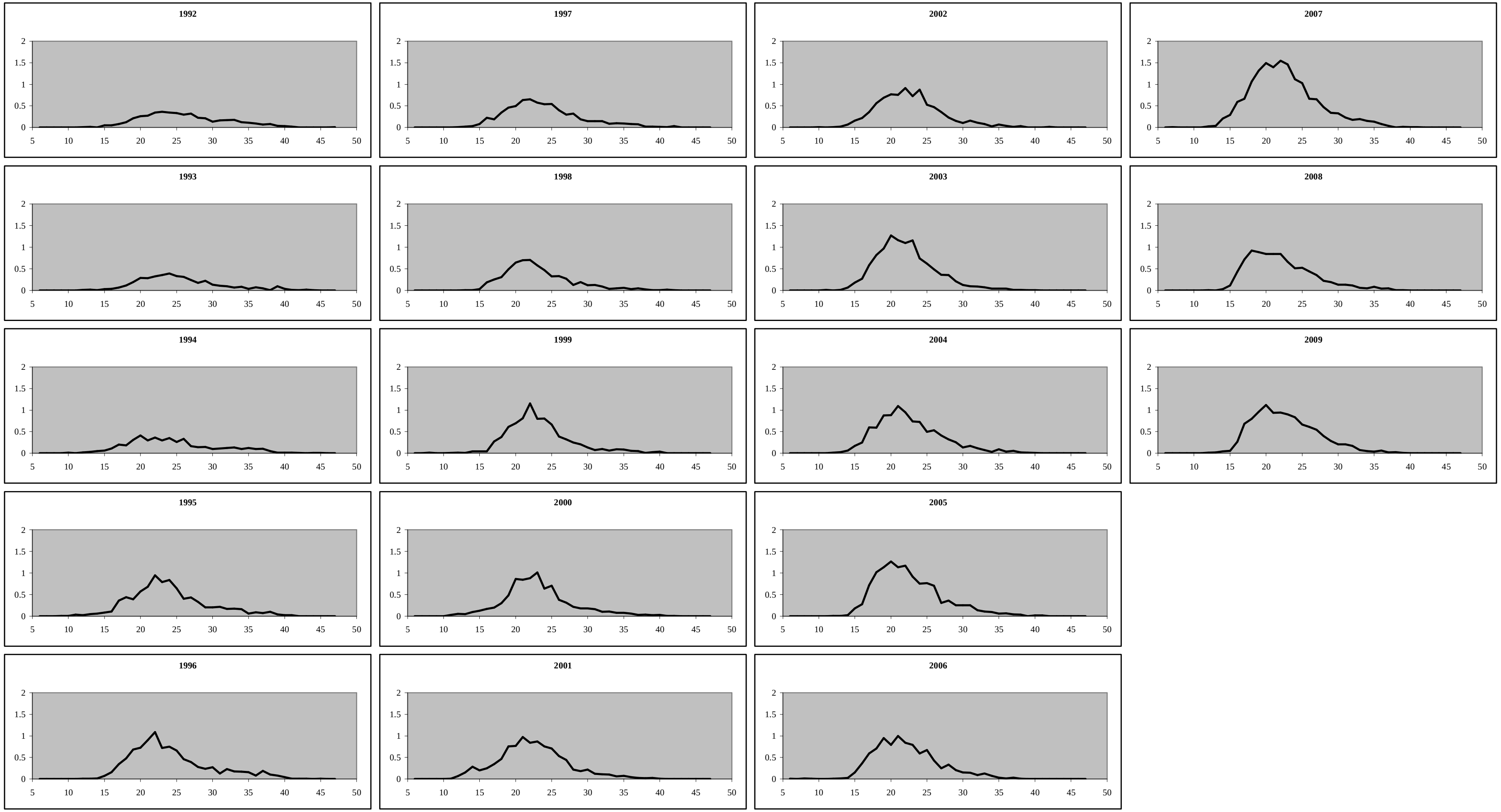


Figure 2.2.5 - Abundance (no per nm) by length (cm) of lemon sole caught annually in the North Sea survey, between 1992 and 2009.

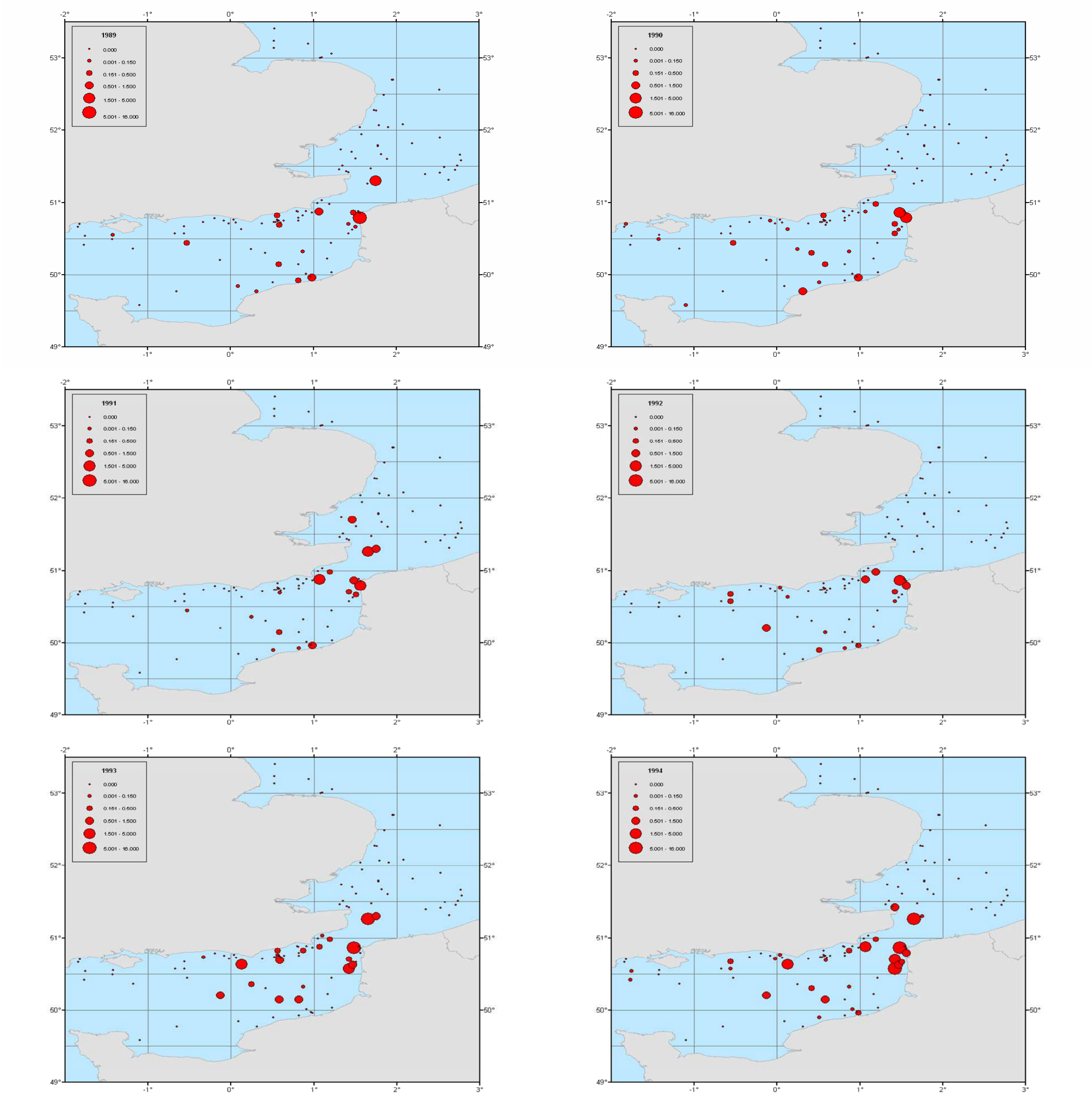


Figure 2.2.6 - Abundance (no per m beam per nm) of lemon sole caught annually in the eastern Channel beam trawl survey, by fishing station, between 1989 and 2009.

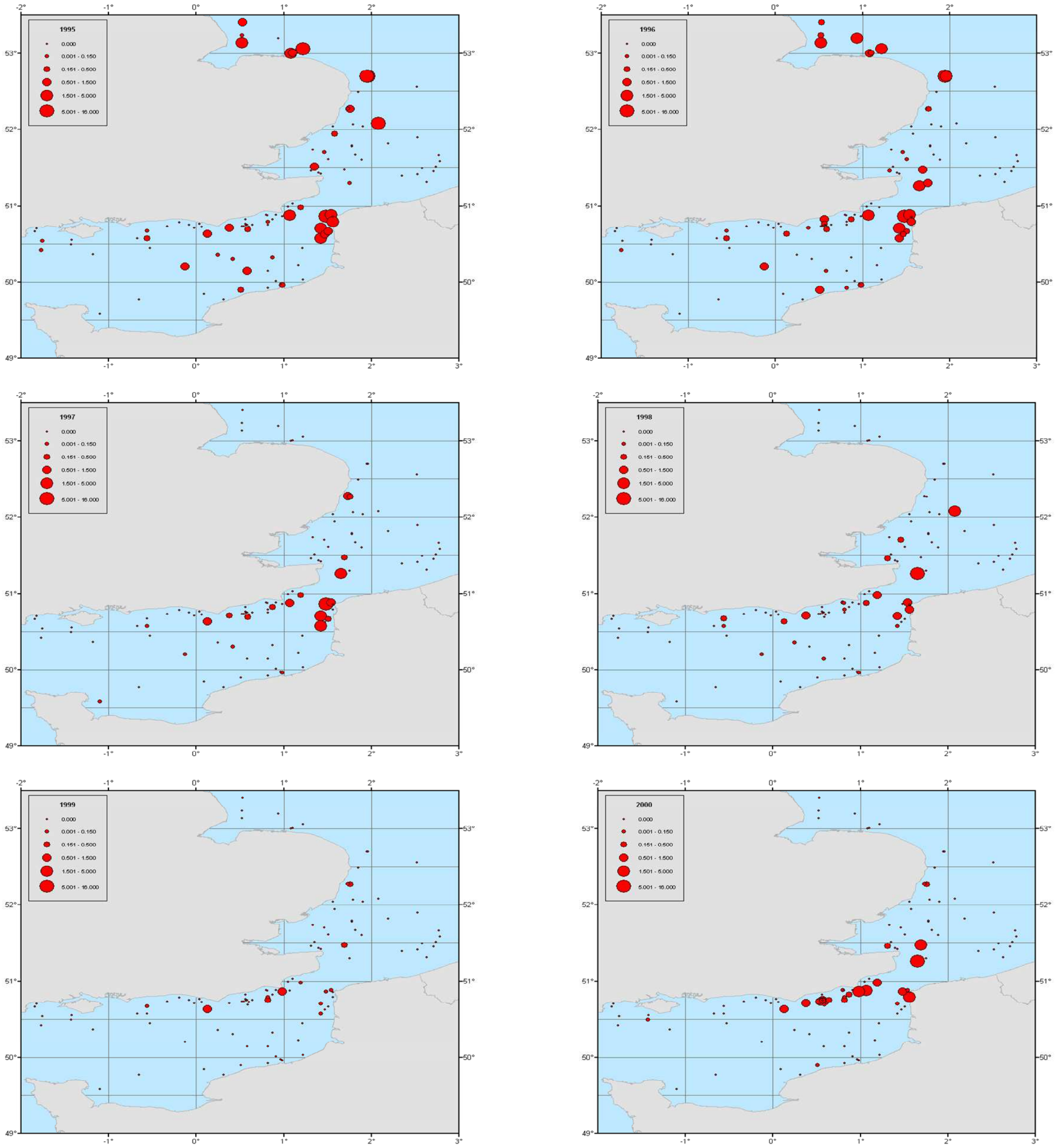
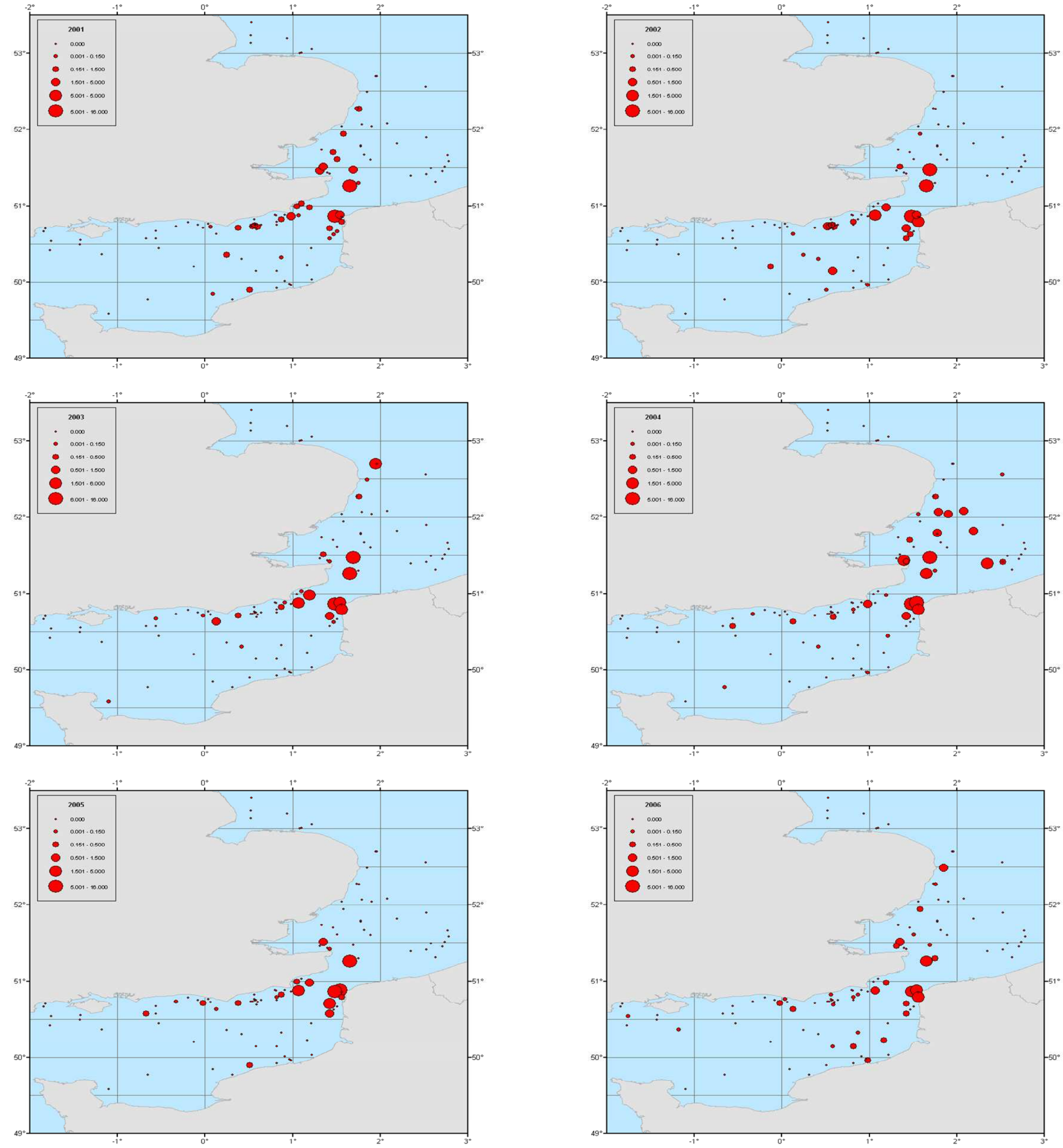


Figure 2.2.6 - Continued.



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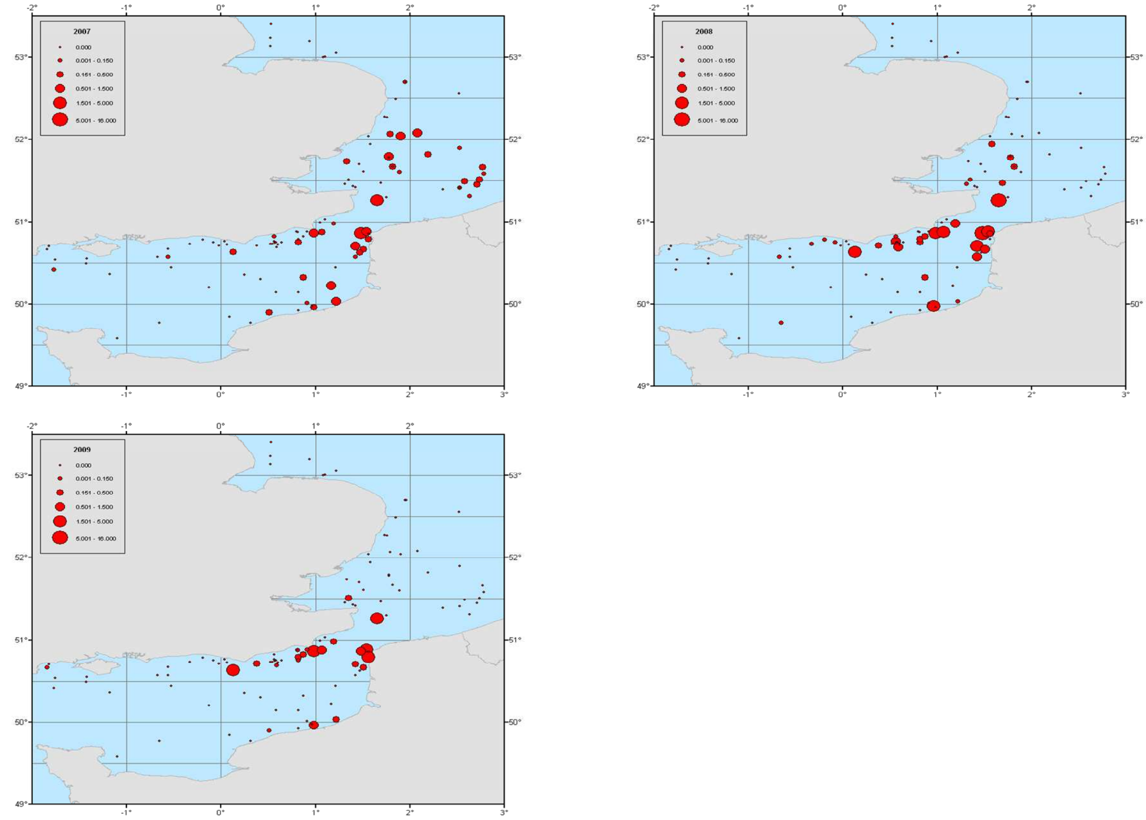


Figure 2.2.6 - Continued.

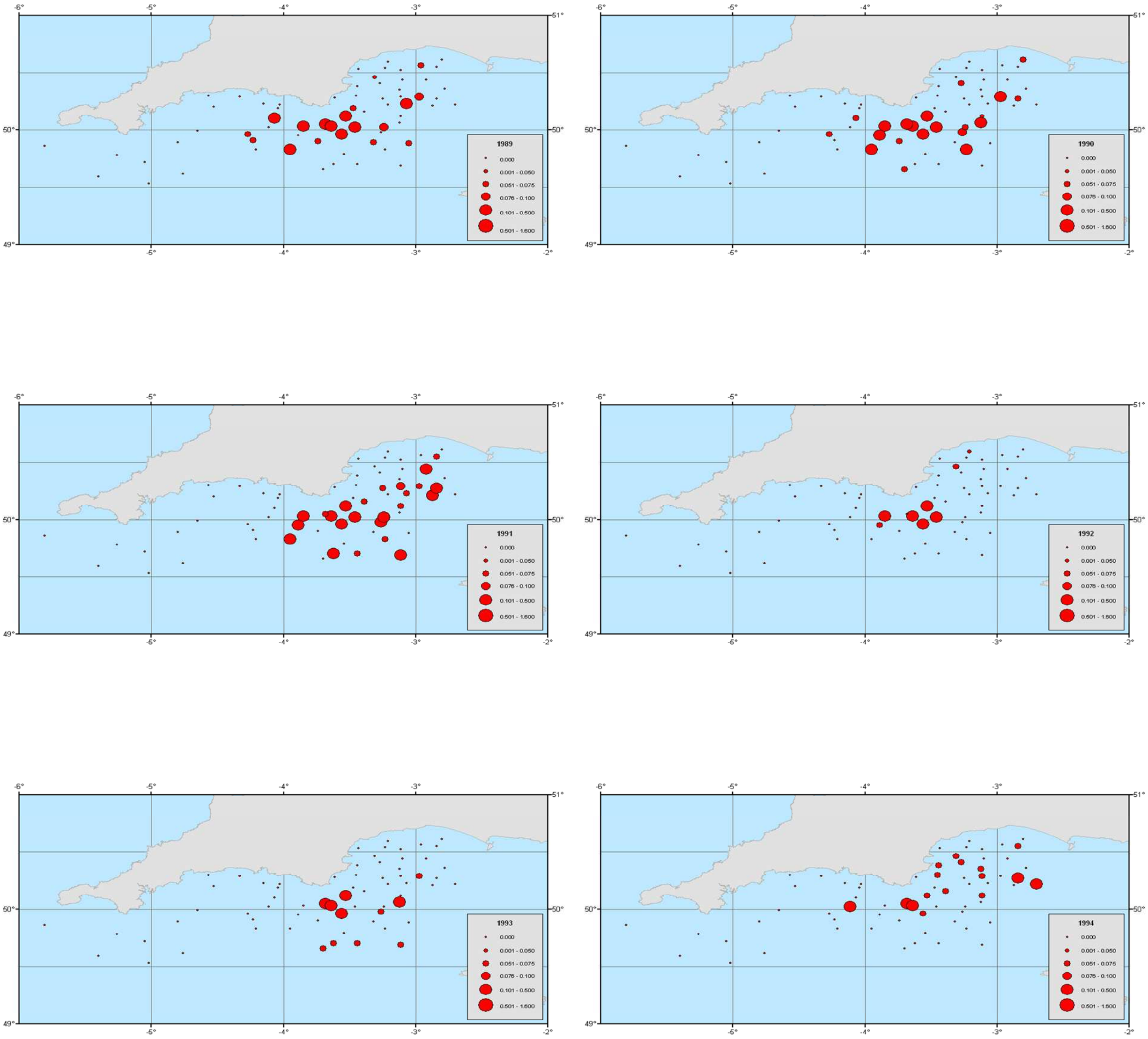


Figure 2.2.7 - Abundance (no per m beam per nm) of lemon sole caught annually in the Carhelmar survey, by fishing station, between 1989 and 2009.

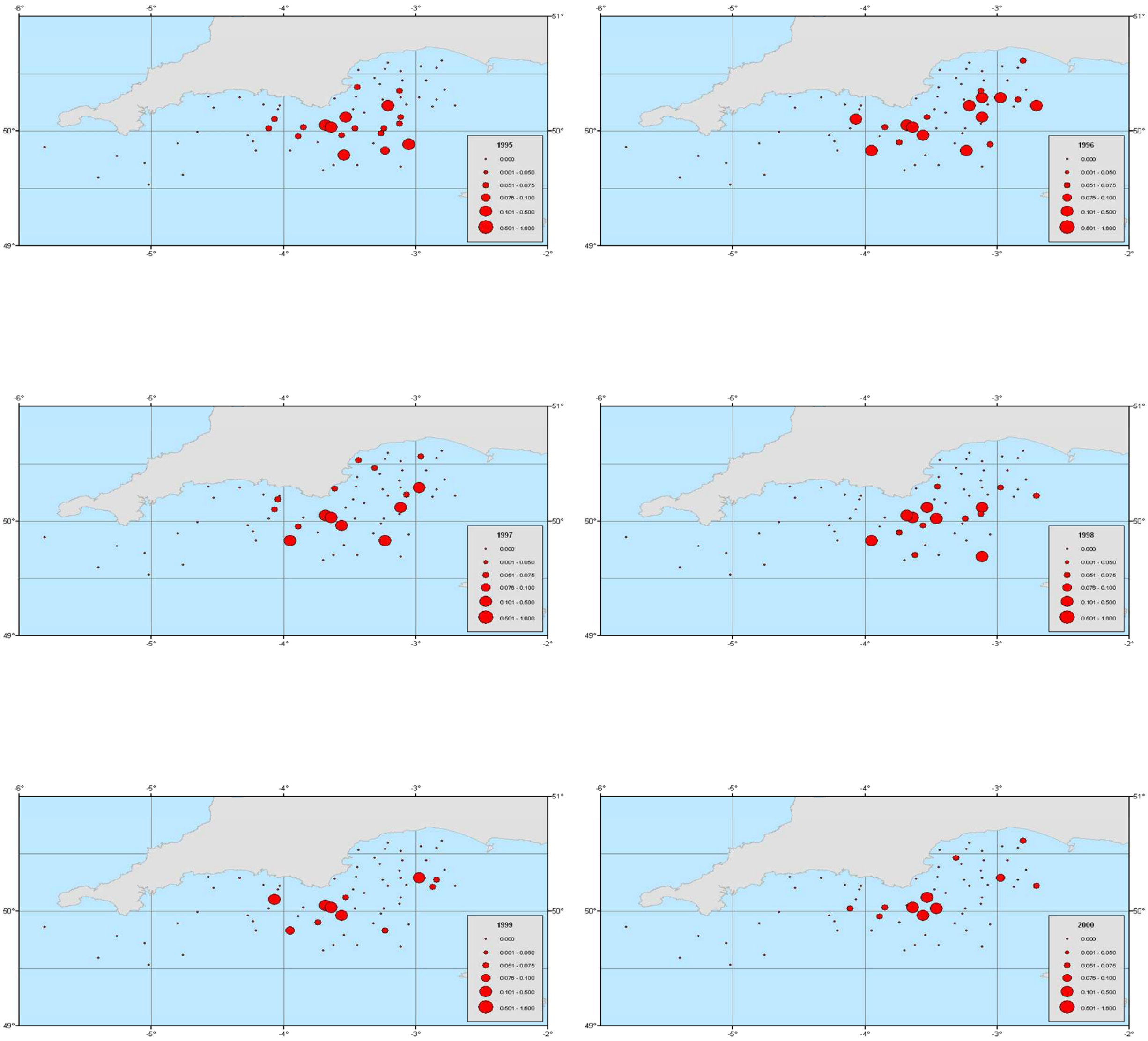
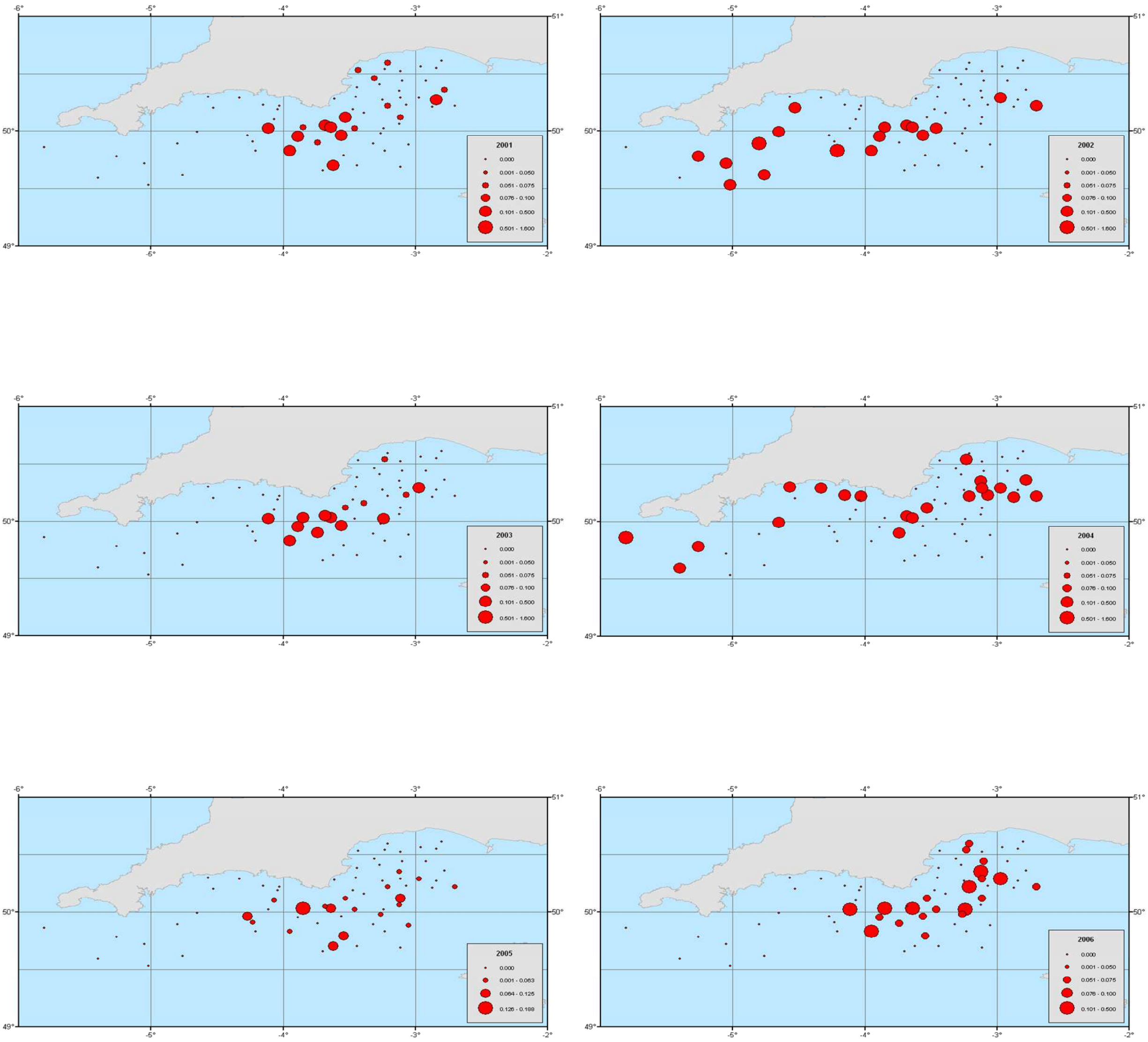


Figure 2.2.7 - Continued.



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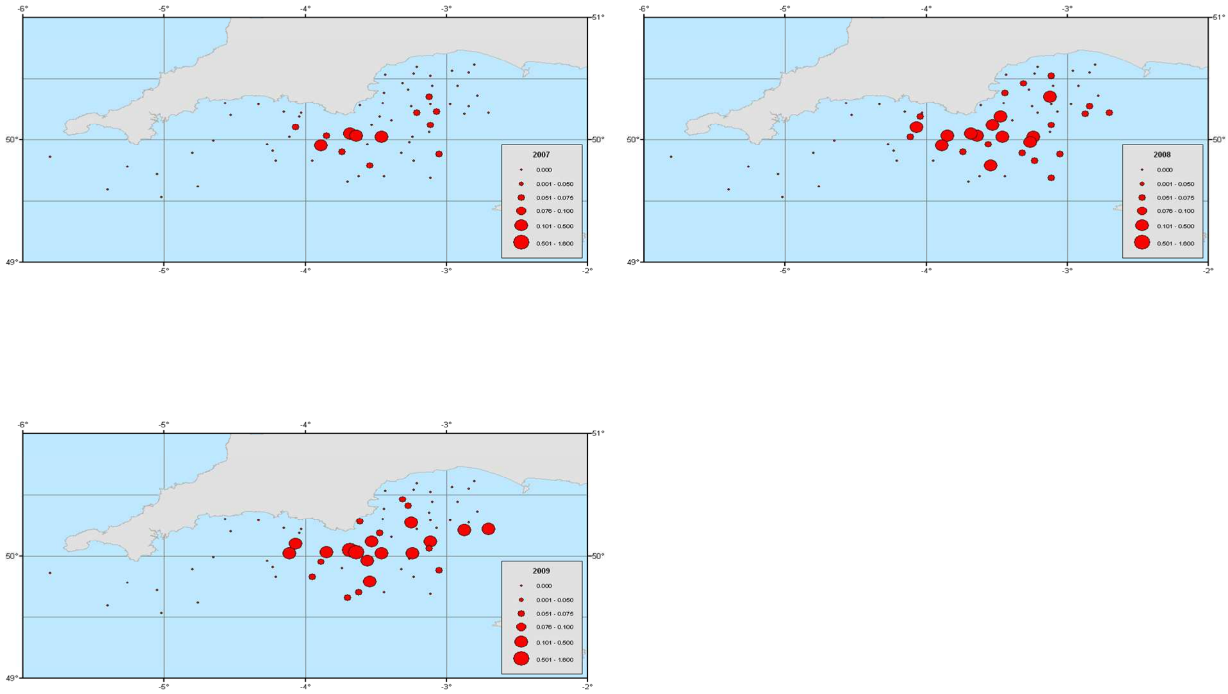


Figure 2.2.7 - Continued.

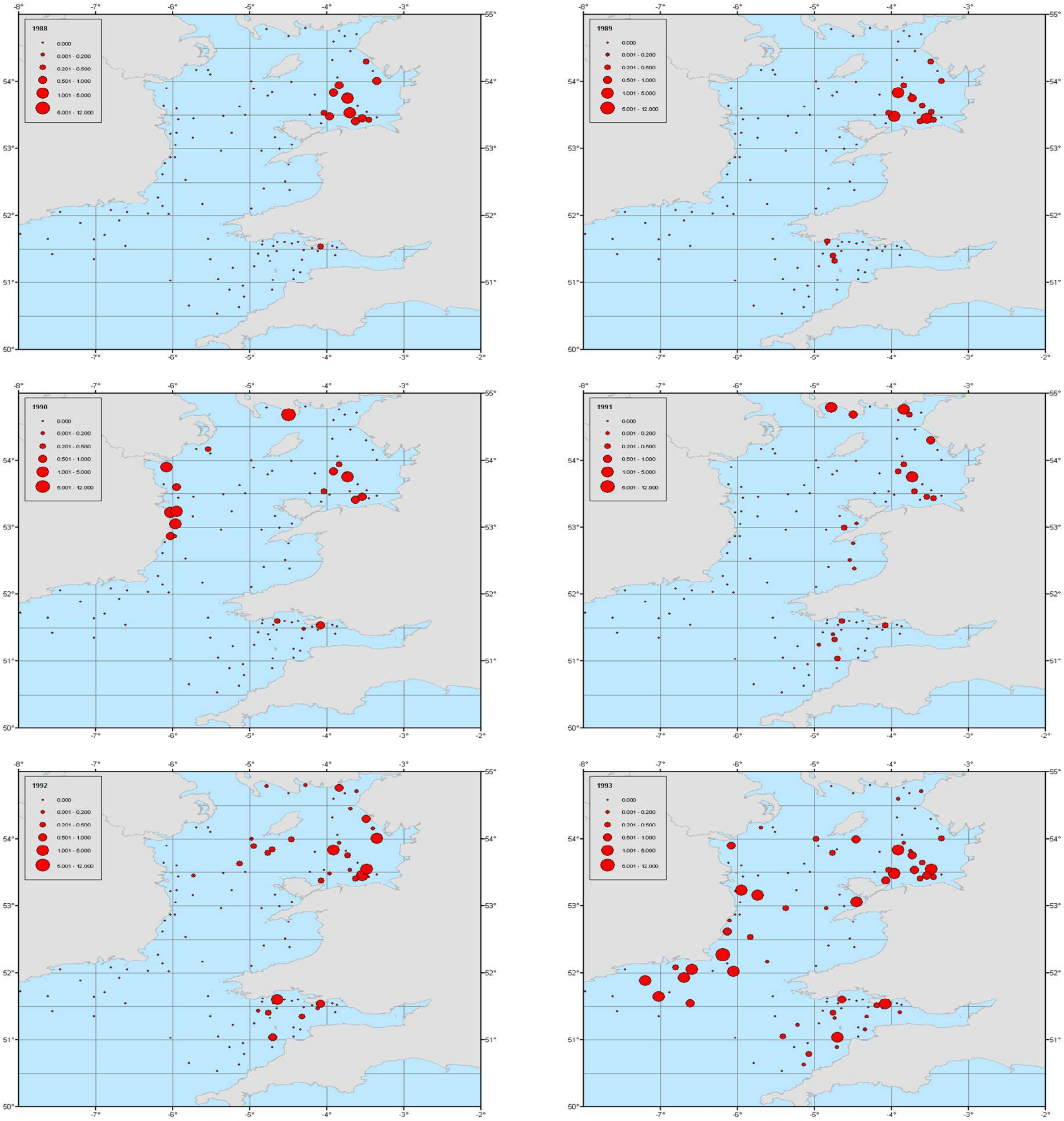


Figure 2.2.8. Abundance (no per m beam per nm) of lemon sole caught annually in the Irish Sea/Bristol Channel beam trawl survey, by fishing station, between 1988 and 2009.

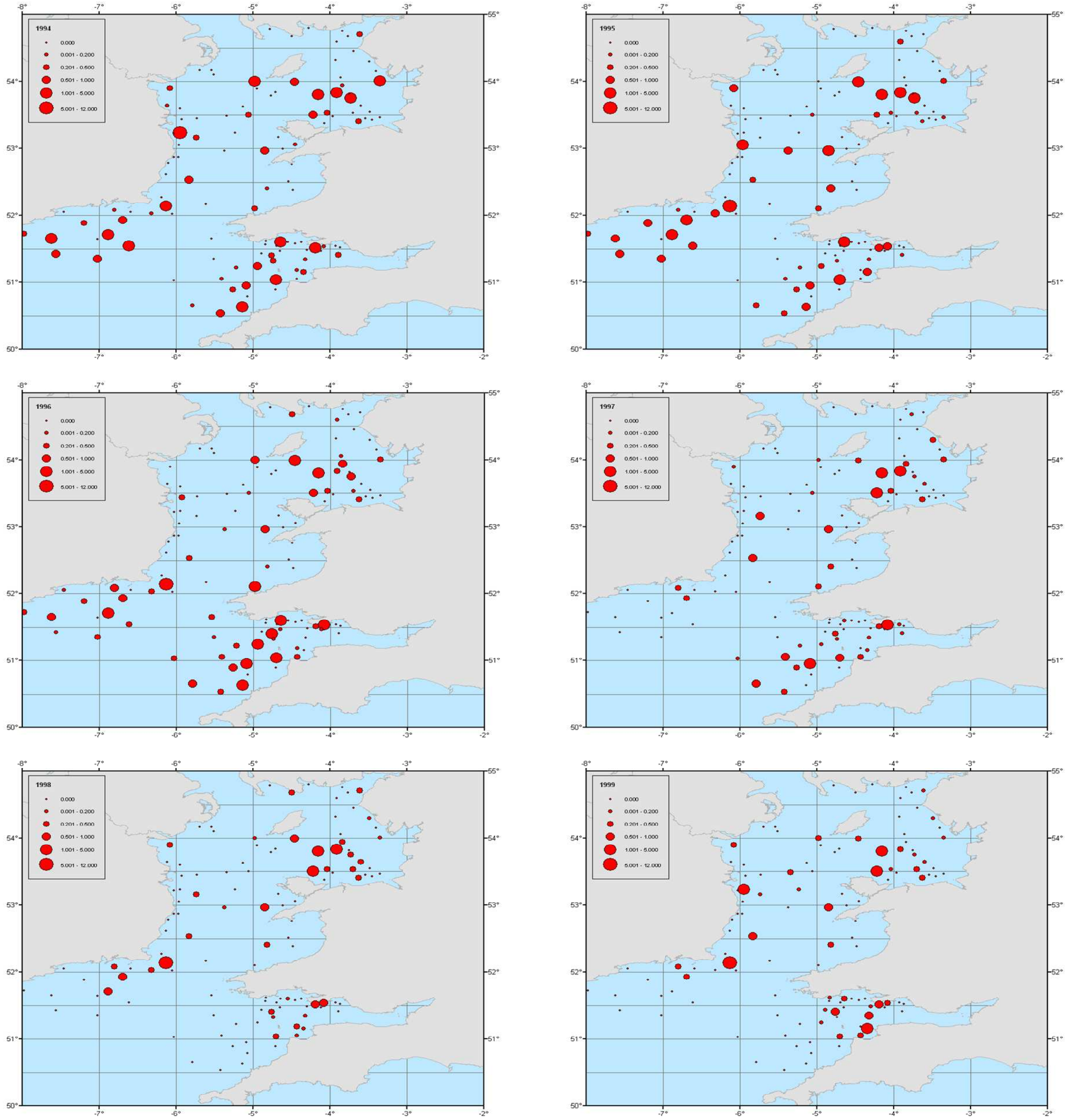
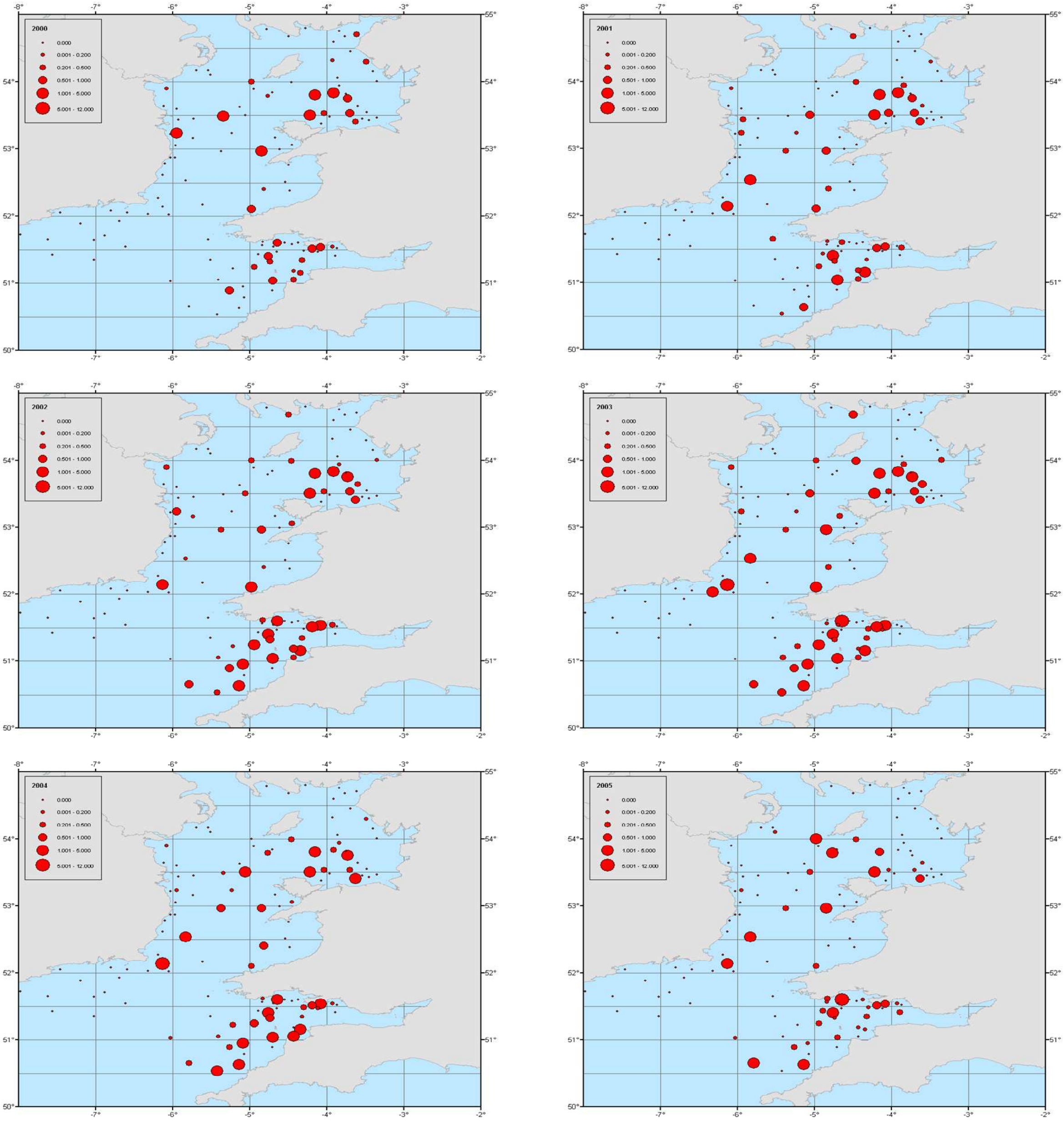


Figure 2.2.8 – Continued.



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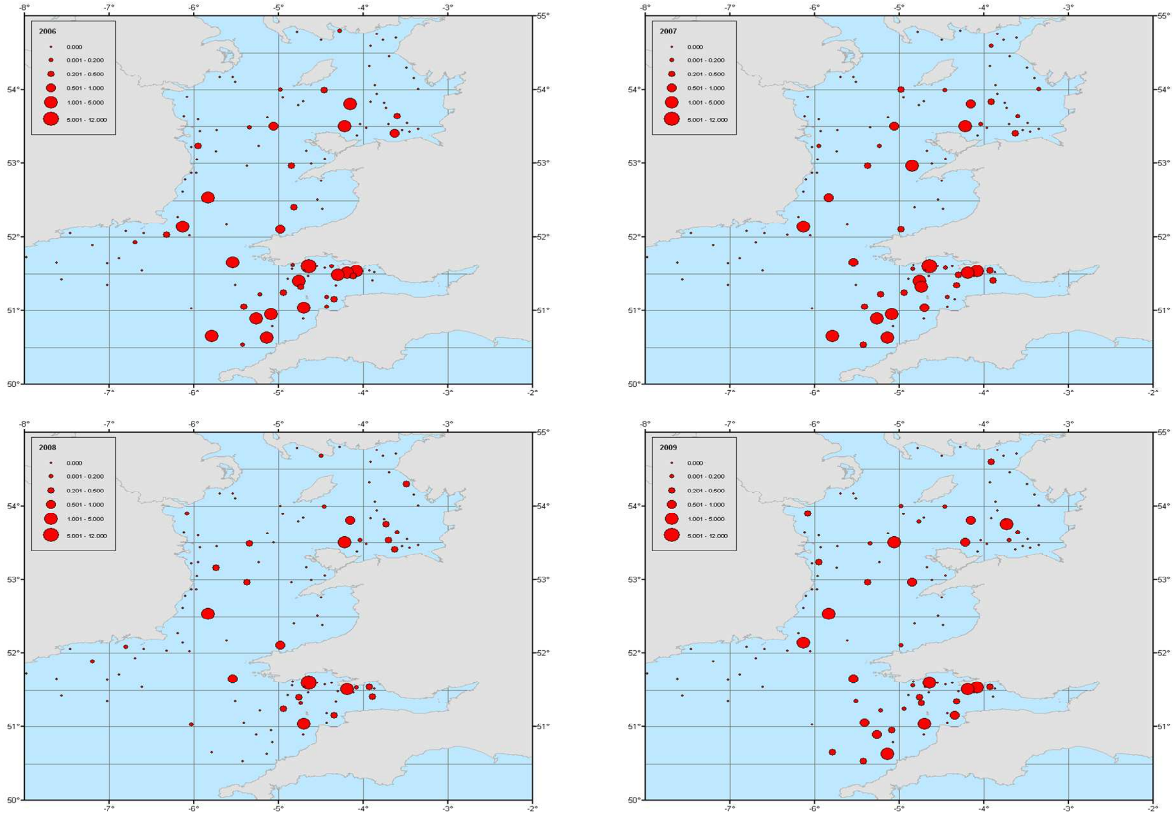

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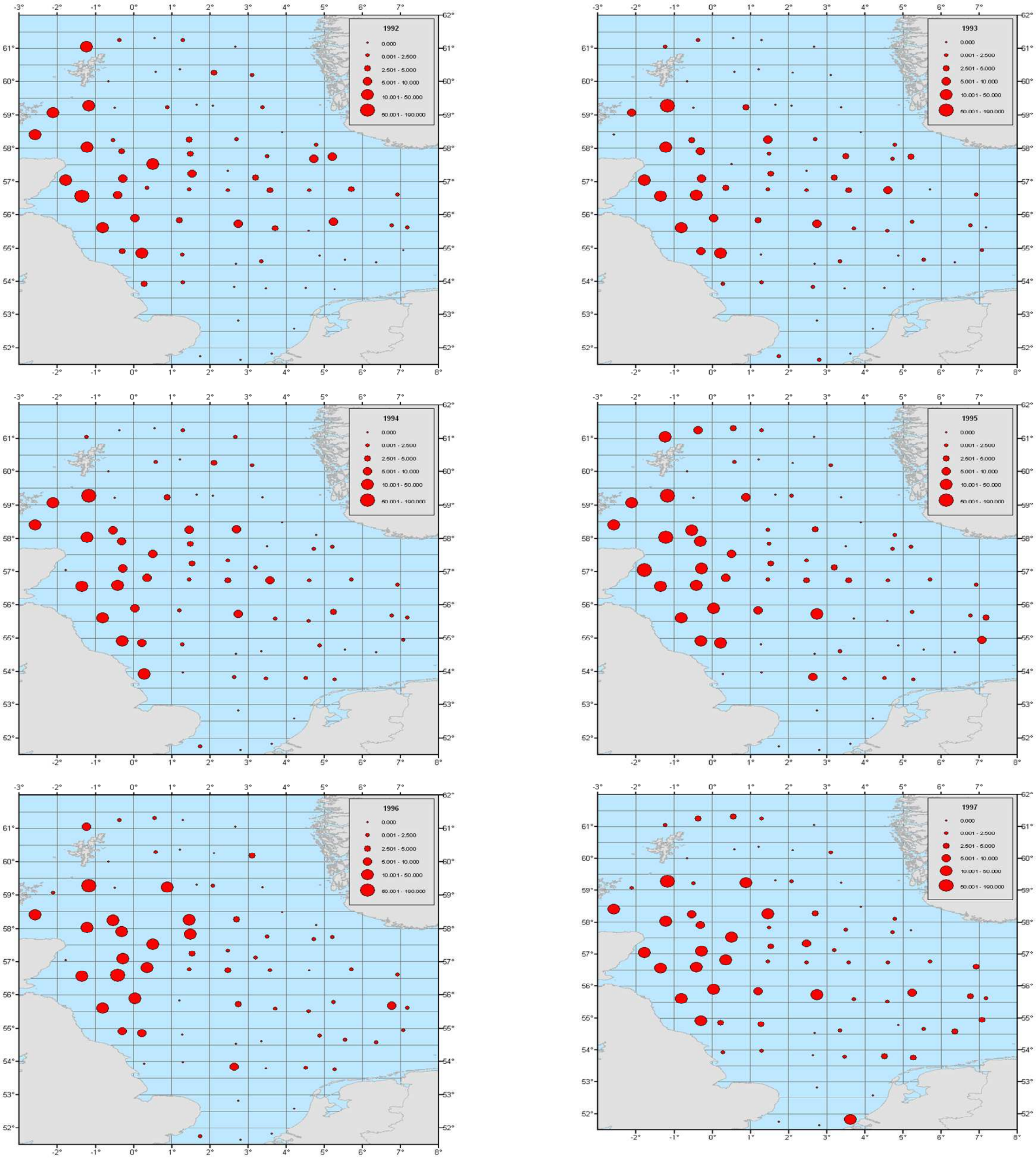
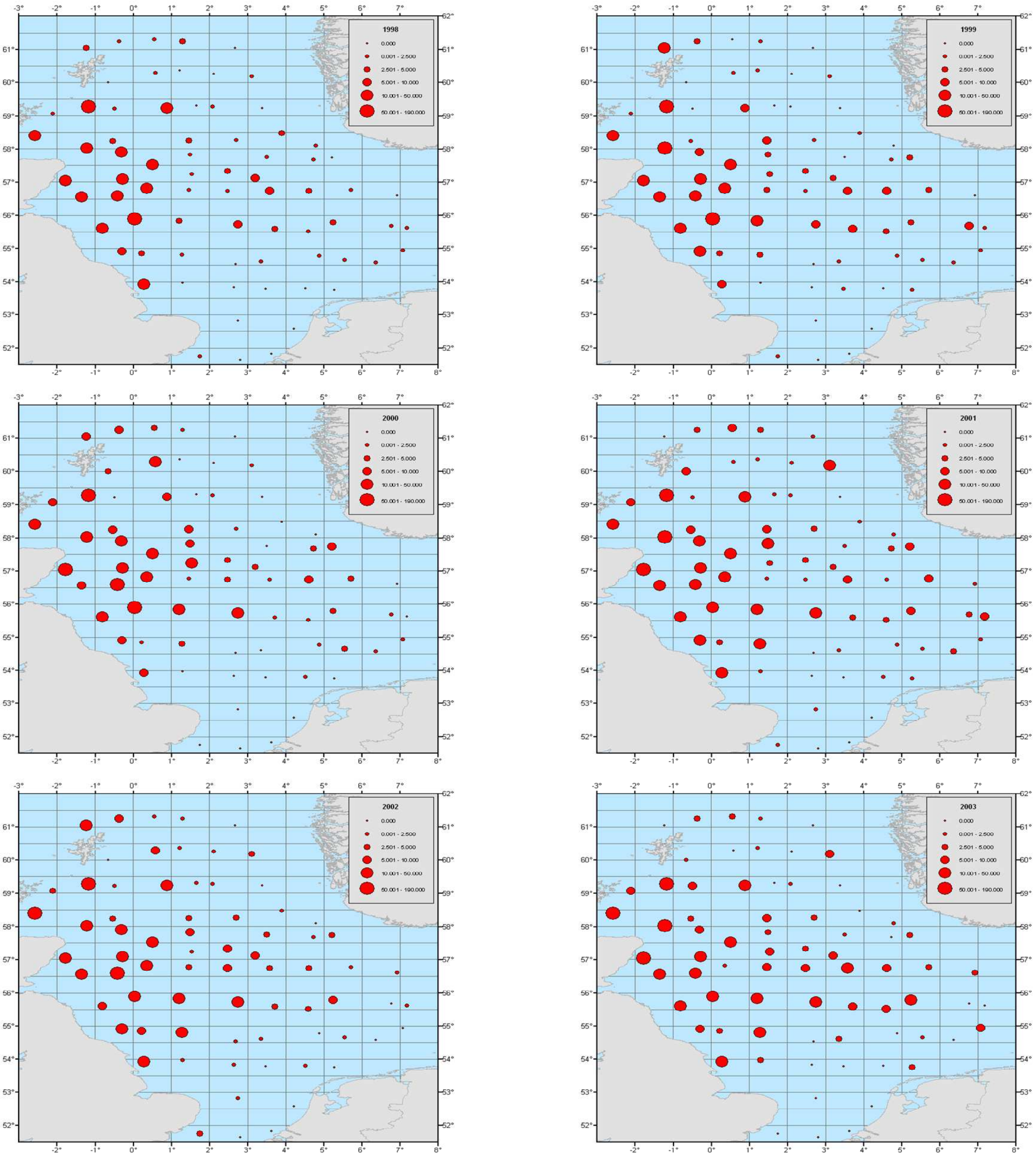


Figure 2.2.9. Abundance (no per nm) of lemon sole caught annually in the North Sea survey, by fishing station, between 1992 and 2009.



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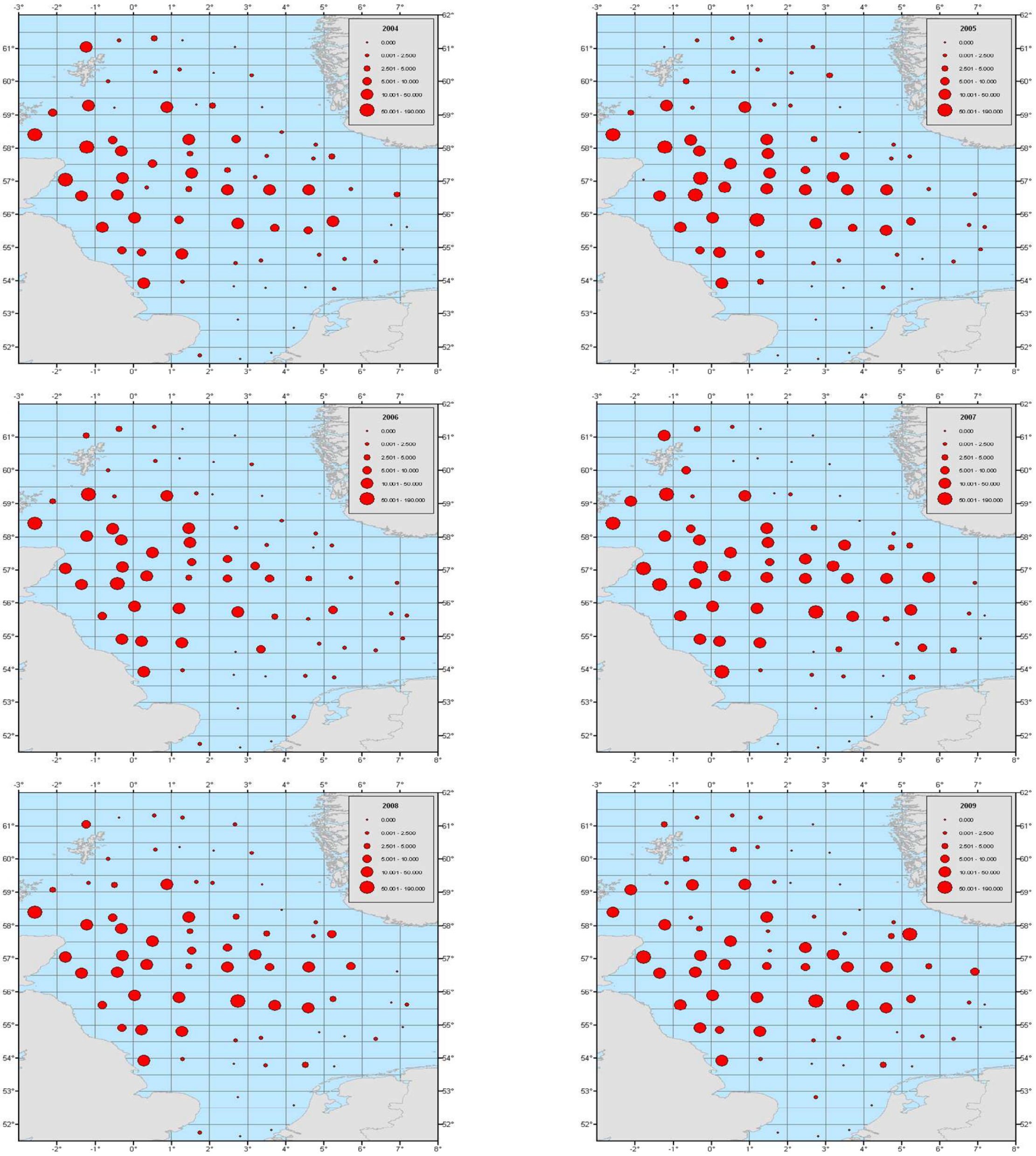

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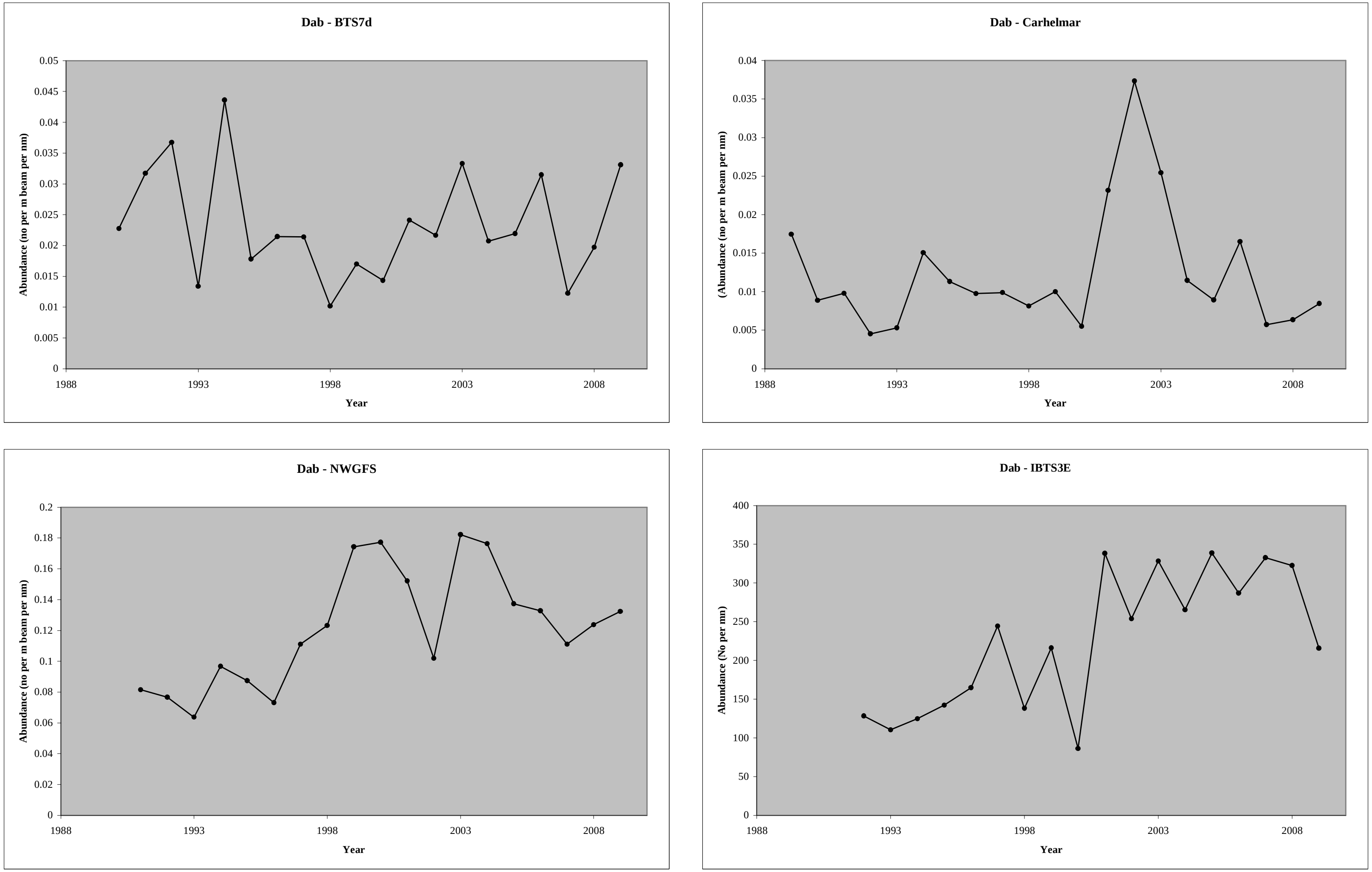


Figure 2.2.10 - Indices of abundance of dab caught in 4 Cefas surveys: the eastern Channel Beam Trawl survey (BTS7d), the western Channel (VIIe) (Carhelmar) Beam Trawl survey, the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl survey (NWGFS) and the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E). Abundances are given as number of fish per m beam per nm for the beam trawl surveys and as number of fish per nm for the groundfish survey.

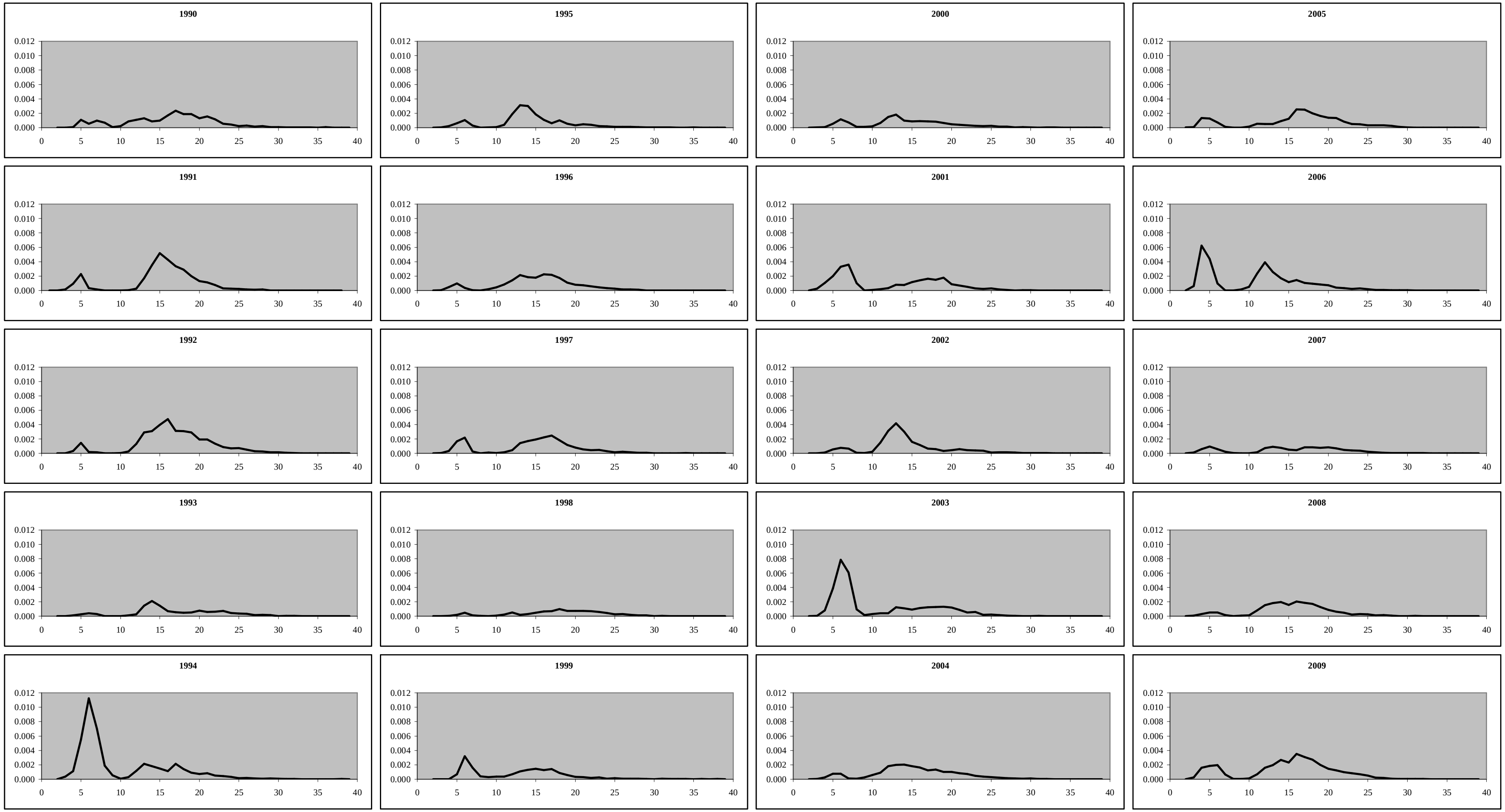


Figure 2.2.11 - Abundance (no per m beam per nm) by length (cm) of dab caught annually in the eastern Channel beam trawl survey, between 1990 and 2009.

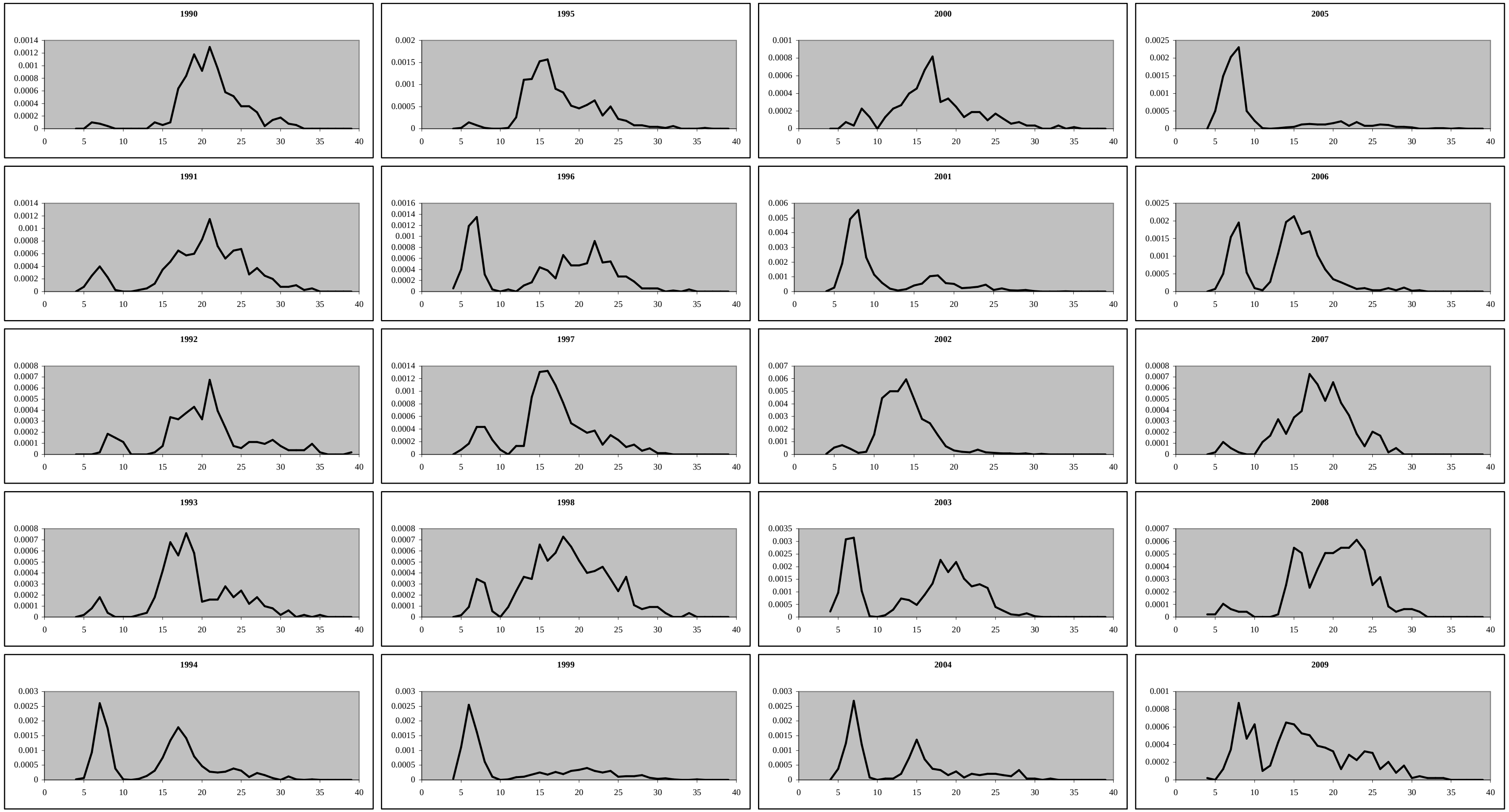


Figure 2.2.12 - Abundance (no per m beam per nm) by length (cm) of dab caught annually in the Carhelmar survey, between 1990 and 2009.

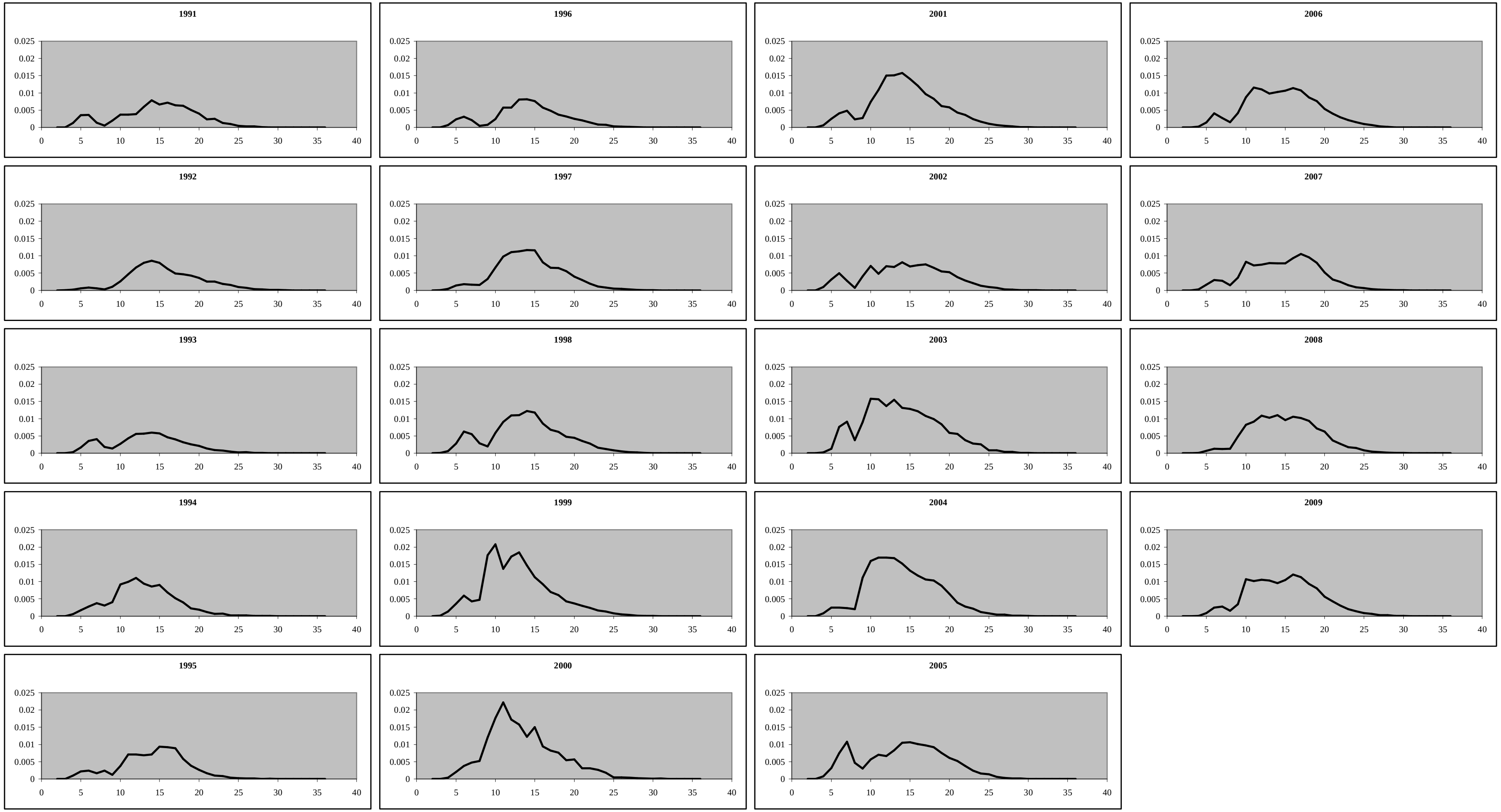


Figure 2.2.13 - Abundance (no per m beam per nm) by length (cm) of dab caught annually in the Irish Sea/Bristol Channel beam trawl survey, between 1991 and 2009.

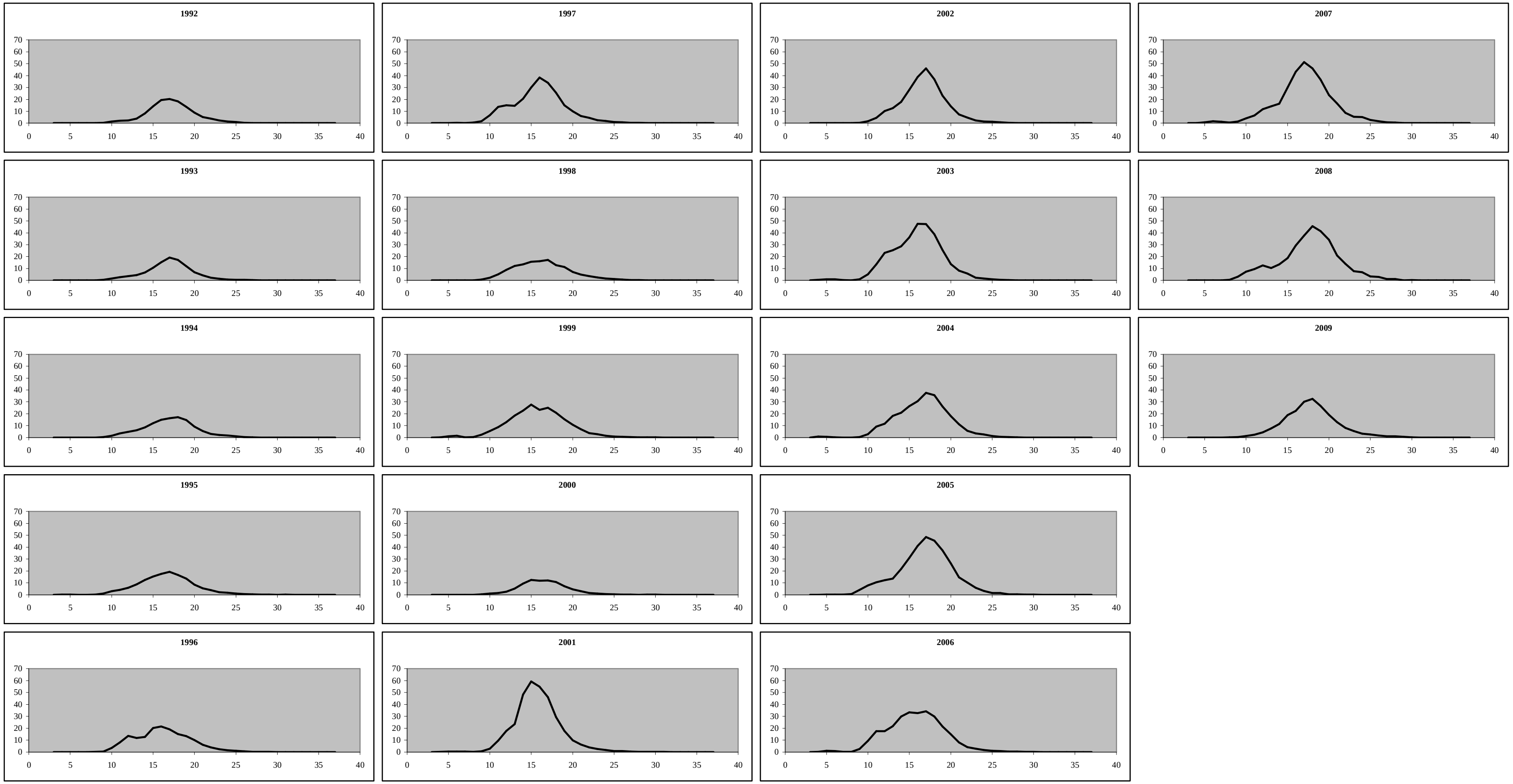


Figure 2.2.14 - Abundance (no per nm) by length (cm) of dab caught annually in the North Sea survey, between 1992 and 2009.

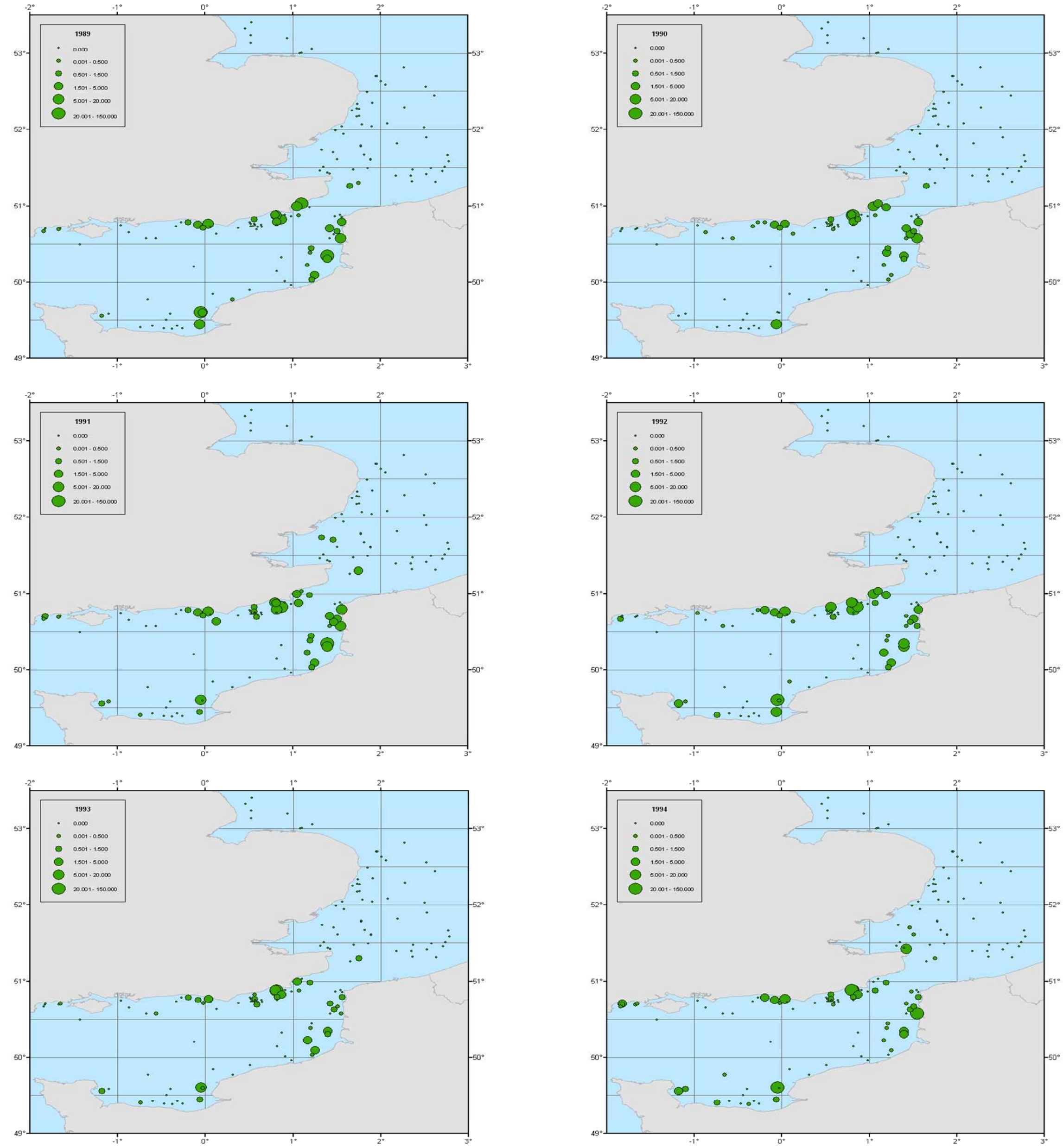
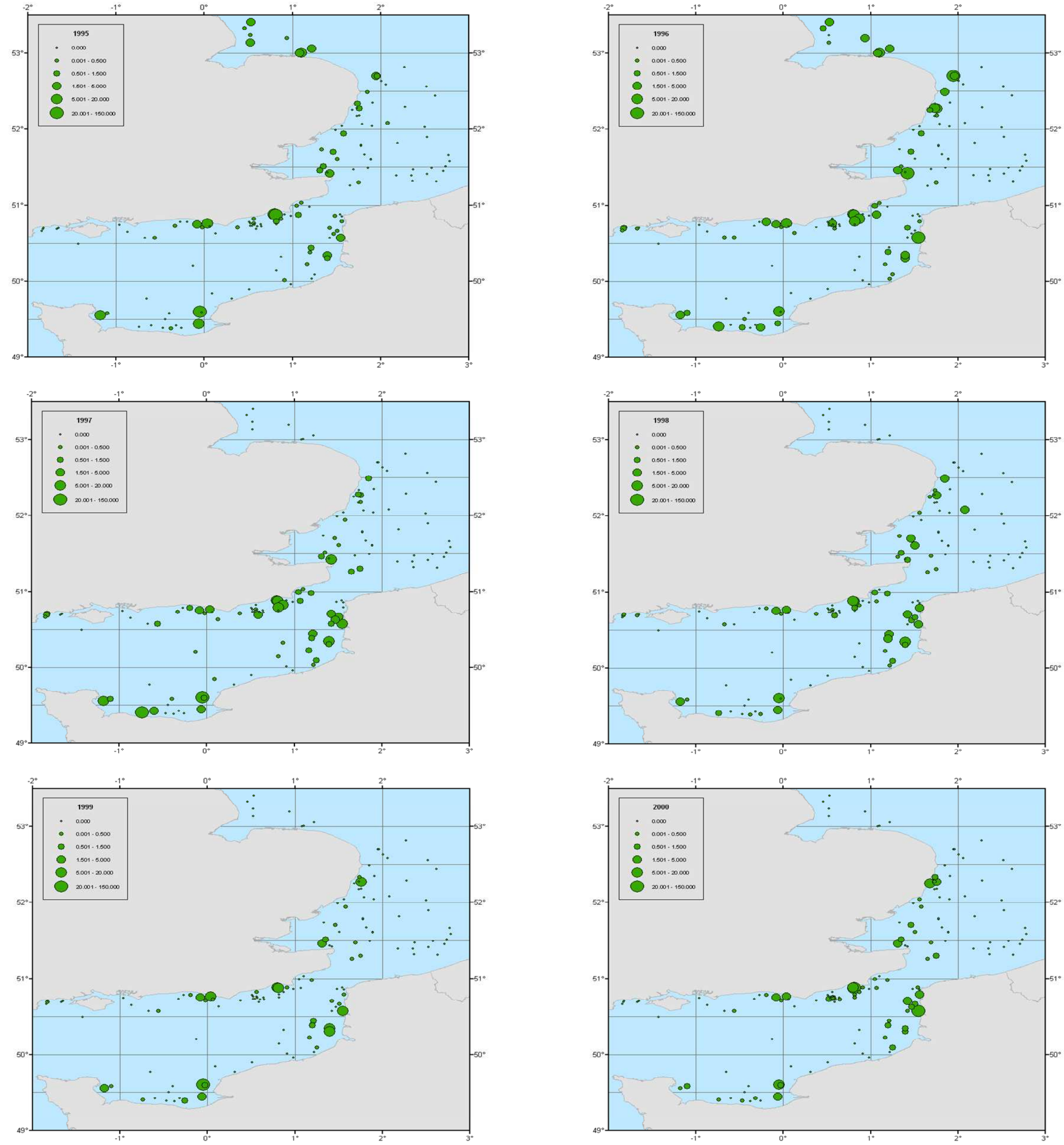


Figure 2.2.15 - Abundance (no per m beam per nm) of dab caught annually in the eastern Channel beam trawl survey, by fishing station, between 1989 and 2009.



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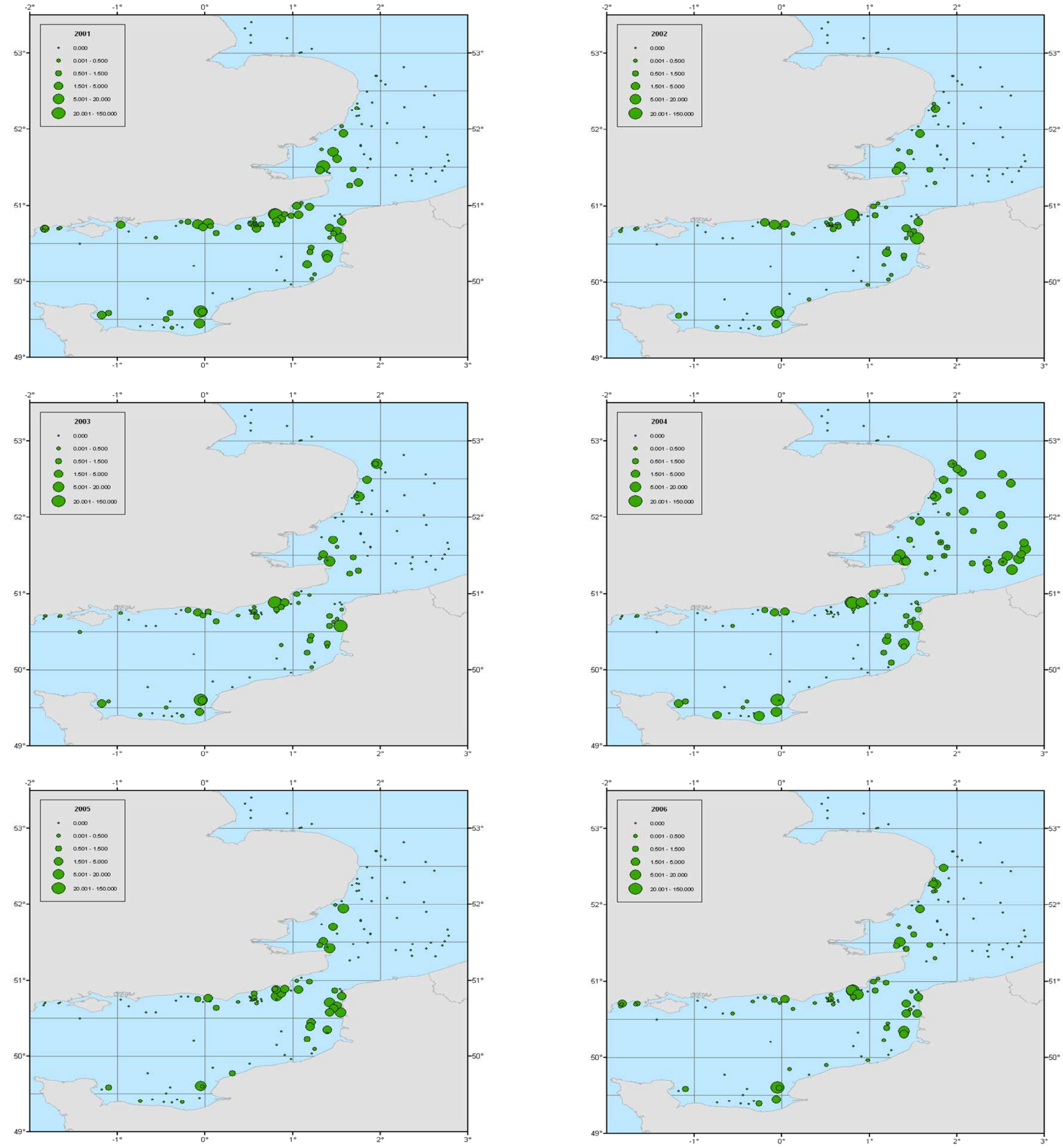

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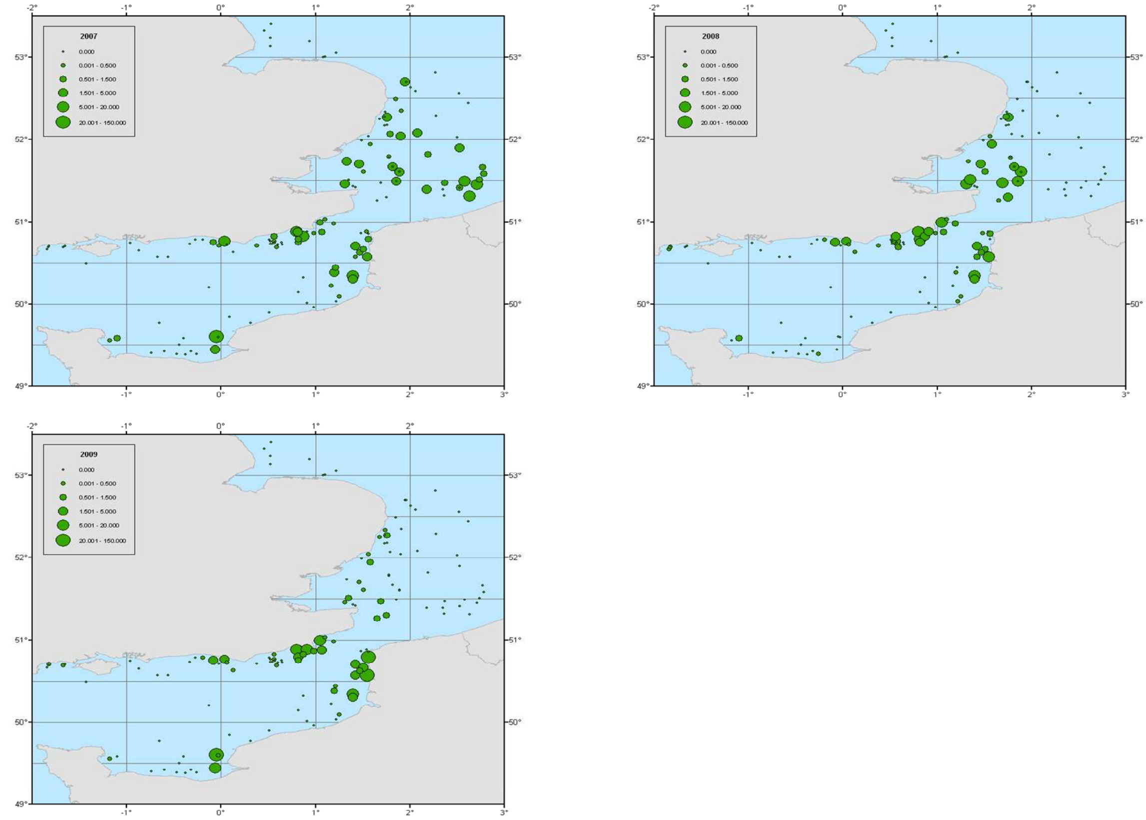

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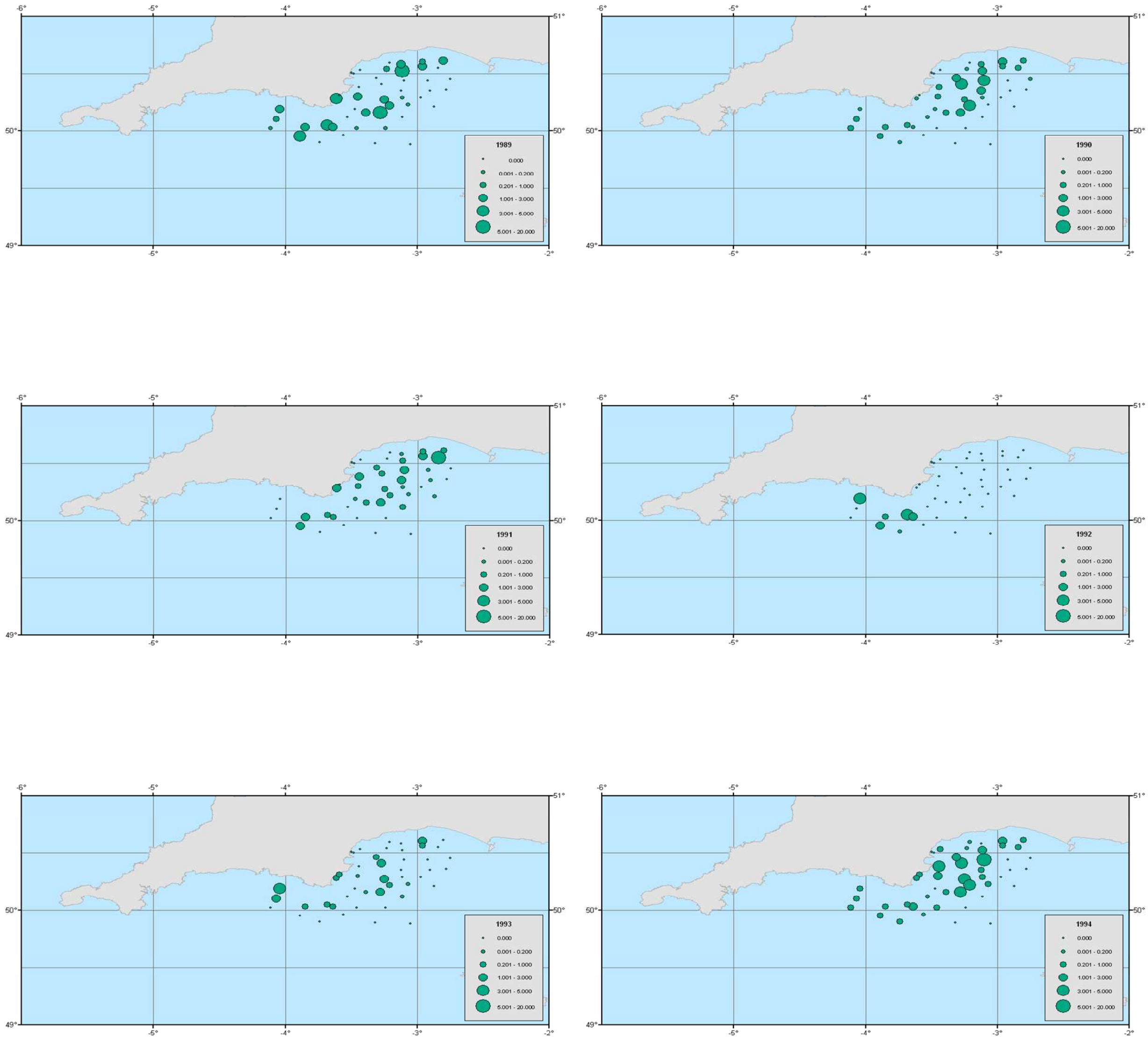
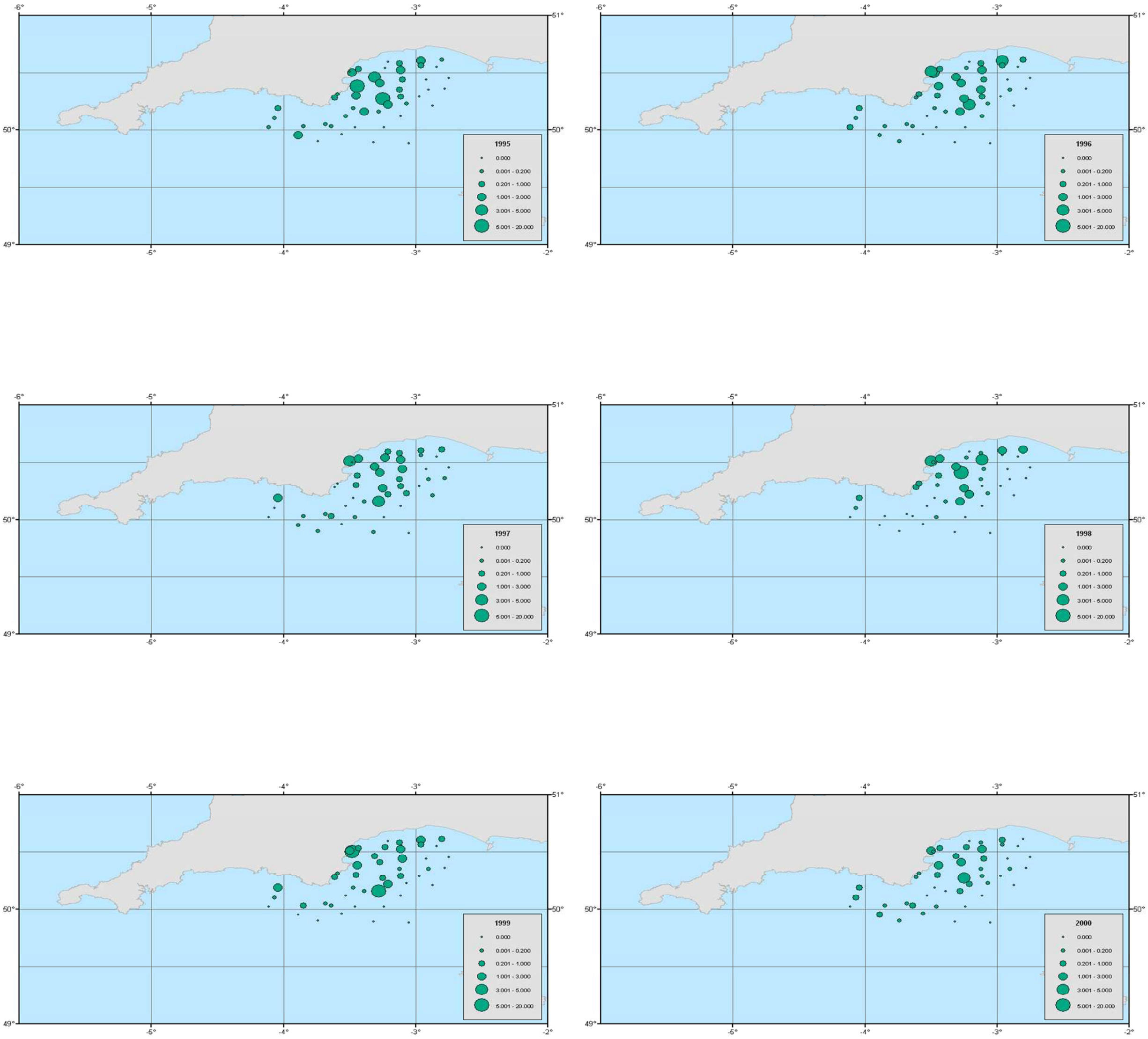


Figure 2.2.16 - Abundance (no per m beam per nm) of dab caught annually in the Carhelmar survey, by fishing station, between 1989 and 2009.



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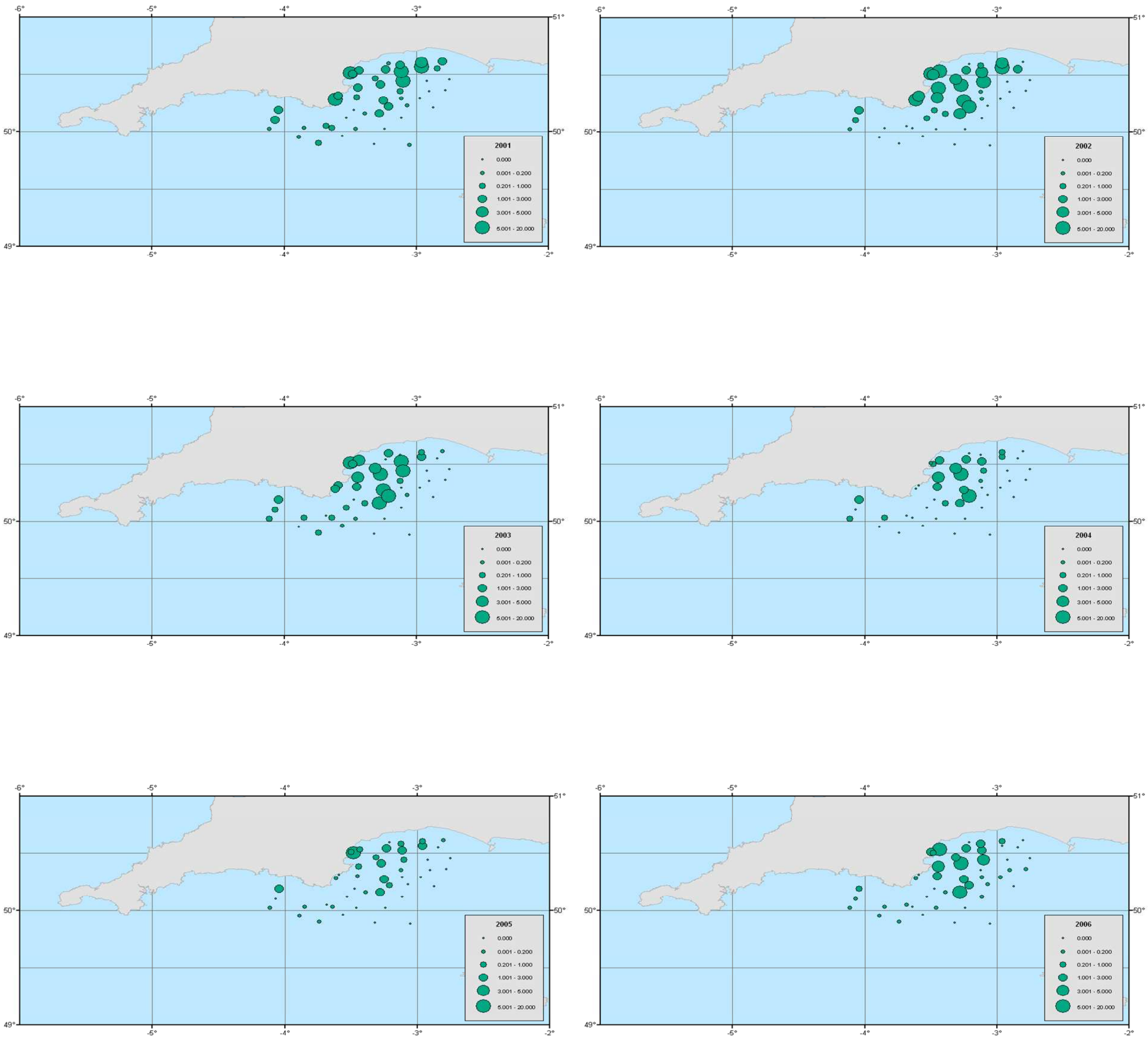

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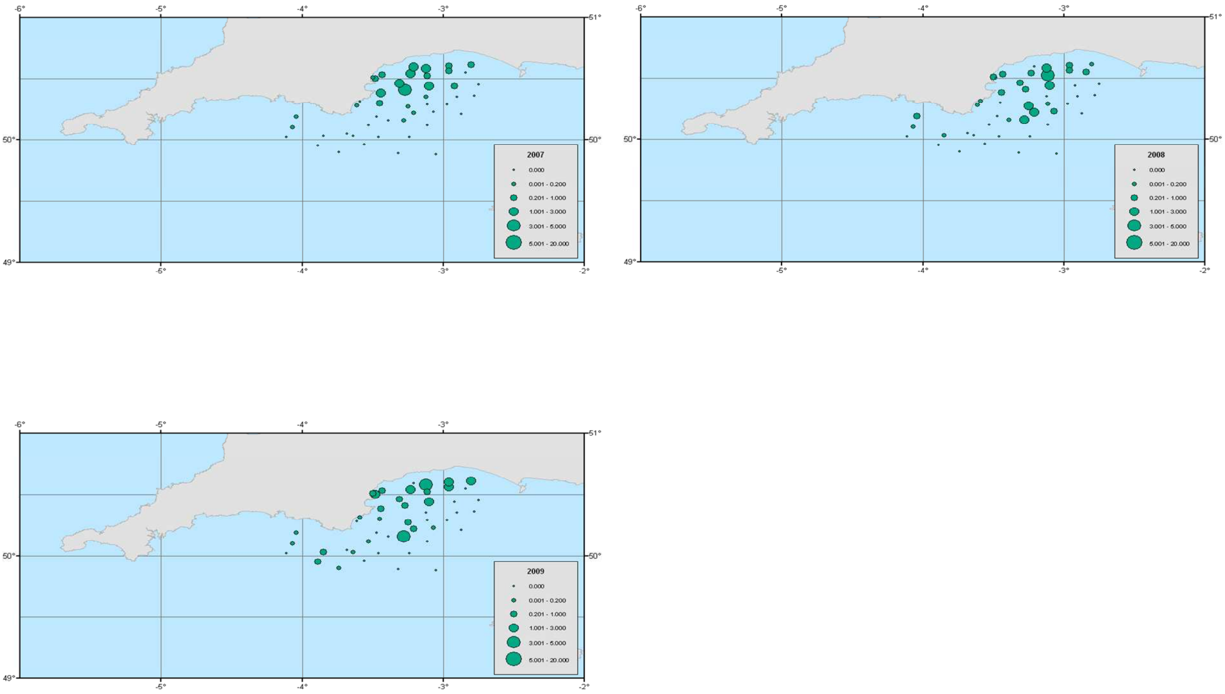

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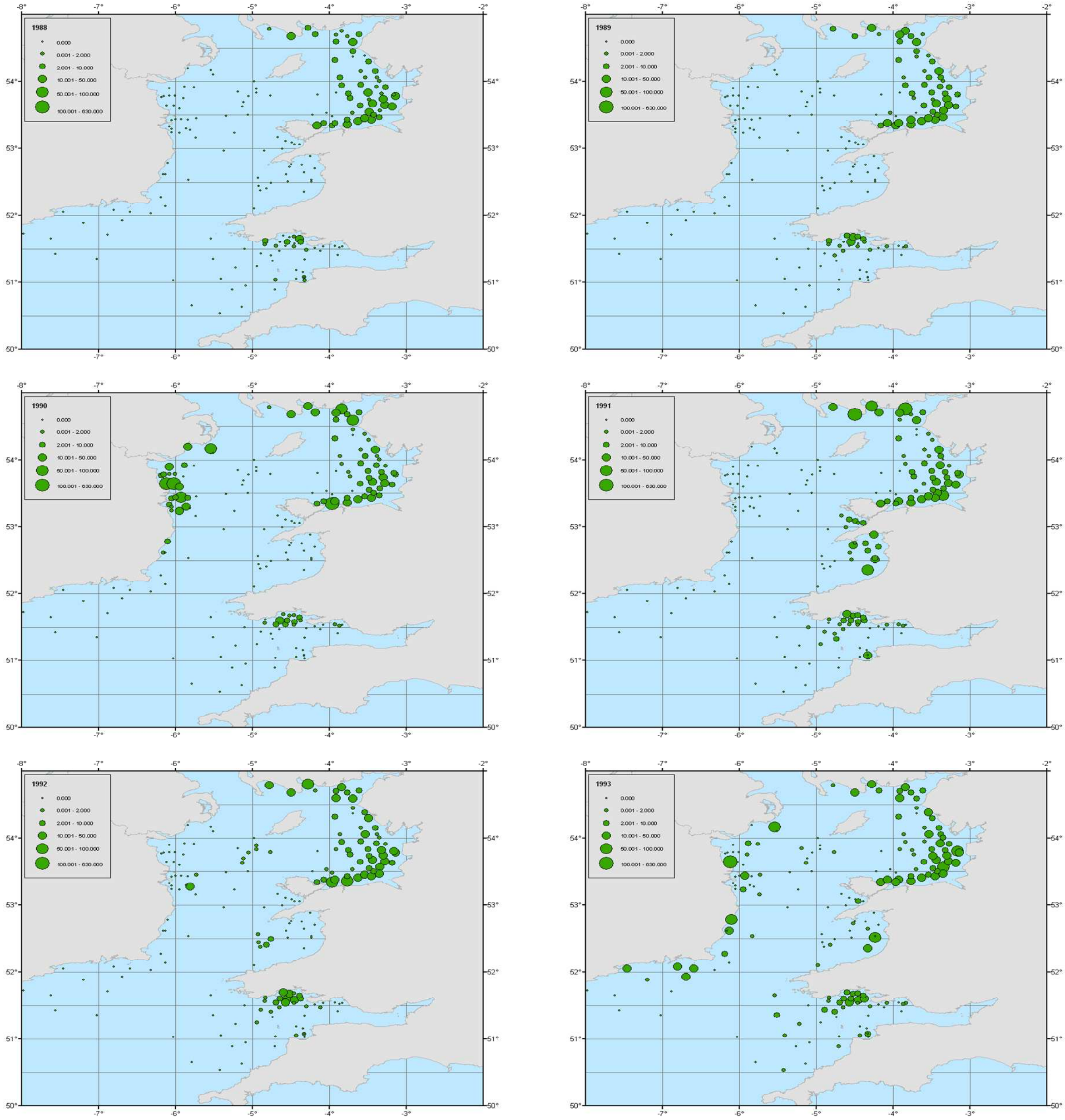
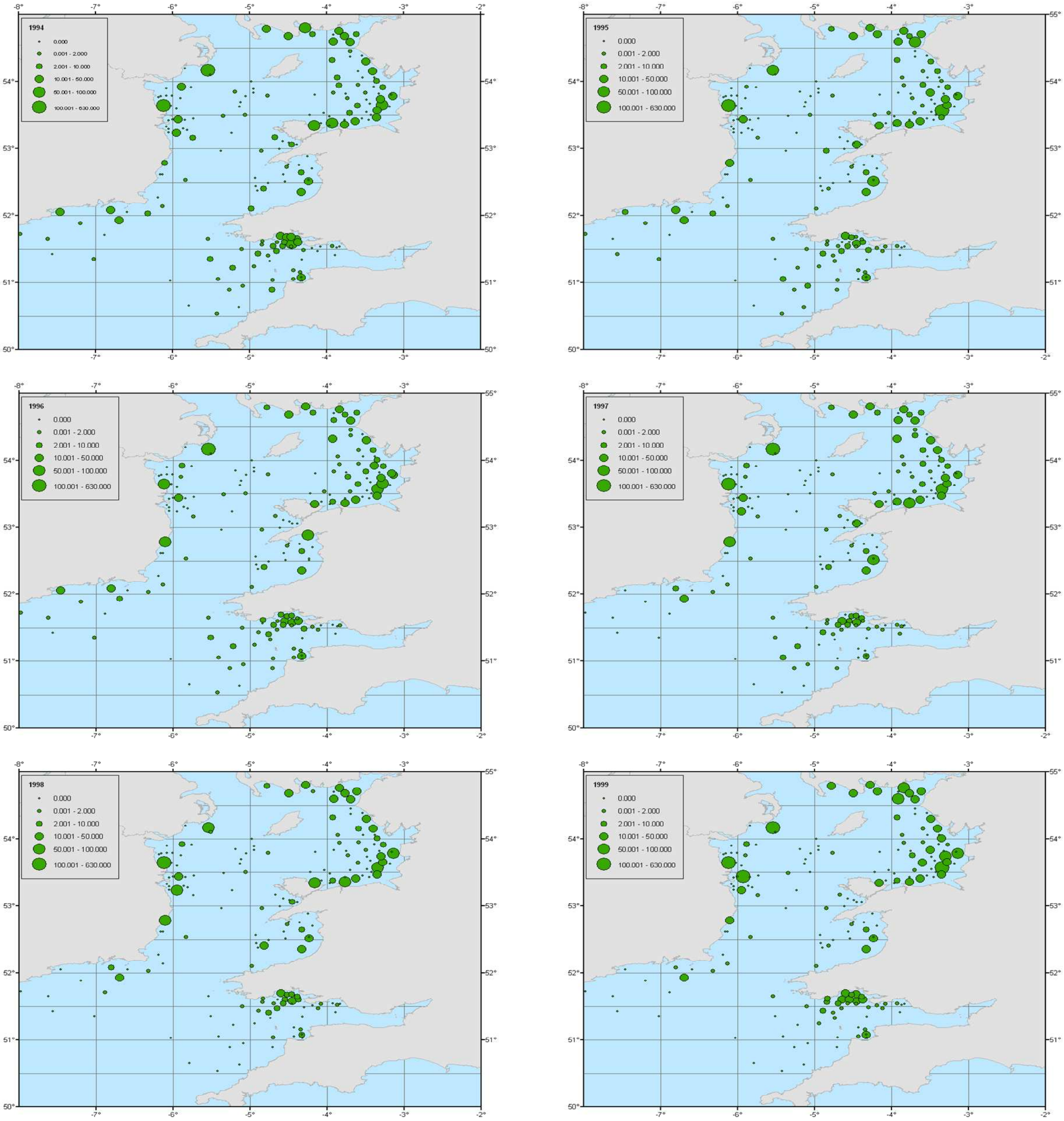


Figure 2.2.17 - Abundance (no per m beam per nm) of dab caught annually in the Irish Sea/Bristol Channel beam trawl survey, by fishing station, between 1988 and 2009.



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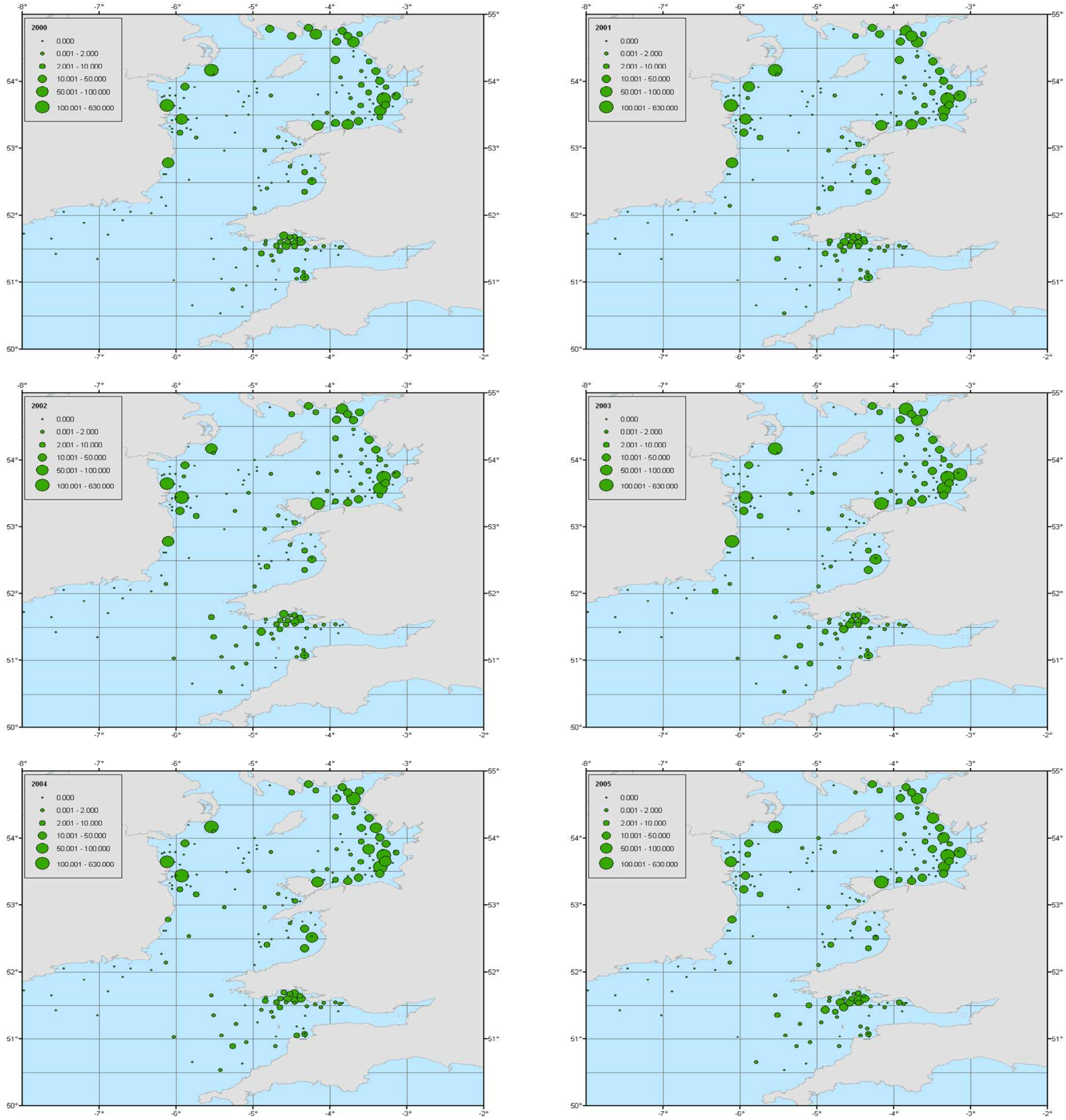

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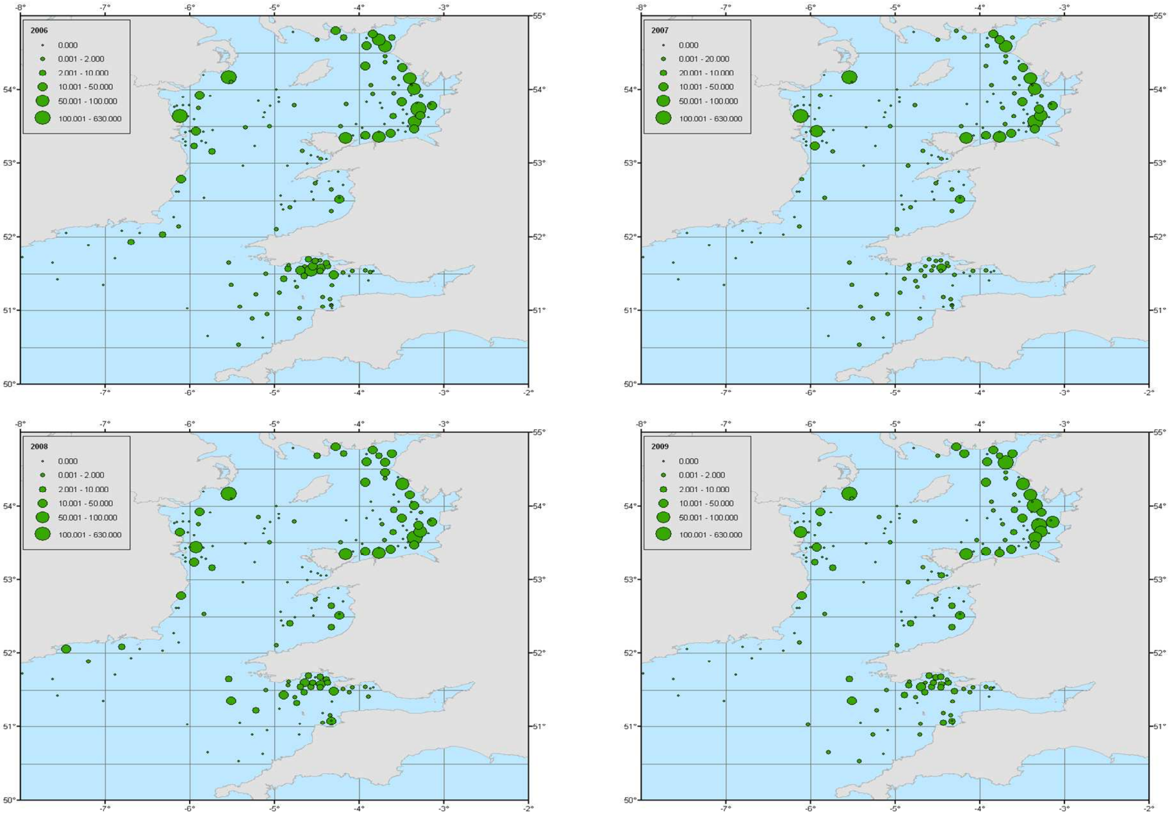

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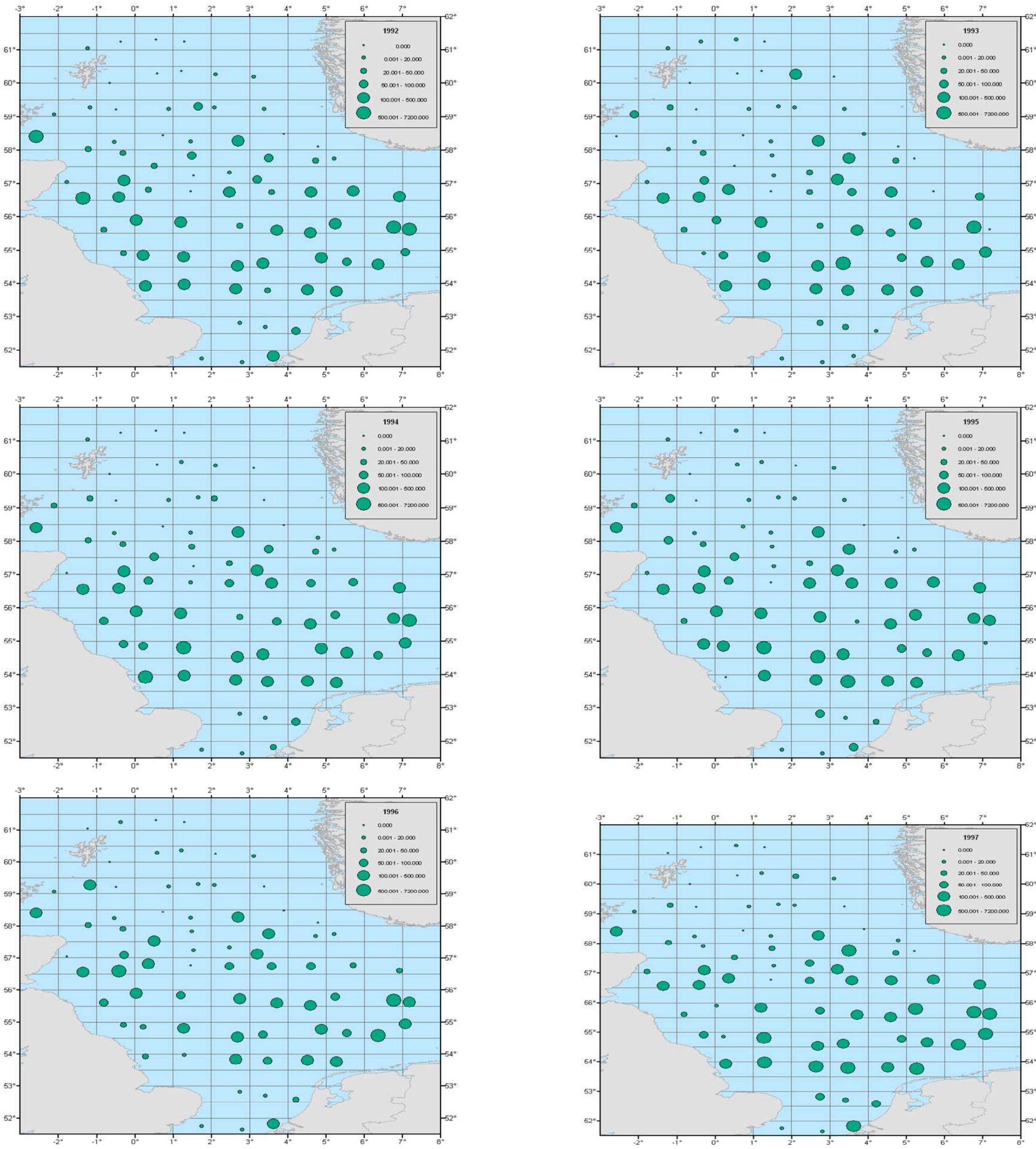
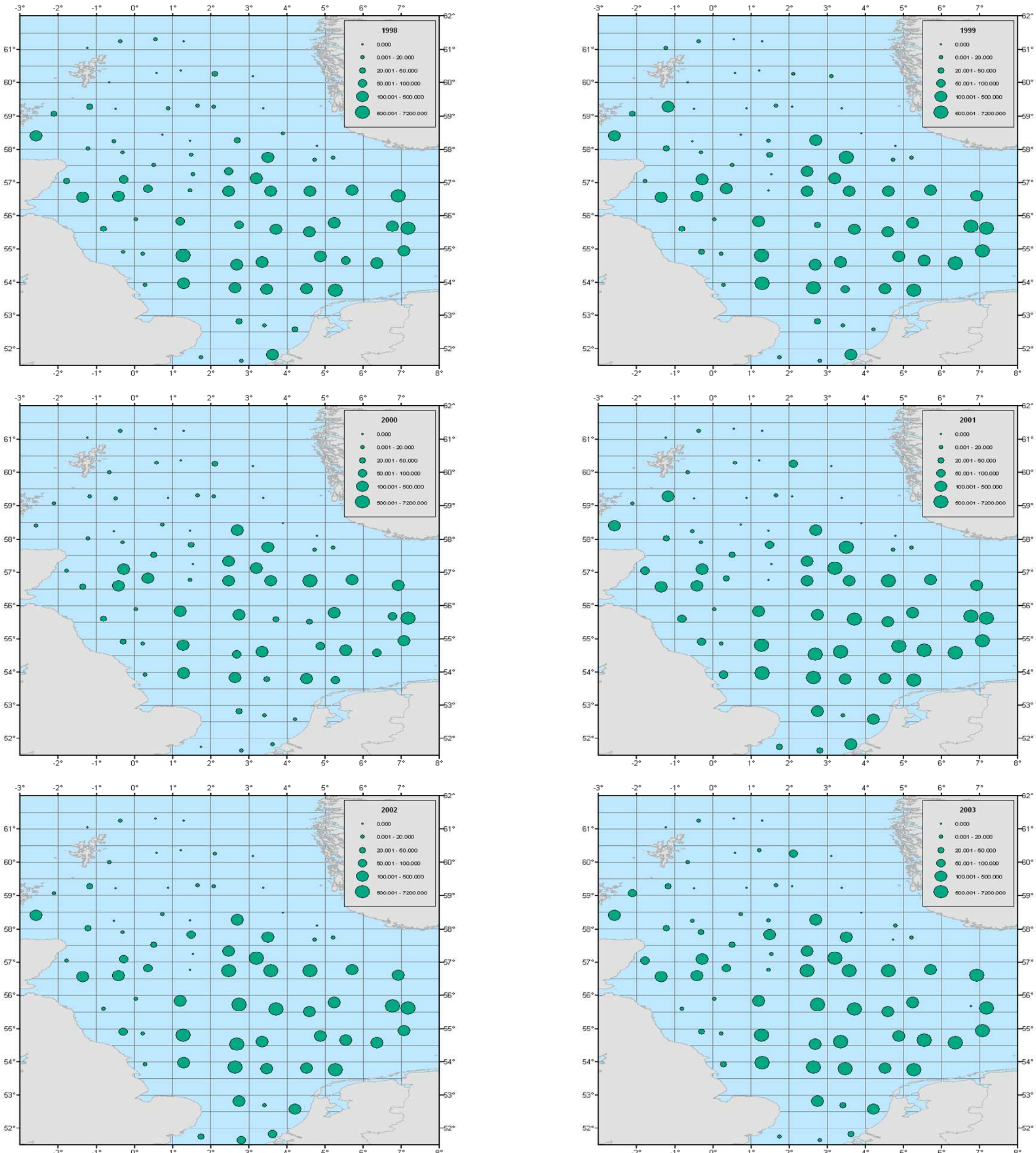


Figure 2.2.18 - Abundance (no per nm) of dab caught annually in the North Sea survey, by fishing station, between 1992 and 2009.



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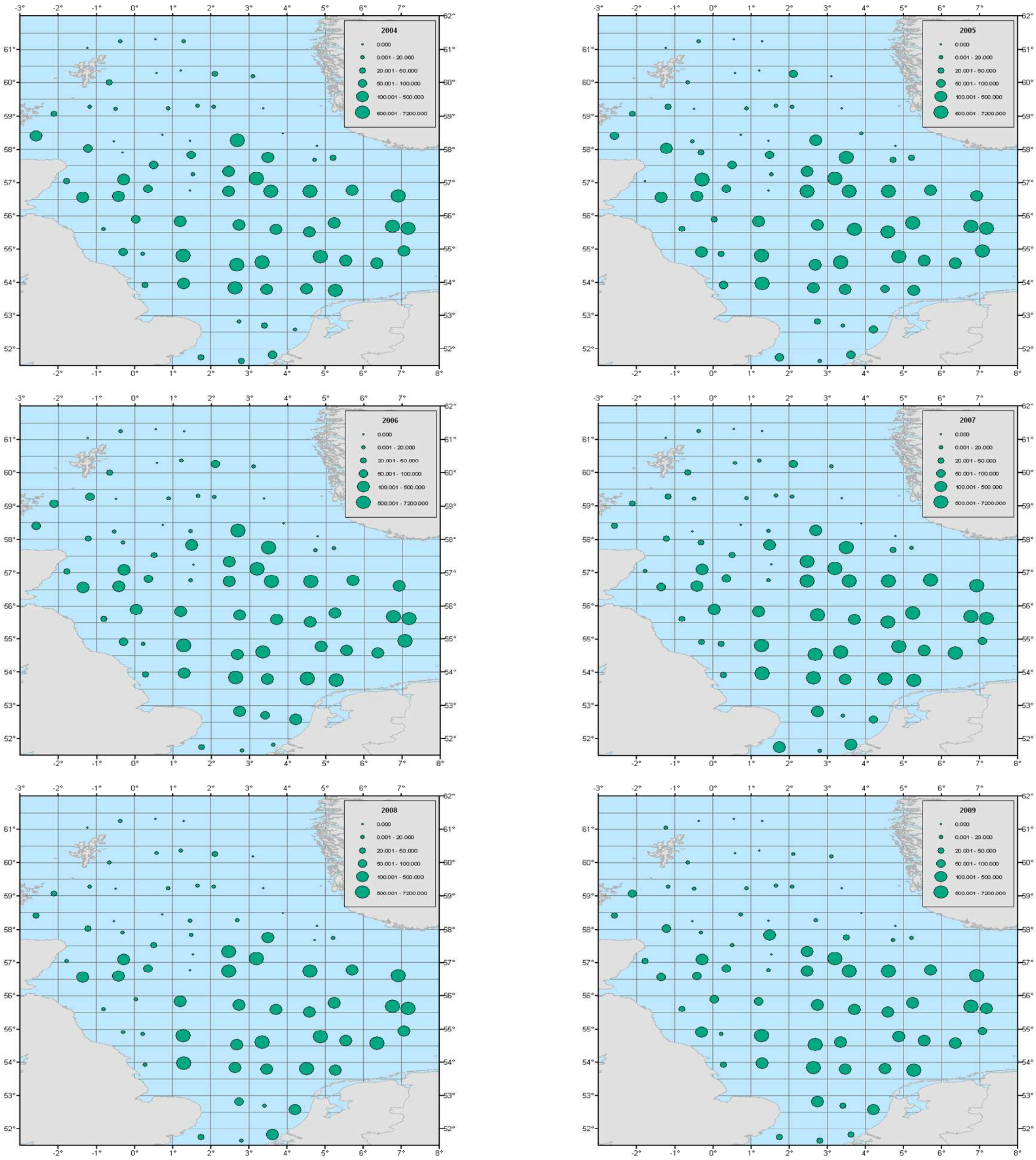


Figure 2.2.18 – Continued.

2.3 IFREMER[3]

In this section analyses are presented of survey data for striped red mullet, red gurnard, tub gurnard and John dory. The data that were used for the analyses presented in this section are from three French surveys:

International Bottom Trawl Survey (IBTS) in the North Sea
The IBTS surveys are one of the surveys to study the fish populations in the North Sea. Survey methods were standardised between countries involved in this programme: for example, the use of a standard GOV bottom trawl and the sampling of all the areas by two different research vessels. In order to determine indices of herring and sprat larvae (0 groups), each participating vessel operates a MIK (Methot Isaac Kidd) plankton net during the night.

For 20 years, the southern and central part of the North sea has been allocated to the French vessel. Since 2007, the eastern Channel has been added to the sampled area (Figure 2.3.1). As migration and exchange of stocks between these two areas are important, the eastern Channel is often combined with the North Sea for stock assessments. Herring for example which is exploited all year round in the North sea migrates into the Channel during November and December for reproduction.

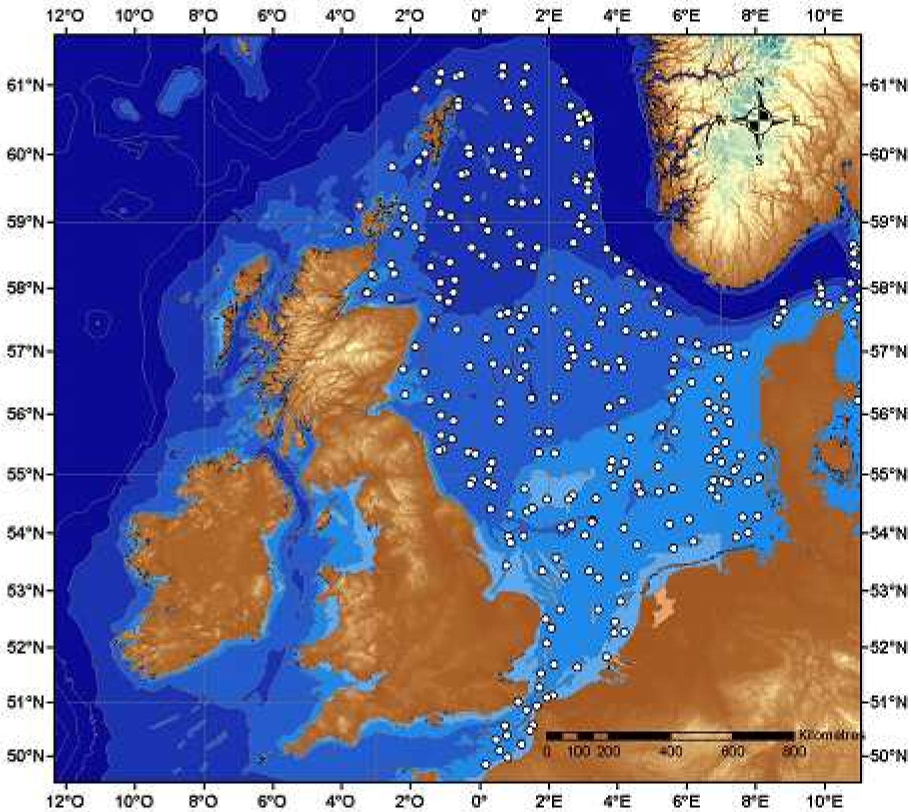


Figure 2.3.1 - Station map of the IBTS in the North Sea in 2009, quarter 1.

Channel Groundfish Survey (CGFS) in the eastern Channel
The Channel Ground Fish Survey provides recruitment indices in response to the second criterion defined by the SGRN: to provide information for management decisions. The indices for whiting, plaice and cod from this survey are being used by the Working Group on “Assessment of Demersal Stocks in the North Sea and Skagerrak” of the International Council for the Exploration of the Sea (ICES).

3 Authors: Jean Claude Mahé, Frank Coppin, Yves Vérin, Robert Bellail & Kelig Mahé

The objectives of the CGFS are in accordance with the priorities of the Common Fisheries Policy, namely to acquire the necessary data allowing to estimate the state of the resources. The abundance of stocks and of their distribution is monitored by a research vessel survey, in combination with the biological sampling of commercial catches.

The objectives are to collect mainly the following data during these surveys:

- distribution and fish abundance;
- abundance indices by age for the main commercial species for the ICES working group on the "Assessment of Demersal Stock in the North Sea and Skagerrak";
- estimate of recruitment and its variations;
- ichthyologic knowledge of populations;
- growth parameters for the main commercial species;
- hydrological data (temperature and salinity);
- localisation of nurseries and estimation of their importance;
- management recommendations, expertise and advice to the local national and Community decision structures, mainly within the framework of the exploited stocks and coastal management.
- spatial distribution and abundance of benthic populations

The sampling area covers the whole eastern English Channel (ICES Subdivision VIId), extending from the southern part of the North Sea (northern latitude 51°20', Belgian border) to the longitude of the Cotentin Peninsula (western 2°00') (Figure 2.3.2). The rocky seabed to the north of Cherbourg is not sampled because it is not possible to trawl ther. The survey area is divided into rectangles of 15' latitude and 15' longitude, and sampling design is of the systematic type. From 1997 to 2006, sampling of the zones which are potential whiting spawning grounds (bay of the Seine, bay of Veys and bay of Rye) was reinforced.

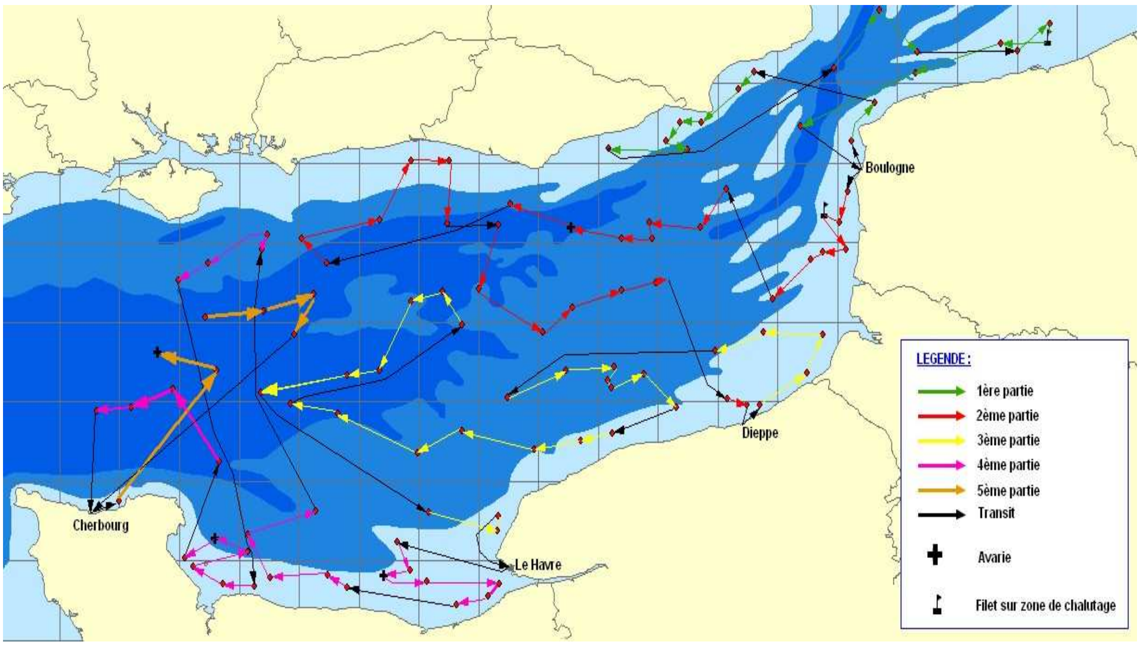


Figure 2.3.2 – Station map of CGFS survey in the eastern Channel.

The sampling scheme consists of at least 1 haul in each rectangle. 105 hauls are made with a small version of the GOV-trawl. Some hauls are done in sensitive areaa like nurseries (bay of Rye, bay of Seine and bay of Veys).

Hydrological parameters were recorded (salinity and temperature) during each haul. All species were sorted, weighted, counted and most of them are measured. In order to obtain age-length keys, otoliths and scales are collected from the main commercial species. These species are also sexed and the maturity stage is recorded as well.

French EVHOE survey in the Bay of Biscay and the Celtic Sea
The French EVHOE demersal survey began in 1987. The survey area was first limited to the Bay of Biscay (ICES divisions VIIh, VIIIa,b,c and d) and in 1990, the survey area was extended towards the north to cover the grounds of the Celtic Sea deeper than 100 m (ICES divisions VIIe, f, g, h and j).

Between 1987 and 1996, the EVHOE survey was conducted in the Bay of Biscay on an annual basis with the exception of 1993 and 1996. It was conducted in the third or fourth quarter except in 1991, when it took place in May. In 1988, two surveys were conducted: one in May the other in October.

The Celtic Sea was surveyed from 1990 to 1994, but sampling was restricted to a small geographical area. Since 1997, the survey has covered all the Celtic Sea and Bay of Biscay during the 4th quarter for 40 to 45 days depending on year and availability of ship time.

The survey has the following main objectives:

- construction of time-series of abundance indices for all commercial species in the Bay of Biscay and the Celtic Sea with an emphasis on the yearly assessed species where abundance indices at age are computed;
- to describe the spatial distribution of the species and to study their interannual variations;
- to estimate and/or update biological parameters (growth, sexual maturity, sex ratio).

Since 1997, the French survey has been carried out on the R/V Thalassa, a stern trawler of 73.7 m length by 14.9 m wide, gross tonnage of 3022 t. The fishing gear used is a GOV 36/47 without exocet Kite which is replaced by 6 additional floats. On average, the gear has a horizontal opening of 20 m and a vertical opening of 4 m. The doors are plane-oval with a weight of 1350 kg.

The sampling design is a stratified random allocation. The whole area surveyed has been separated in 5 geographical strata or sectors (Figure 2.3.3): southern Bay of Biscay (GS) and northern Bay of Biscay (GN), southern Celtic Sea (CS), central Celtic Sea (CC) and northern Celtic Sea (CN). In each sector a depth-stratified sampling strategy has been adopted with 7 depth ranges: 0 - 30m, 31 - 80 m, 81-120 m, 121 - 160 m, 161 - 200 m, 201 - 400 m and 401 – 600m.

The number of hauls per stratum was optimised by a Neyman allocation taking into account the most important commercial species in the area (hake, monkfish and megrim). A minimum of two stations per stratum is sampled and 155 fishing stations are planned every year. The stratification scheme adopted defines 6 depth strata within a geographic stratification that separates the Bay of Biscay in 2 areas and the Celtic Sea in 3 areas (Figure 2.3.3). This number of hauls is adjusted according to the ship time available at sea.

The catch is sorted by species, counted and weighted. In the case of a huge catch of one dominant species, only a fraction of the catch is sorted. All finfish and a selection of invertebrate (mainly Nephrops and squids) are measured. Since 2008, benthic species are also sorted. Biological parameters (length, weight, status of maturity among others) and hard structures (otoliths and illicia) are collected.

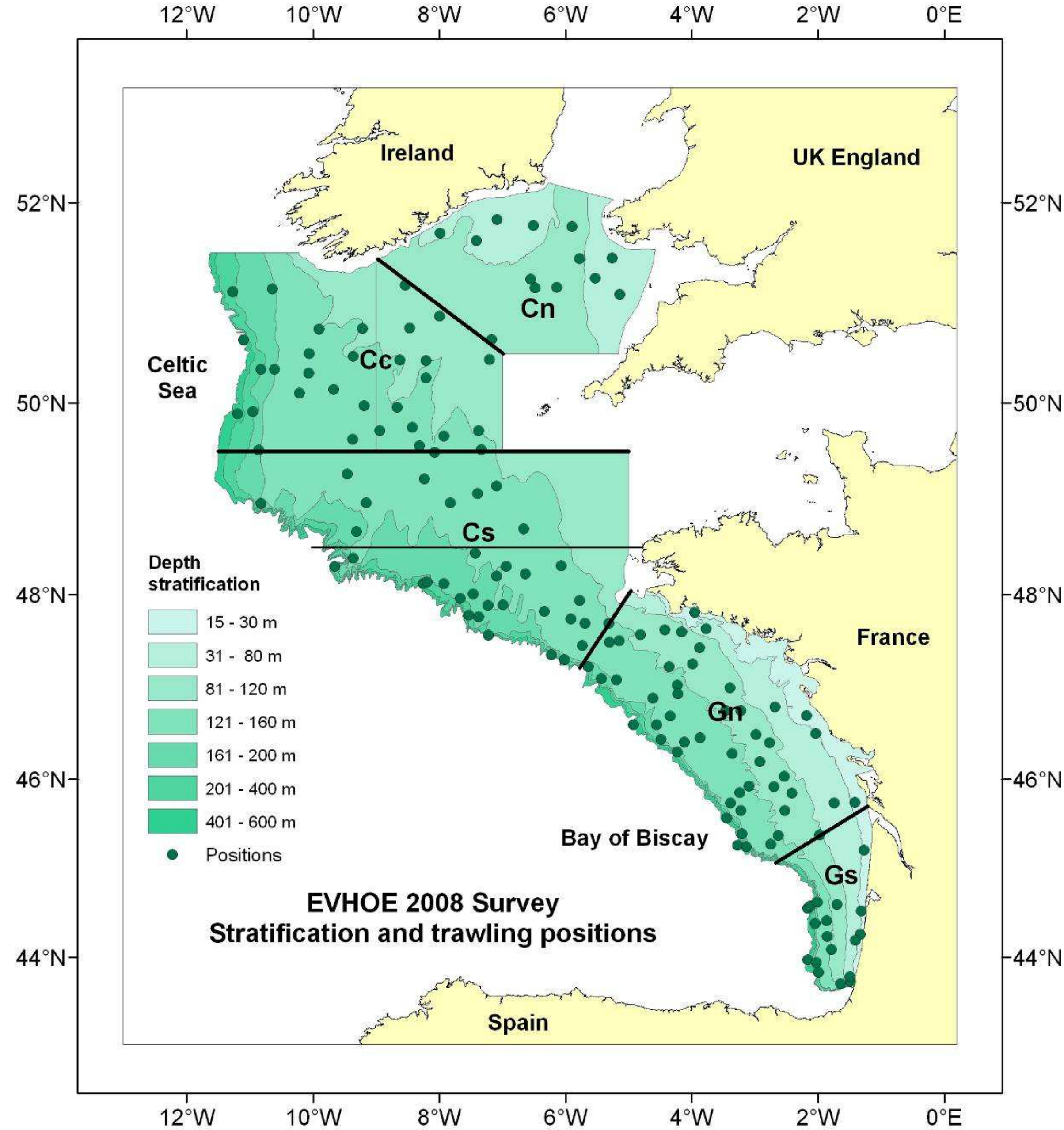


Figure 2.3.3 - Area covered, stratification used and an example of trawling positions in the EVHOE survey.

For striped red mullet, red and tub gurnard and John dory, the time series of abundance by size class, annual and average length frequencies, annual and average distribution by size/class are presented in the following sections.

2.3.1 Striped red mullet

Since 1988, striped red mullet abundance has increased in the Bay of Biscay (EVHOE survey), in the Celtic Sea especially from 2001 to 2004 (EVHOE survey), in the eastern Channel (CGFS survey) and in the southern part of the North Sea (IBTS survey). However, the increase is more significant in the eastern Channel and the southern North Sea.

During the last decade, three years with good recruitment (TL from 8 cm to 15 cm) can be observed, particularly in the eastern Channel: 2003, 2007 and 2009 (Figure 2.3.4). In the Bay of Biscay, 2001, 2003 and 2005 are the years with the best recruitment.

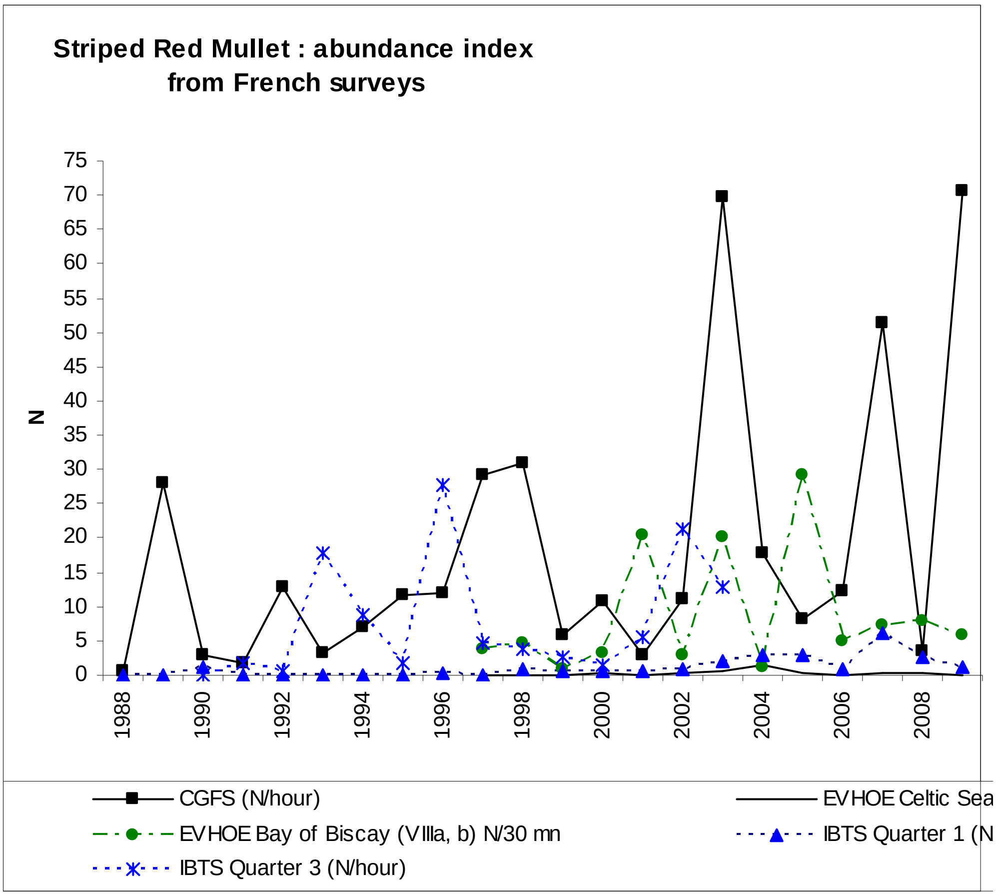


Figure 2.3.4 - Time series of abundance of striped red mullet base on FR-Surveys from 1980 to 2009.

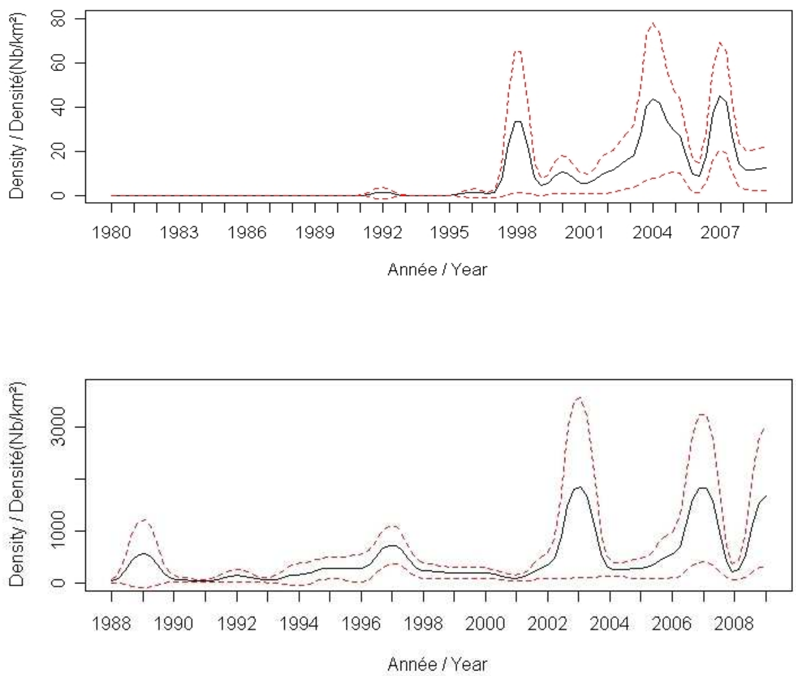


Figure 2.3.5 - Time series of abundance of striped red mullet in the North Sea based on FR-IBTS data (Nb/km²) from 1980 to 2009 (upper panel) and in the eastern Channel based on FR-CGFS data (Nb/km²) from 1988 to 2009 (lower panel). Lines are smoothed, 95% confidence intervals are shown.

Table 2.3.1 - Abundance index (Nb/hr) for striped red mullet for the International Bottom Trawl Survey (FR-IBTS, IVb,c) and Channel Ground Fish Survey (FR-CGFS, VIId).

Year	IBTS Quarter 1	IBTS Quarter 3	CGFS
1988	0.00		0.72
1989	0.00		28.14
1990	1.18		2.93
1991	0.00	0.14	1.62
1992	0.00	1.88	12.8
1993	0.00	0.56	3.07
1994	0.00	17.81	6.86
1995	0.00	8.75	11.78
1996	0.29	1.88	11.84
1997	0.00	27.71	29.19
1998	0.77	4.66	30.92
1999	0.63	3.82	5.7
2000	0.46	2.69	10.7
2001	0.64	1.50	2.92
2002	0.89	5.54	11.04
2003	1.95	21.20	69.73
2004	3.04	12.79	17.69
2005	2.97		8.1
2006	0.97		12.34
2007	6.26		51.3
2008	2.68		3.45
2009	1.14		70.75

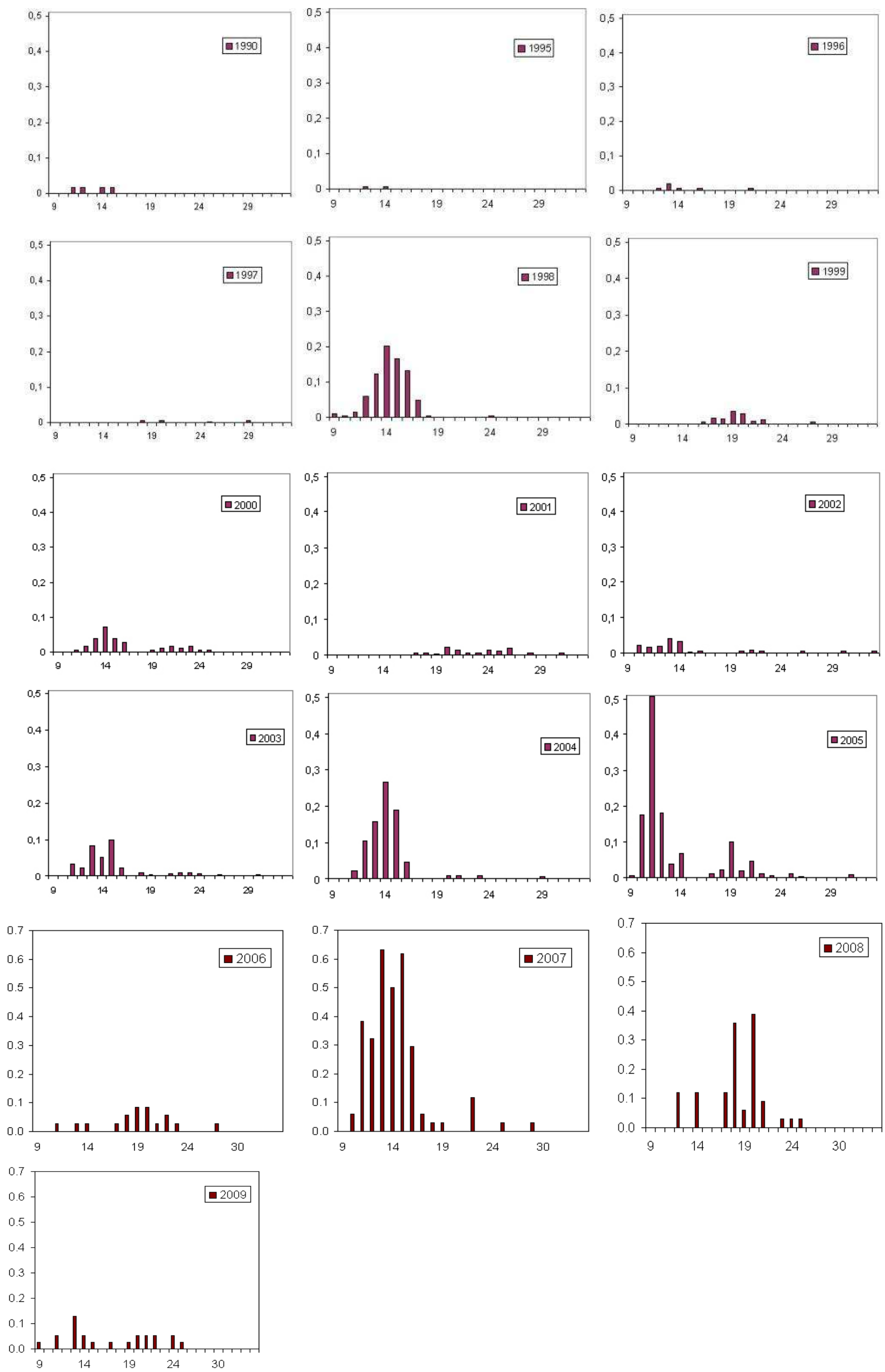


Figure 2.3.6 - Abundance indices (N/30 min) of striped red mullet per size class (length in cm.) during IBTS-Q1, all countries, from 1990 to 2009.

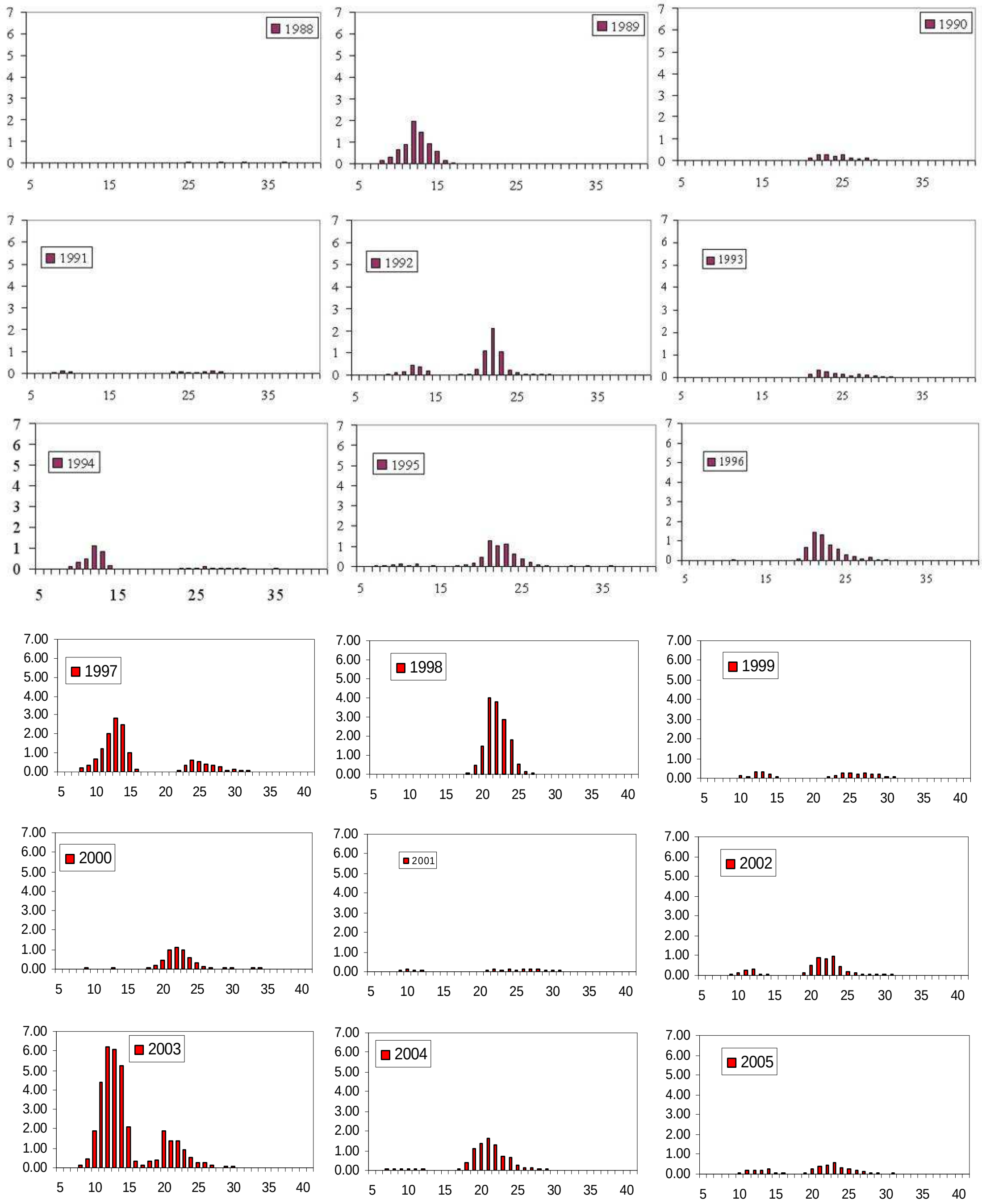


Figure 2.3.7 - Abundance indices (N/30 min) of striped red mullet per size class (length in cm.) during FR-CGFS from 1988 to 2009.

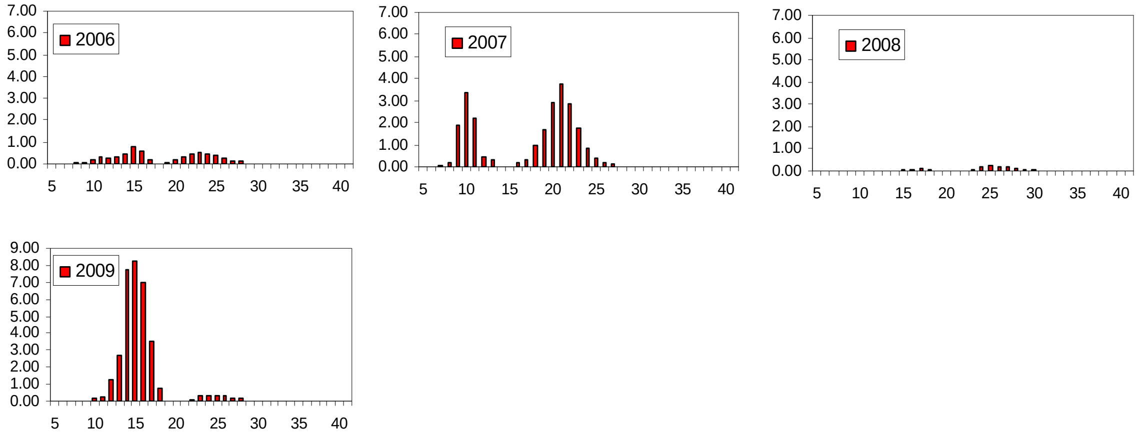


Figure 2.3.7 – Continued

Table 2.3.2 - The average abundance (number and weight (kg) per 30 min) of striped red mullet annually for the FR-EVHOE survey in the Celtic sea (VIIg, h, j) and in the Bay of Biscay (VIIIa,b).

Year	Celtic Sea (VIIg, h, j)		Bay of Biscay (VIIIa, b)	
	Number/30minutes	W(kg)/30minutes	Number/30minutes	W(kg)/30minutes
1997	0,02	0,00	3,77	0,16
1998	0,02	0,00	4,68	0,09
1999	0,10	0,03	0,81	0,05
2000	0,16	0,03	3,13	0,14
2001	0,04	0,01	20,48	0,91
2002	0,29	0,08	2,85	0,08
2003	0,66	0,10	20,02	0,85
2004	1,40	0,26	1,16	0,15
2005	0,43	0,11	29,08	1,00
2006	0,14	0,01	4,89	0,24
2007	0,23	0,05	7,32	0,20
2008	0,36	0,11	7,95	0,47
2009	0,10	0,03	5,73	0,74

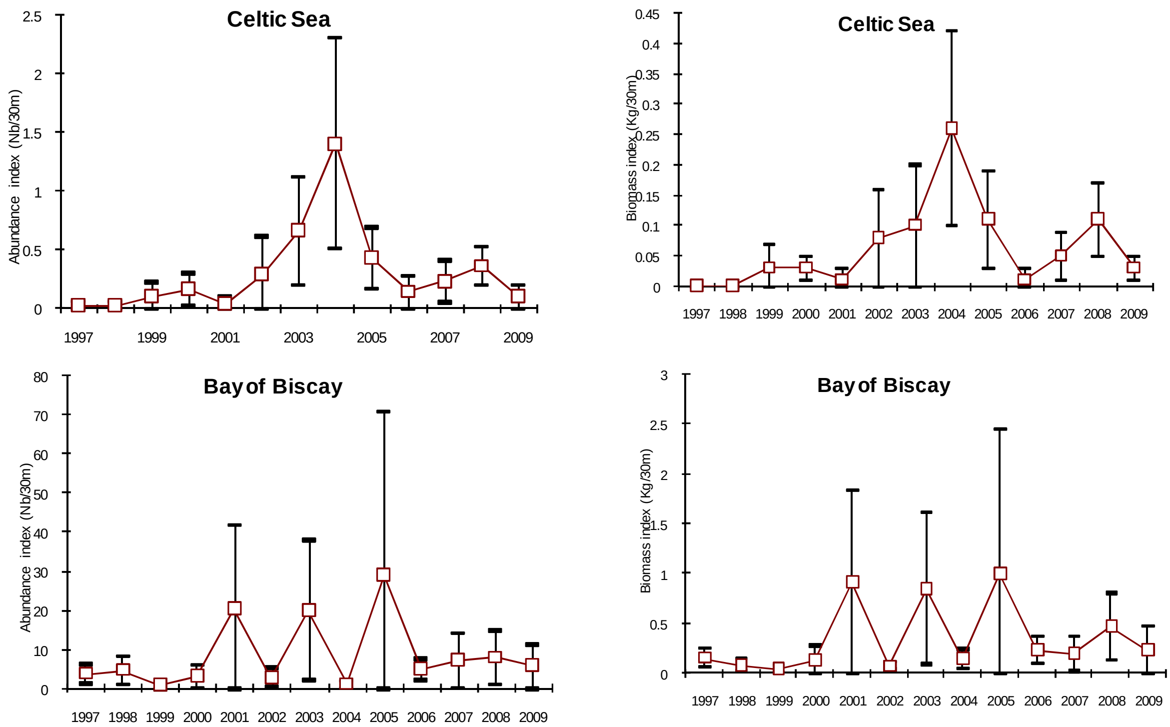


Figure 2.3.8 - Time series of abundance (N) and biomass (kg) per 30 minutes of striped red mullet in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

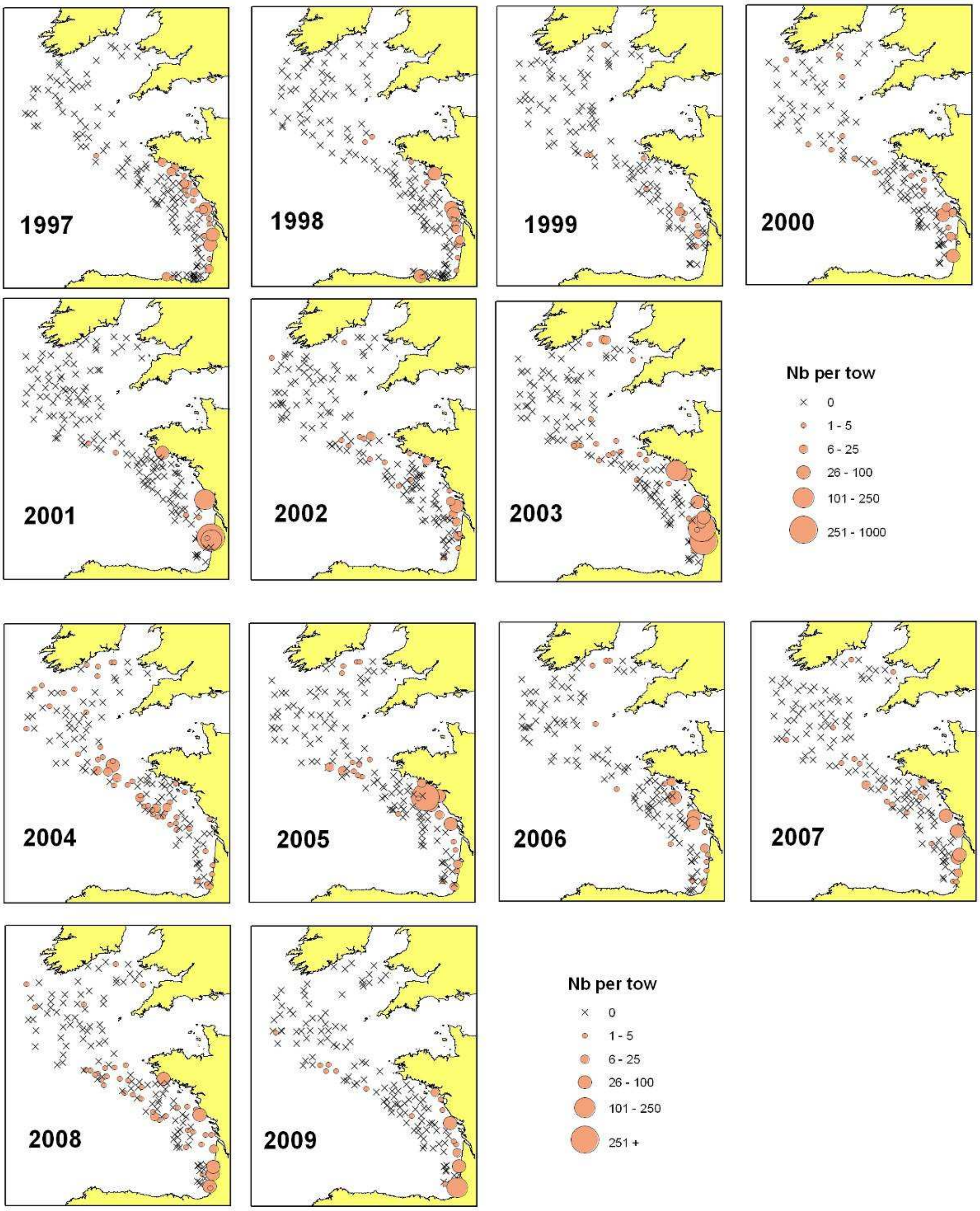


Figure 2.3.9 – Distribution of striped red mullet in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

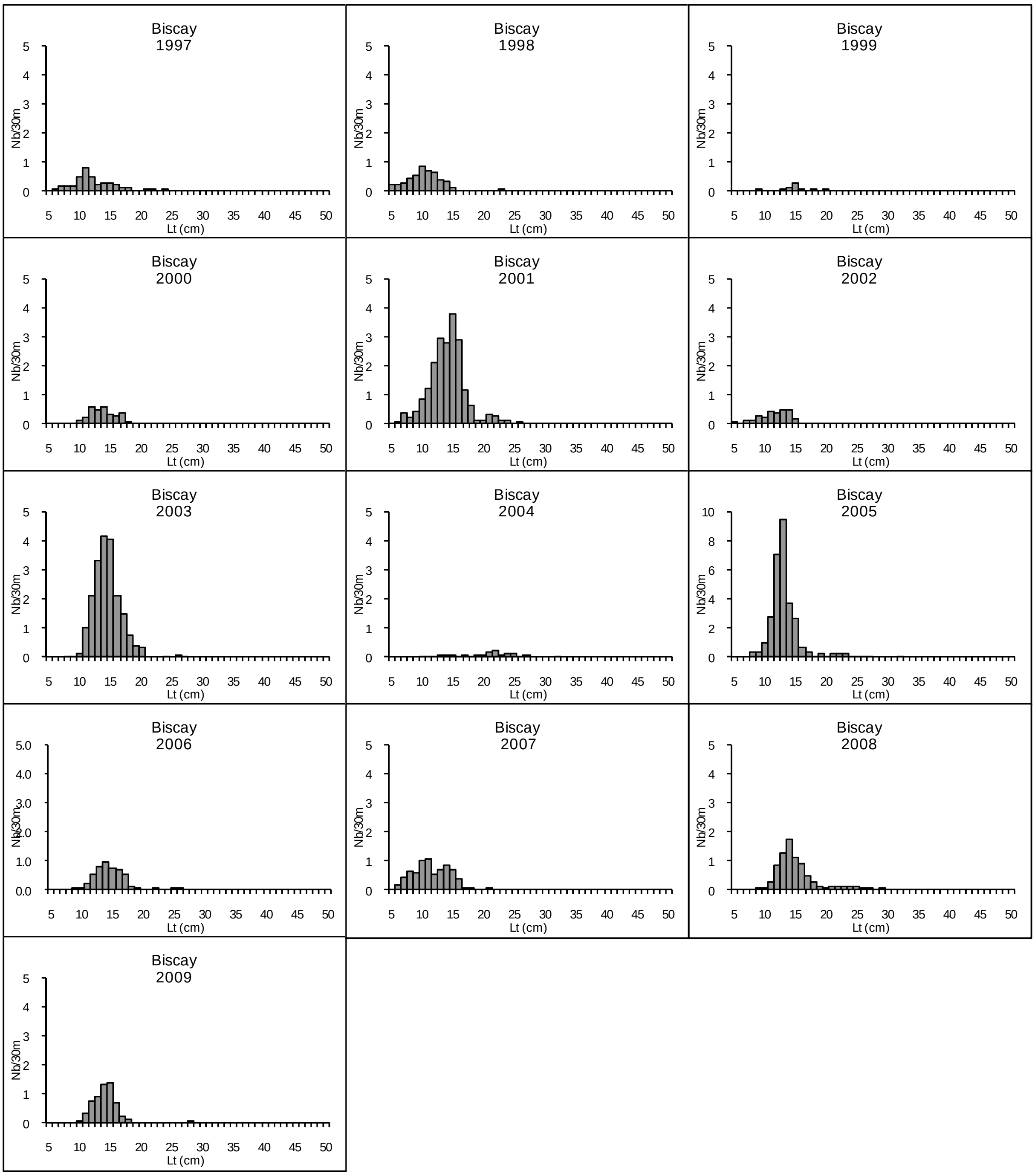


Figure 2.3.10 - Abundance indices (N/30 min) of striped red mullet per size class (length in cm) during FR-EVHOE (Bay of Biscay) from 1997 to 2009.

2.3.2 Red gurnard

Red gurnard abundance is very low in the North Sea in quarter 1. In the eastern Channel, abundance tends to increase since 1999. The spatial distribution of red gurnard in this area observed in October is mainly located in the center of the eastern Channel marked by strong sediments in relation with the potential habitat of this species during this period. There is no variability of mean lengths in the length distribution in which one can notice the complete absence of juveniles in catches.

In the Celtic Sea and the Bay of Biscay, survey indices are higher than in the north and in particular in the Celtic Sea. Since 2006, the abundance index increases gradually in the Celtic Sea with a value in 2009 of 38.7 similar to 2005. Ageing was done in 2006, 2008 and 2009 and for those years, abundance indices at age are provided (Figure 2.3.17).

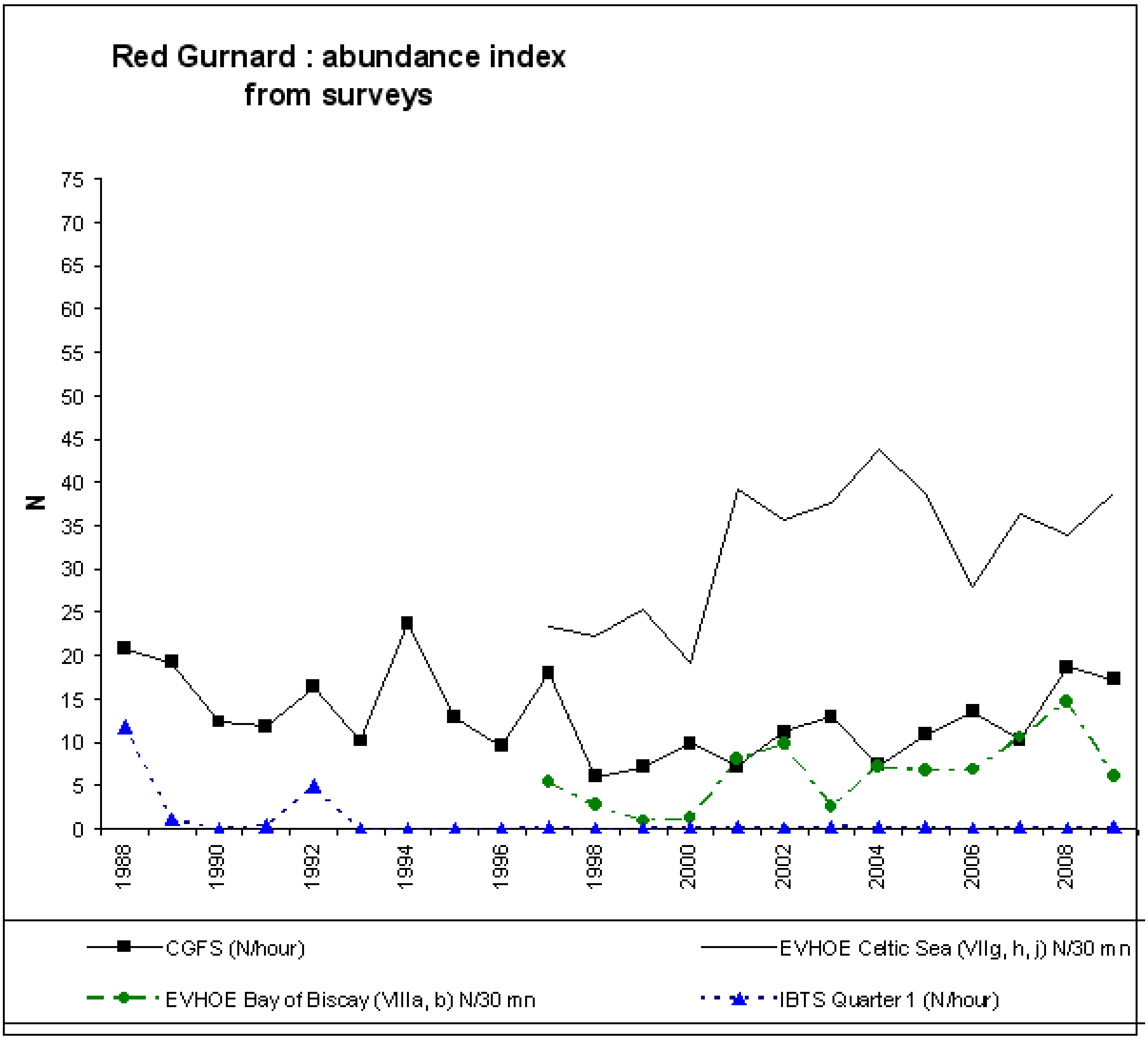


Figure 2.3.11 - Time series of abundance of red gurnard base on FR-Surveys from 1980 to 2009.

Table 2.3.3 - The abundance index (N/h) of red gurnard for International Bottom Trawl Survey (IBTS, IVb,c) and Channel Ground Fish Survey (FR-CGFS, VIId).

Year	IBTS Quarter 1	CGFS
1986	11.87	20.77
1987	1.17	19.24
1988	0.00	12.33
1989	0.37	11.87
1990	4.91	16.35
1993	0.00	10.12
1994	0.00	23.71
1995	0.00	12.89
1996	0.00	9.56
1997	0.06	18.01
1998	0.00	6
1999	0.00	7.09
2000	0.11	9.83
2001	0.12	7.17
2002	0.05	11.18
2003	0.24	12.92
2004	0.22	7.34
2005	0.10	10.9
2006	0.00	13.56
2007	0.23	10.26
2008	0.00	18.64
2009	0.24	17.24

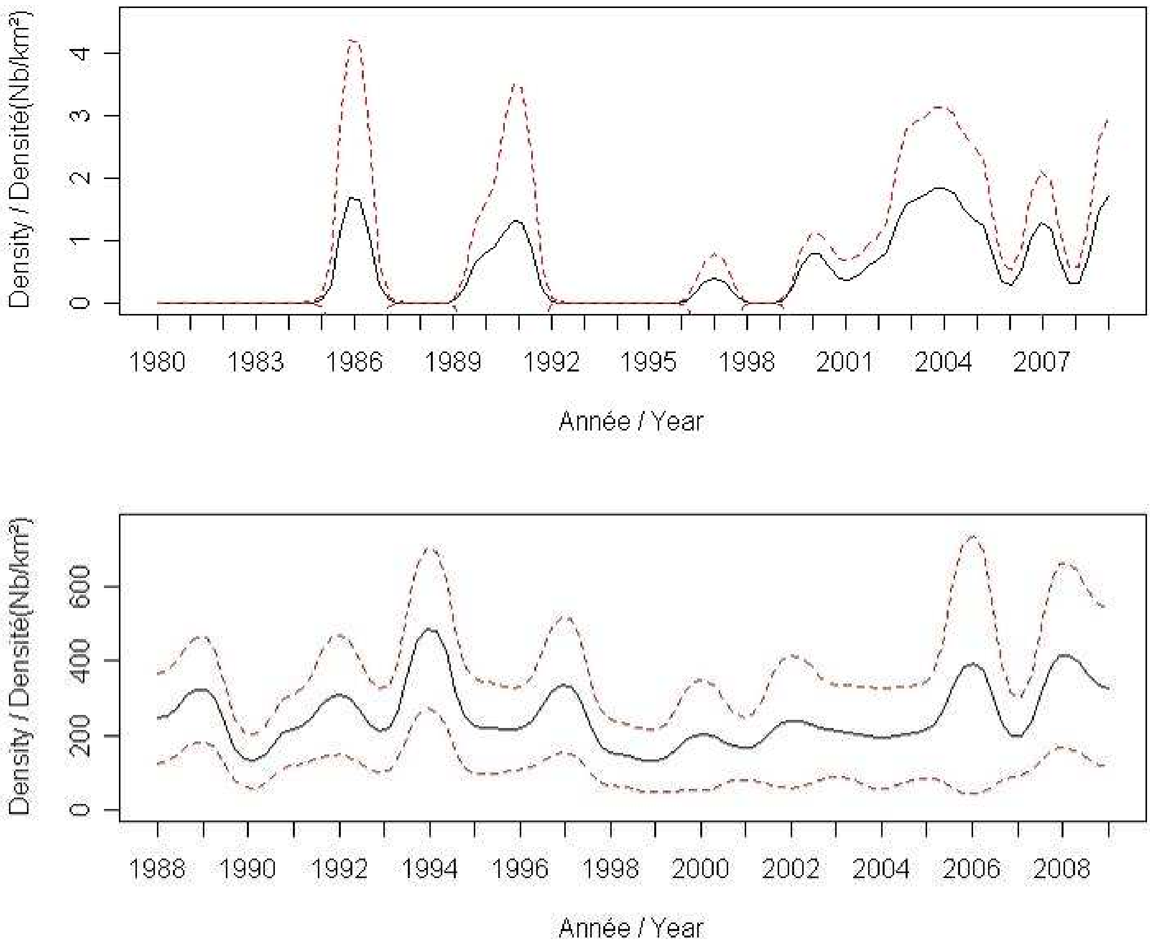


Figure 2.3.12 - Time series of abundance of red gurnard in the North Sea based on IBTS data (N/km²) from 1980 to 2009 (upper panel) and in the eastern Channel based on FR-CGFS data (N/km²) from 1988 to 2009 (lower panel). Lines are smoothed, 95% confidence intervals are shown.

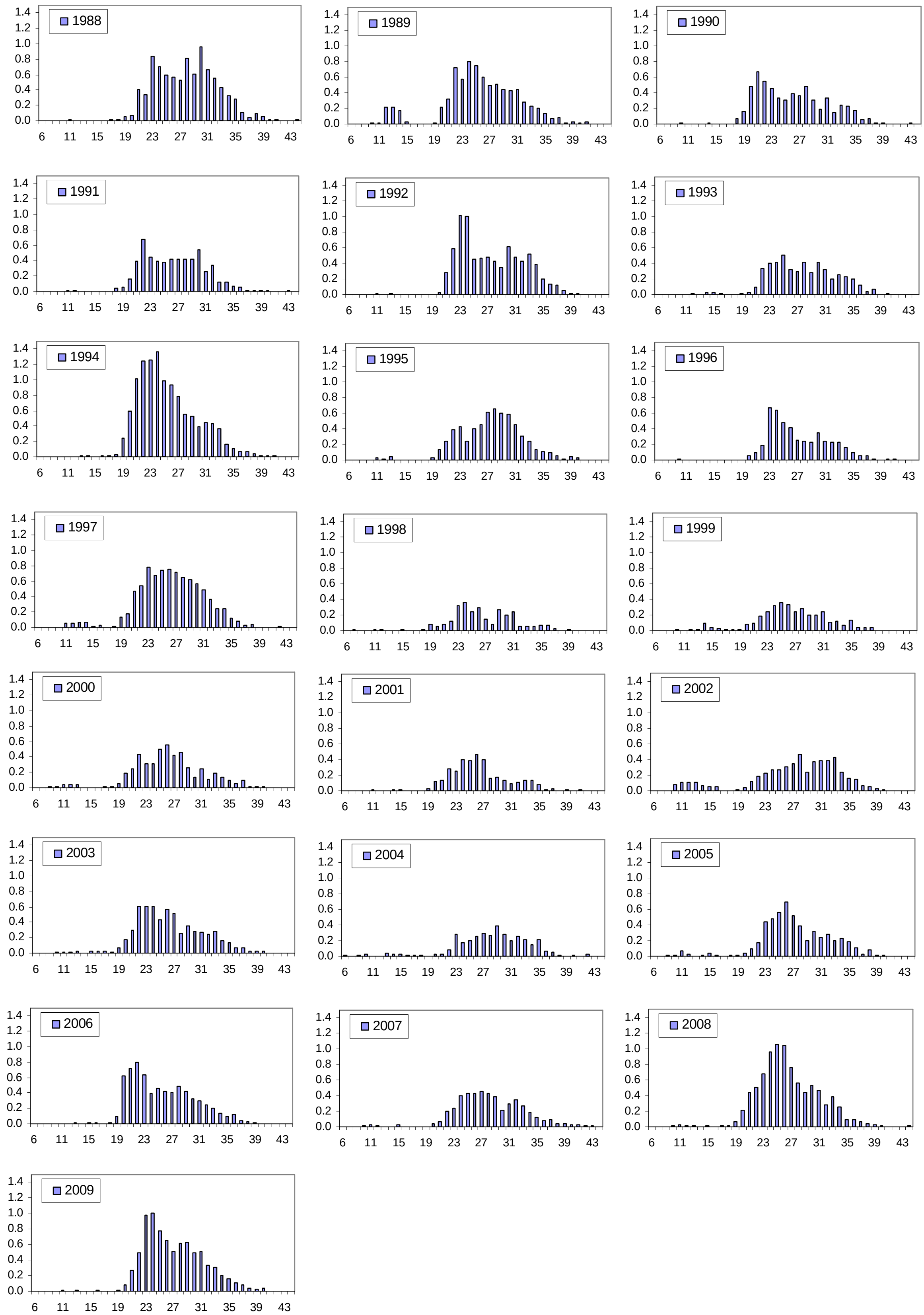


Figure 2.3.13 – Abundance index at length of red gurnard in the Eastern Channel from FR-CGFS surveys.

Table 2.3.4 – The average abundance (number and weight (kg) per 30 minutes) of red gurnard annually for FR-EVHOE survey in the Celtic sea (VIIg, h, j) and in the Bay of Biscay (VIIIa,b).

Year	Celtic Sea (VIIg, h, j)		Bay of Biscay (VIIIa, b)	
	Number/30minutes	W(kg)/30minutes	Number/30minutes	W(kg)/30minutes
1997	23.29	2.24	5.34	0.43
1998	22.32	2.35	2.79	0.25
1999	25.22	2.35	0.9	0.09
2000	19.12	1.65	1.2	0.11
2001	39.11	3.03	8.02	0.7
2002	35.75	2.97	9.79	0.69
2003	37.62	2.8	2.61	0.21
2004	43.76	3.66	7.19	0.58
2005	38.84	3.39	6.7	0.57
2006	27.89	2.56	6.82	0.53
2007	36.41	3.18	10.59	0.81
2008	33.97	3.39	14.71	1.42
2009	38.7	3.82	6.04	0.53

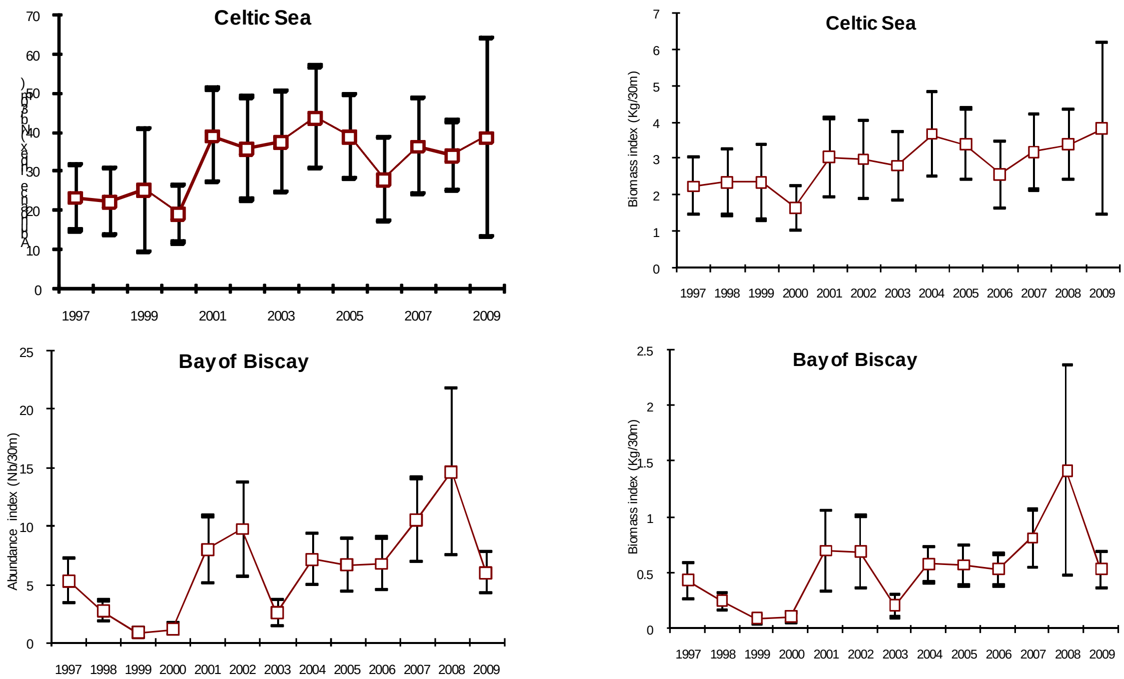


Figure 2.3.14 – Time series of abundance (N and W(kg)/30 min) of red gurnard in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

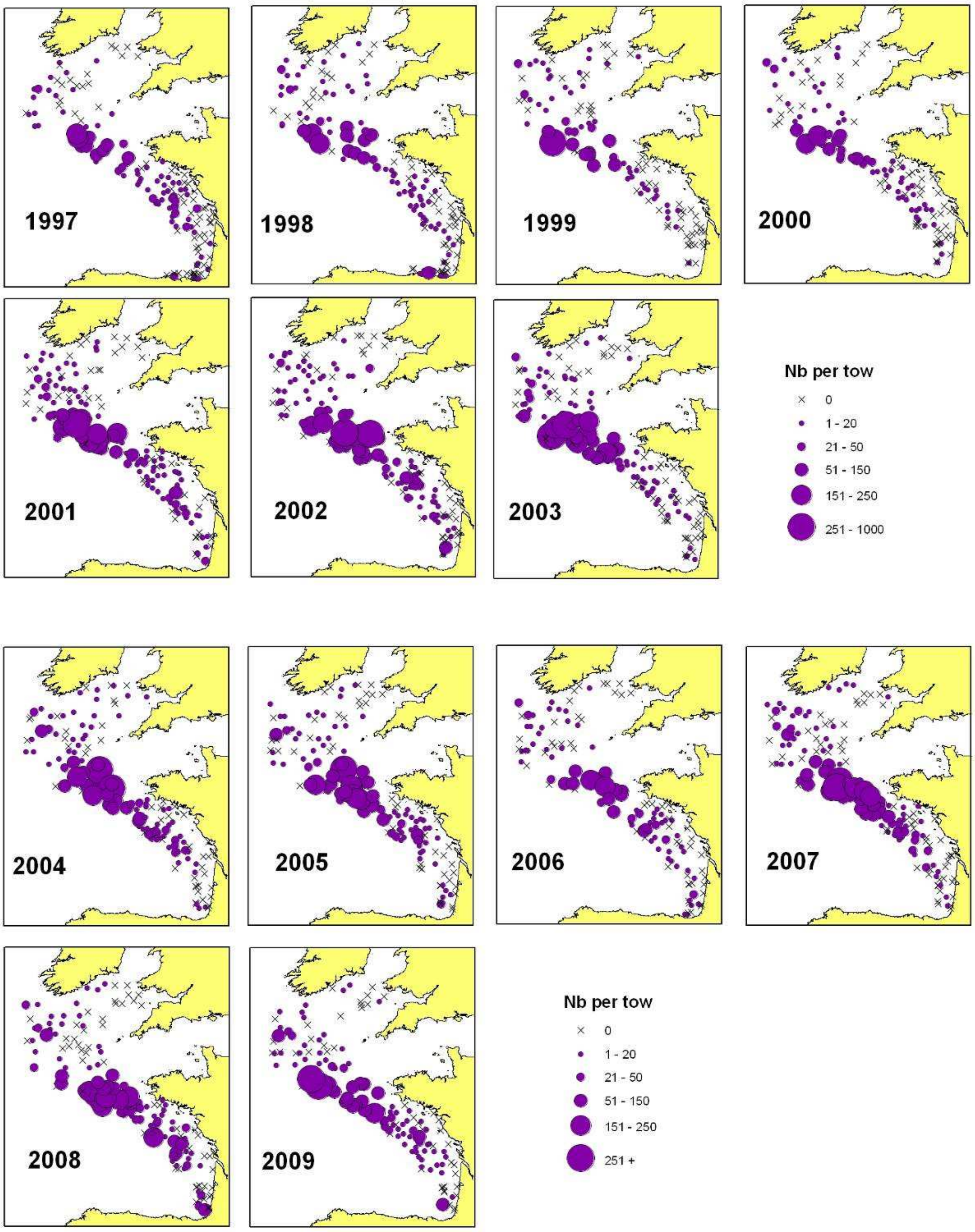


Figure 2.3.15 – Distribution of red gurnard in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

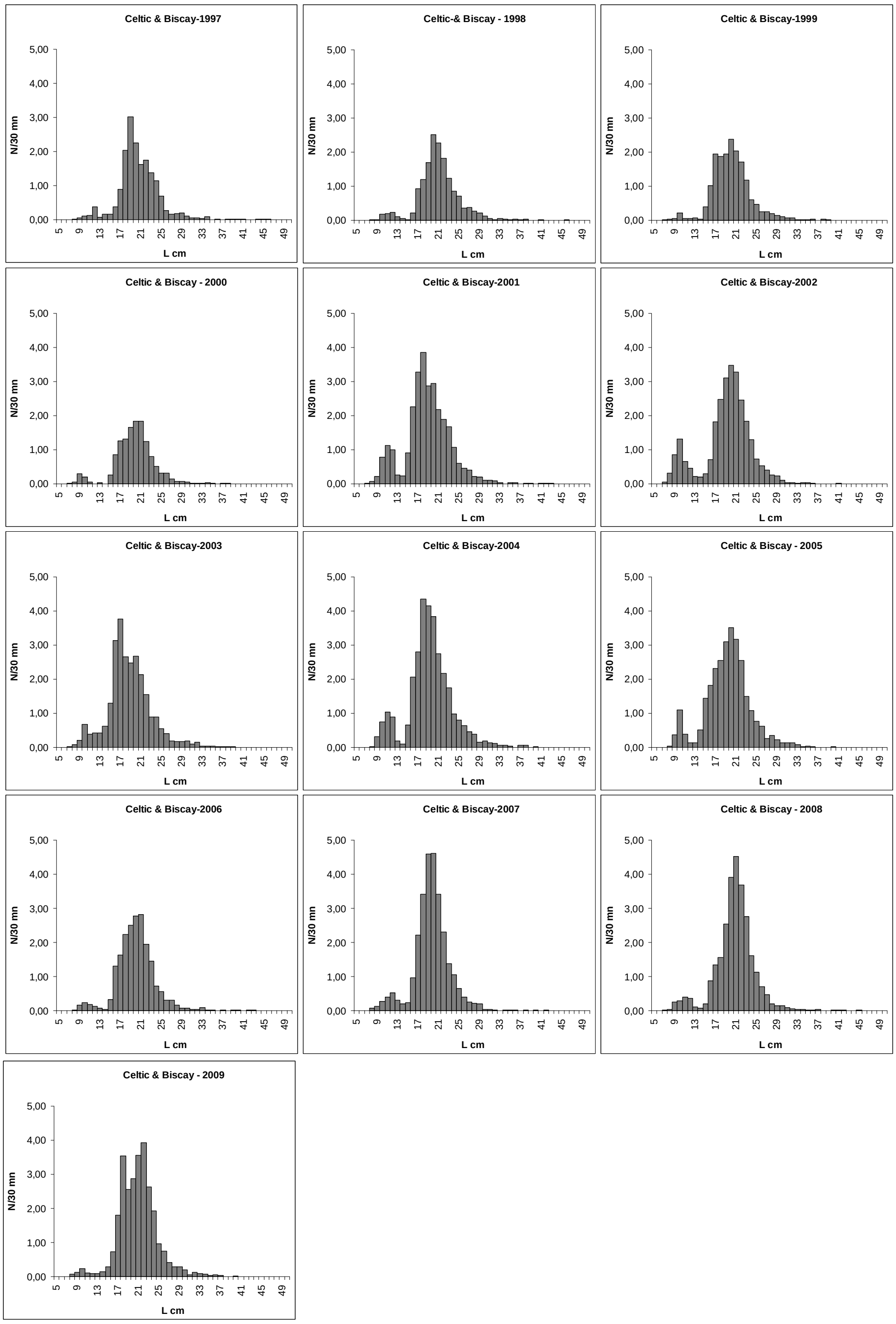


Figure 2.3.16 - Length abundance index of red gurnard in the combined areas of Celtic Sea and bay of Biscay from FR-EVHOE surveys series.

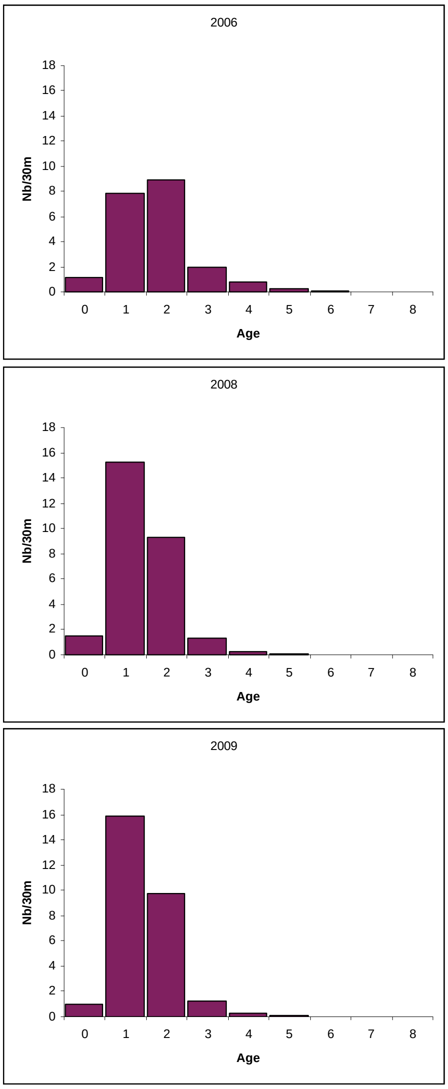


Figure 2.3.17 - Abundance index at age of red gurnard in the combined areas of Celtic Sea and Bay of Biscay from FR-EVHOE surveys series for 2006, 2008 and 2009.

2.3.3 Tub gurnard

Tub gurnard abundance indexes are very low all along the series in the North Sea (especially during quarter 1) and the Eastern Channel. One can notice that this species is more regularly seen in the catches the last years in the North Sea. Concerning the abundance during the CGFS survey, the general trend is stable. The length distribution is stretched and sometimes shows two modes separating juveniles and adults. The abundance of tub gurnard in the area covered by the EVHOE survey is too low to provide meaningful information. This species belongs to the bycatch species and is mainly caught by demersal fisheries and more particularly by trawlers.

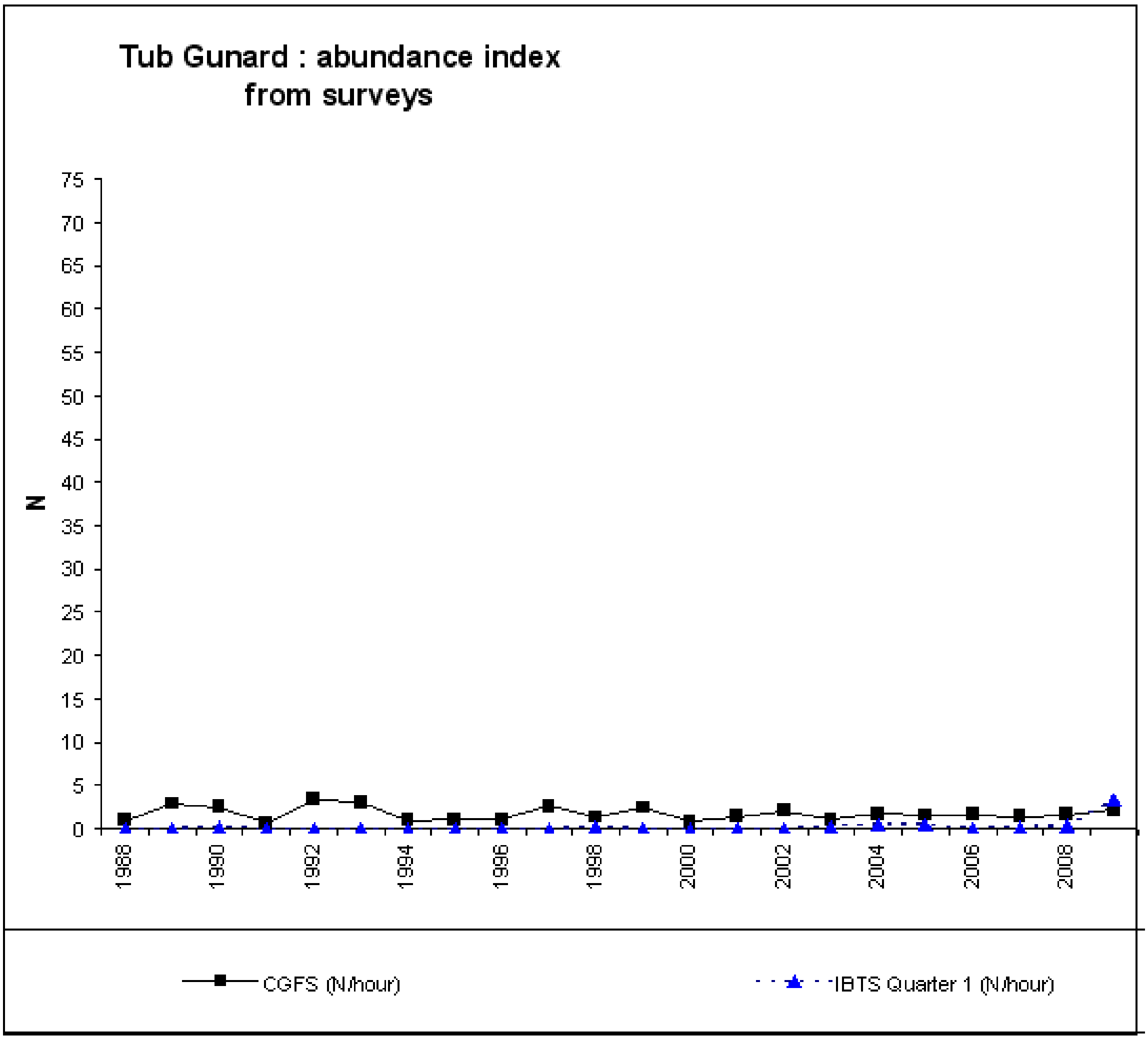


Figure 2.3.18 – Time series of abundance of tub gurnard based on FR-Surveys from 1980 to 2009

Table 2.3.5 – Abundance index (Nb/hr) of tub gurnard from International Bottom Trawl Survey (IBTS, IVb,c) and Channel Ground Fish Survey (FR-CGFS, VIId).

Year	IBTS Quarter 1	CGFS
1980	0.00	
1981	0.00	
1982	0.00	
1983	0.00	
1984	0.00	
1985	1.58	
1986	0.00	
1987	0.00	
1988	0.00	0.94
1989	0.00	2.88
1990	0.13	2.52
1991	0.00	0.59
1992	0.00	3.4
1993	0.00	3.03
1994	0.00	1
1995	0.00	1.01
1996	0.00	1.09
1997	0.00	2.61
1998	0.10	1.36
1999	0.00	2.46
2000	0.00	0.84
2001	0.00	1.44
2002	0.00	2.11
2003	0.29	1.09
2004	0.5	1.72
2005	0.48	1.56
2006	0.00	1.61
2007	0.18	1.39
2008	0.36	1.64
2009	3.34	2.19

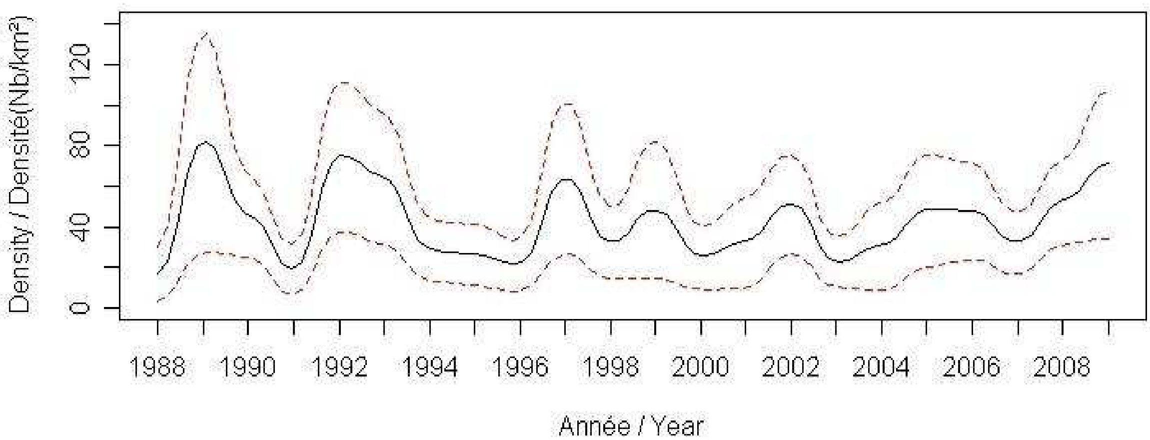


Figure 2.3.19 - Time series of abundance of tub gurnard in the eastern Channel based on FR-CGFS data (N/km²) from 1988 to 2009. Line is smoothed, 95% confidence intervals are shown.

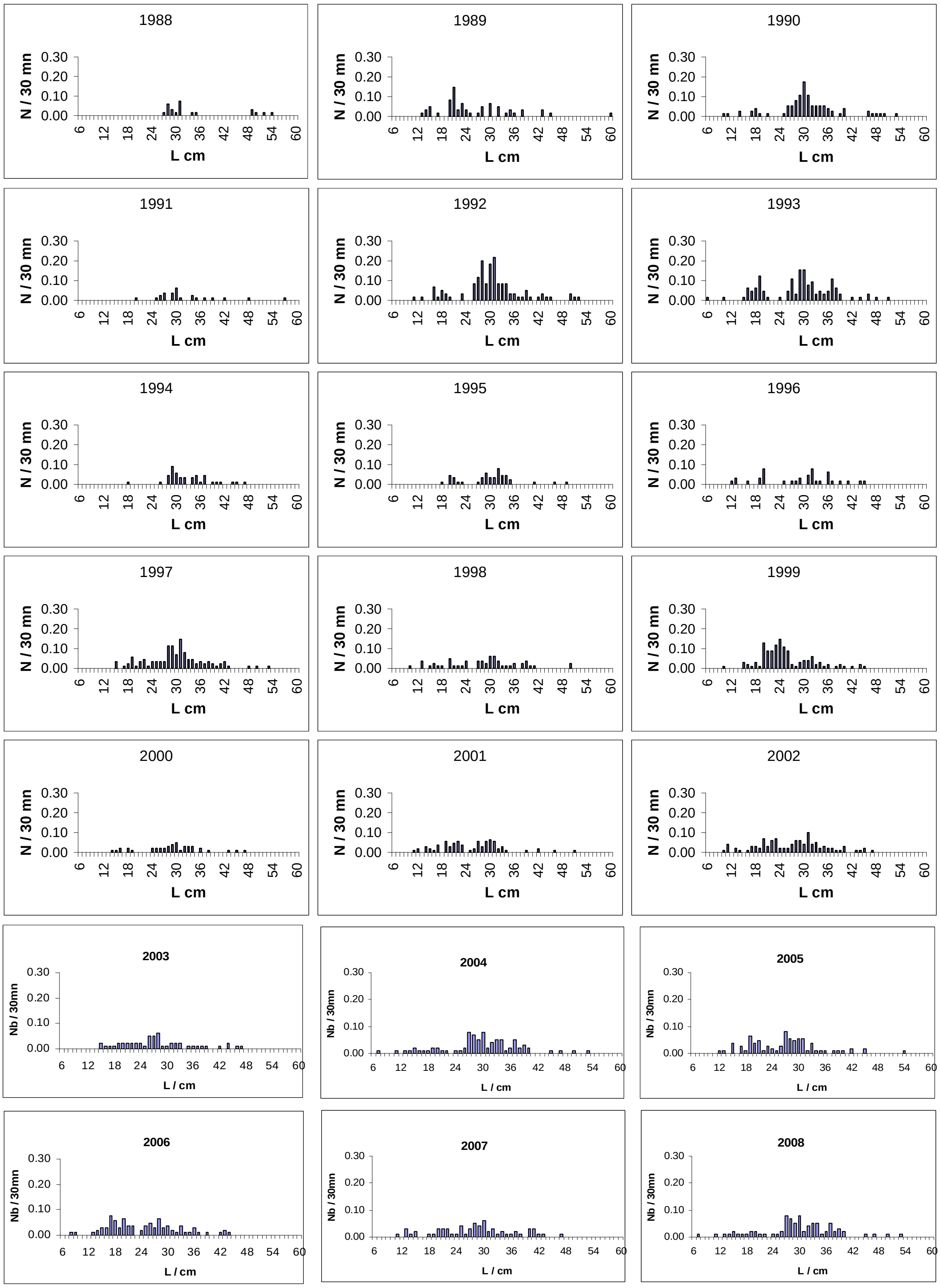


Figure 2.3.20 - Length abundance indices of tub gurnard from FR-CGFS surveys in VIId.

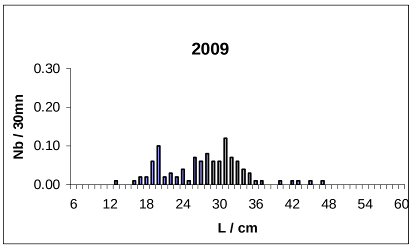


Figure 2.3.20 – Continued

2.3.4 John Dory

John dory is almost absent in the IBTS Q1 catches until the beginning of the 21st century. Similar to tub gurnard the indices for John dory are very poor in the North Sea, but abundance seems to increase. In the eastern Channel, indices are higher and one can notice an increase in the 10 last years. This abundance increase is due to a widening of the spatial distribution. It should be interesting to know if this phenomenon is just temporary or if it can be put in relation with more favourable environmental parameters. The species has also shown an increase in abundance in the EVHOE survey area, mostly in the Celtic Sea.

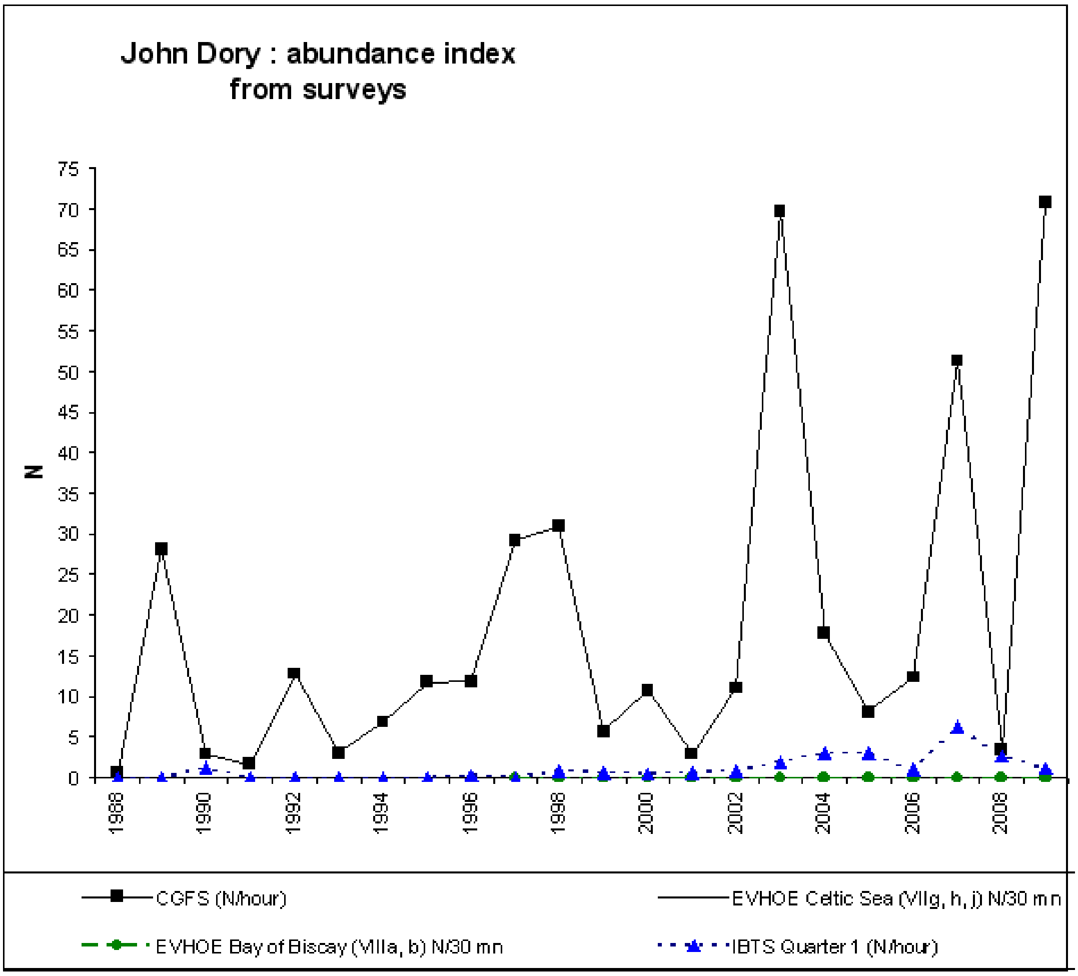
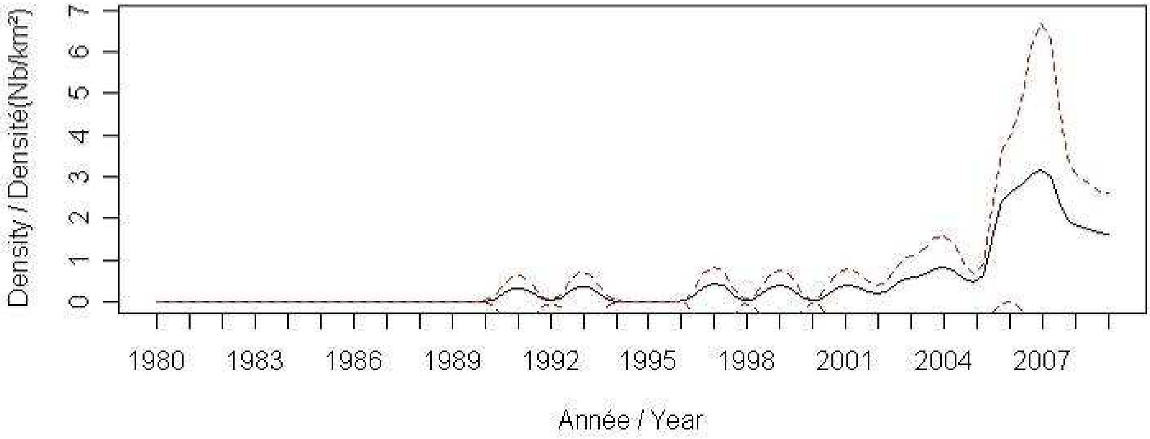


Figure 2.3.21 - Time series of abundance of john dory based on FR-Surveys from 1980 to 2009.



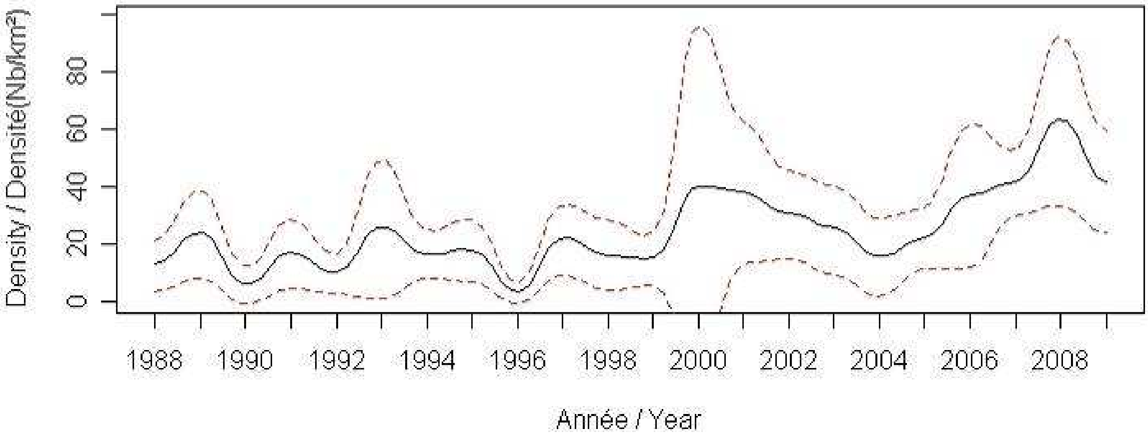


Figure 2.3.22 - Time series of abundance of John dory in the North Sea base don IBTS data (N/km²) from 1980 to 2009 (upper panel) and in the eastern Channel base on FR-CGFS data (N/km²) from 1988 to 2009 (lower panel). Lines are smoothed, 95% confidence intervals are shown.

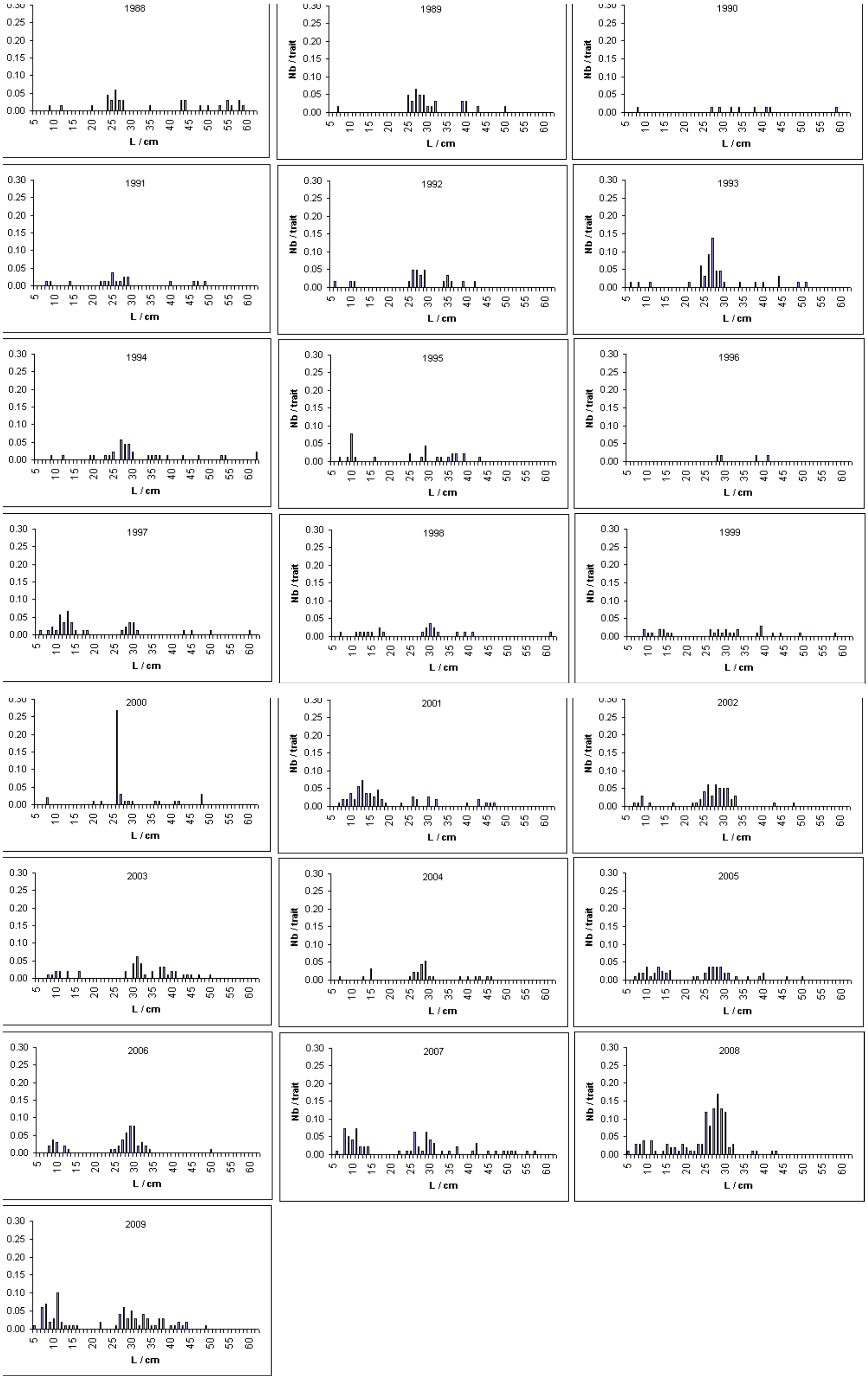


Figure 2.3.23 - Length abundance indices of john dory from FR-CGFS surveys in VIId.

Table 2.3.6 – The average abundance (N and W (kg) per 30 minutes) of John dory annually for FR-EVHOE survey in the Celtic sea (VIIg, h, j) and in the Bay of Biscay (VIIIa,b).

Year	Celtic Sea (VIIg, h, j)		Bay of Biscay (VIIIa, b)	
	Number/30minutes	W(kg)/30minutes	Number/30minutes	W(kg)/30minutes
1997	0.95	0.35	1.07	0.36
1998	2.11	1.35	0.89	0.51
1999	2.15	1.51	0.36	0.32
2000	1.65	1.27	0.1	0.07
2001	1.51	1.28	2.56	0.88
2002	2.09	1.86	2.14	0.54
2003	2.54	2.91	2.67	1.71
2004	2.9	2.83	2.2	0.96
2005	2.13	2.15	1.82	0.71
2006	2.16	2.5	1.66	0.9
2007	4.52	2.85	2.12	0.82
2008	3.97	2.54	3.16	3.05
2009	2.81	2.65	2.27	1.45

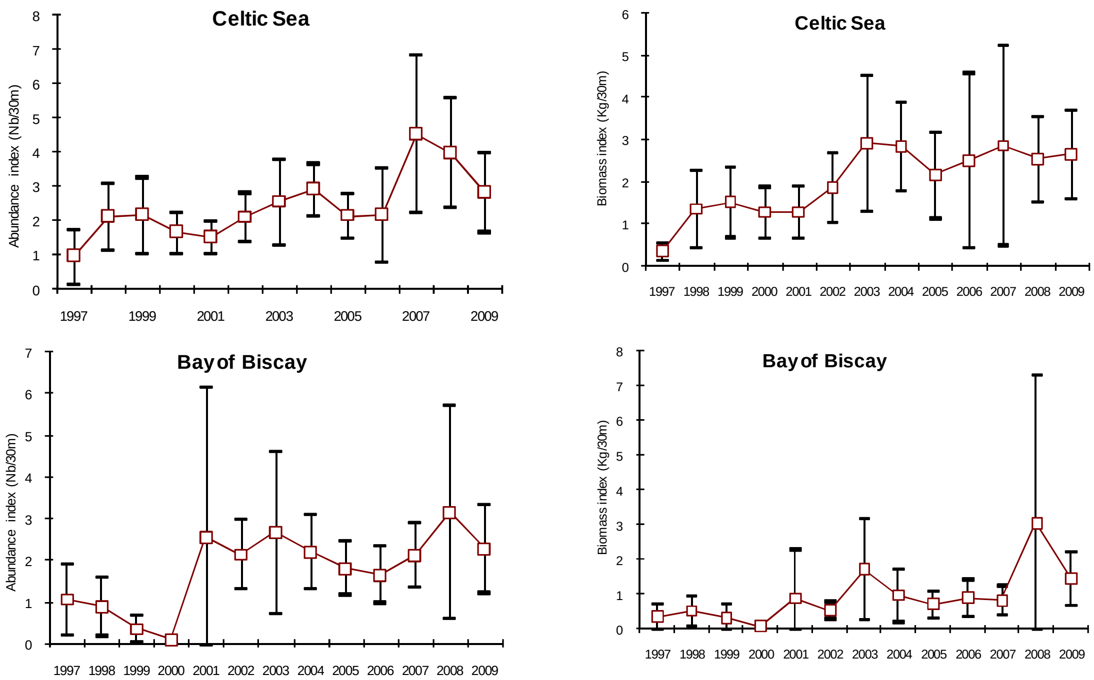


Figure 2.3.24 – Time series of abundance (N and W(kg)/30 min) of John dory in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

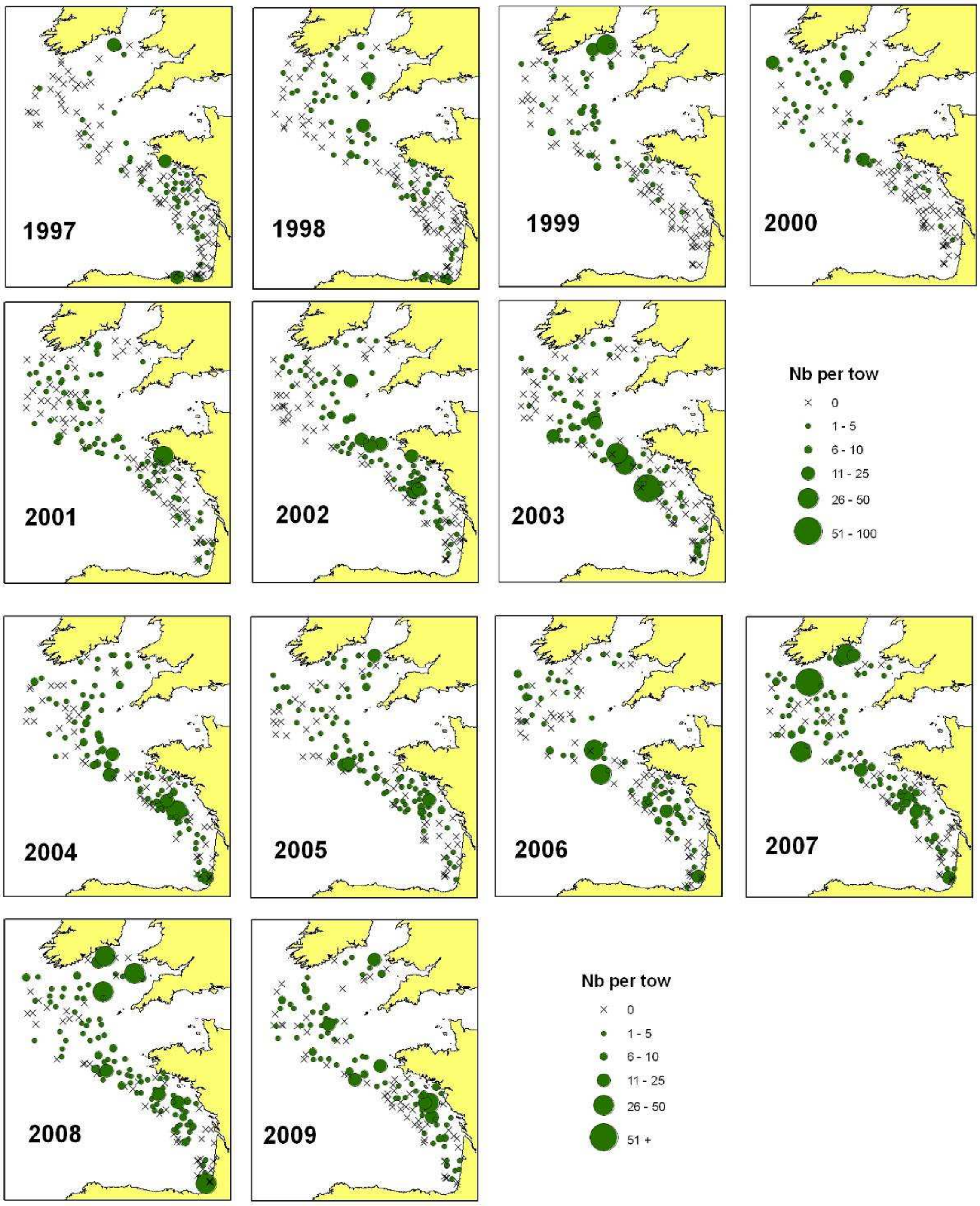


Figure 2.3.25 – Distribution of John dory in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

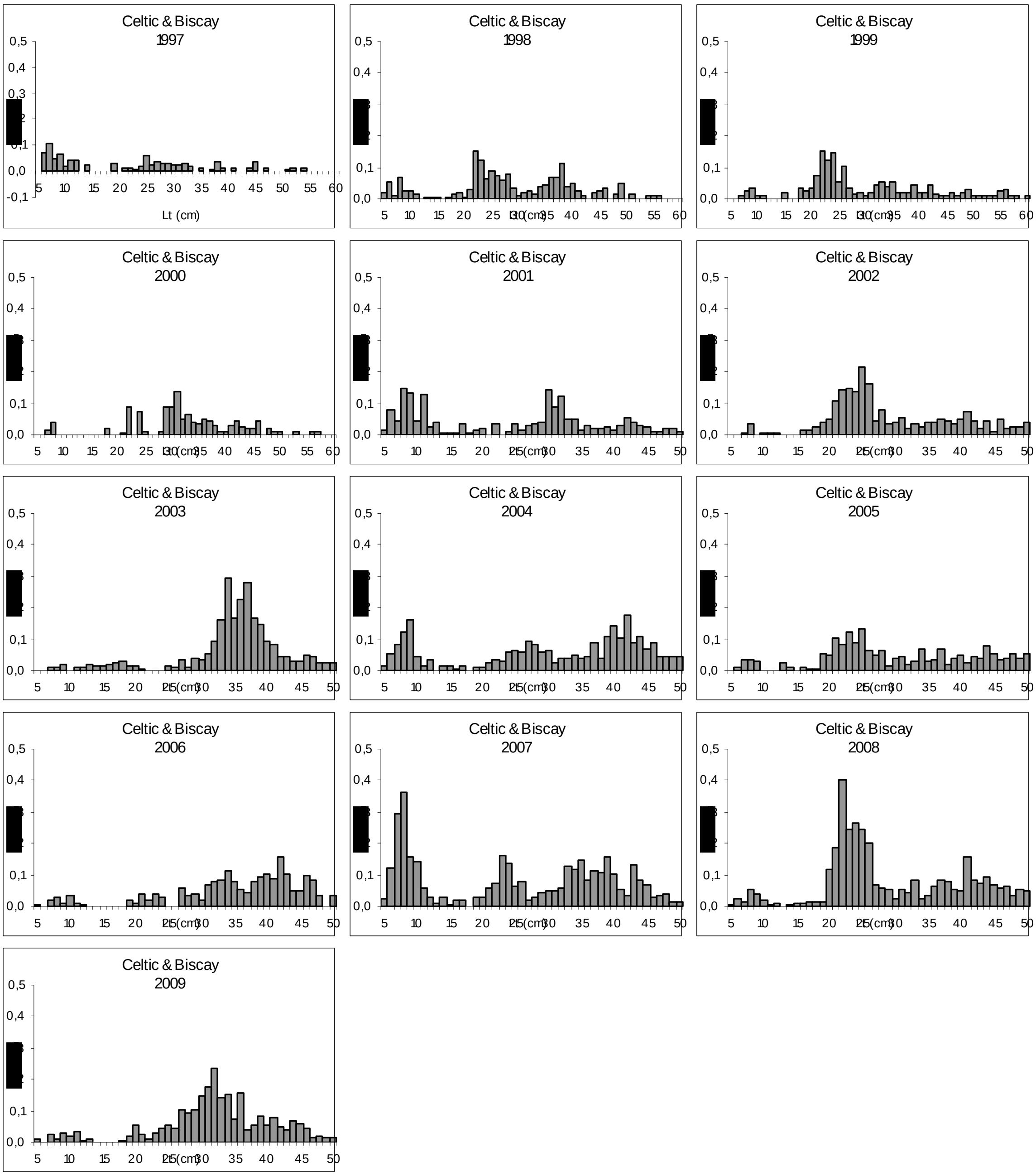


Figure 2.3.26 – Length abundance index of John Dory in Celtic Sea and Bay of Biscay from FR-EVHOE surveys series.

2.4 vTI-SF: Dab[4]

General biology
Dab *Limanda limanda* (Linnaeus, 1758) is a widespread demersal species on the Northeast Atlantic shelf and distributed from the Bay of Biscay to Iceland and Norway; including the Barents Sea and the Baltic Sea. Next to sandeel, it is the most abundant species in the North Sea (Daan et al., 1990). Its centre of distribution in the North Sea is located in the southern North Sea (Lozán, 1988; Daan et al., 1990).

With regard to growth parameters it is an intermediate species with a maximum life span of 12 years and a population doubling time of about 1.4-4.4 years (Froese and Pauly, 2004).

Spawning, pelagic development and settlement of postlarvae all occur within the spawning ground (Bohl, 1959). Settled 0-group specimens migrate to nearby nursery grounds (Bolle et al., 1994).

Recruitment success in terms of 0-group abundance in autumn is negatively related to spring water temperature (Henderson, 1998).

Regional migrations (<200 nm distance) occur. Tagging experiments show that German Bight spawners represent a transient aggregation from the entire North Sea (Rijnsdorp et al, 1992).

Sex- and age-dependent seasonal within-area migrations between spawning grounds, nursery areas and adult feeding grounds are triggered by changes of water temperature (Saborowski and Buchholz, 1997). Spatial aggregations and habitat selection do not occur, although very fine scale distribution patterns, i.e. patchiness, are present at scales < 2 km (Stelzenmüller et al., 2005a, 2005b).

The 0-group shows a general preference for sheltered areas, but not for particular depth or salinity zones (Riley et al., 1981). Correspondingly, dab appears to be euryhaline and eurytherm (Bohl 1959, Henderson and Holmes, 1991).

Trends in abundance and biomass for the North Sea
Five surveys were used to analyse trends in abundance and biomass (Table 2.4.1)[5]. From these surveys the IBTS has an almost complete coverage of the ICES divisions IIIa and IV. The beam trawl survey only covered selected parts.

The beam trawl survey (BTS) is conducted in the North Sea under participation from England, Belgium, Germany, France and the Netherlands, and is coordinated by the ICES Working Group on Beam Trawl Surveys (WGBEAM). The BTS is accomplished each year from July to September and has been carried out since 1985 in the southeastern North Sea. In 1996, it was further extended northward. Trawl speed is set at 4 knots over the ground; nominal haul duration is 30 minutes. Sampling strategy for age, sex and maturity differs between the countries. Analyses were restricted to the German, English and Dutch BTS.

The German survey started in 1991, covering areas off the Jutland coast. The year 2006 is missing in the German series as a result of technical failures. A light beam trawl is used with a width of 7.2 m and five tickler chains attached without modification. Since 1992 the cod-end mesh size is 40 mm.

The Dutch offshore beam trawl survey started in 1985 using an 8 m steel beam trawl. Mesh size in the cod-end is 40 mm. The English beam trawl survey for the eastern English Channel has been carried out since 1989 using a commercially rigged 4m steel beam trawl. Mesh size in the cod-end is 40 mm.

The international bottom trawl survey (IBTS) is conducted in the North Sea and Skagerrak/Kattegat. It is coordinated by the ICES Working Group on International Bottom Trawl Surveys (WGIBTS), formerly known as the

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5 Additional tables with basic survey information may be found in Appendix 2.4

International Young Fish Survey Working Group (WGIYFS). The IBTS is conducted each year in quarters 1 and 3. Data from both quarters were analysed.

IBTS methodology was gradually harmonized and in 1983 all participating nations used the GOV 36/47 as recommended standard gear. Due to that, the results for IBTS Q1 before 1983 should be considered with some care, as also the coverage of the sampling area was less and some countries did not report all species. The average horizontal net opening of the GOV is approximately 20 m with a 20 mm mesh cod-end. The vertical opening is of approximately 5 m. Standard fishing speed is 4 knots measured as trawl speed over the ground. Each haul lasts 30 minutes. The IBTS is conducted in the entire North Sea within the 200-m depth contour, including the Skagerrak and Kattegat. Usually each rectangle is fished by vessels of two different countries, so that at least two hauls are obtained per rectangle.

Table 2.4.1 – Survey characteristics.

	BTS Germany	BTS Netherlands	BTS England	IBTS Q1	IBTS Q3
Area	IVb	IV	IV, VIId	IV, IIIa	IV, IIIa
Period	August	August-September	Aug.-Oct.	Jan.-March	Jul.-Sep.
First year	1991	1987	1989	1965	1991
Haul duration	30 min	30 min	30 min	30 min	30 min
Average trawling speed	4 kn	4 kn	4 kn	4 kn	4 kn
Gear	7 m beam trawl	8 m beam trawl	4 m beam trawl	36/47 GOV, BOT, DHT, FOT, H12, H18, HOB, HT, SOV, VIN, KAB	36/47 GOV
Horizontal net opening	7.2 m	8 m	4 m	20 m	20 m
Mesh size	40 mm	40 mm	40 mm	20 mm	20 mm

Survey Index (SI) calculation
To emphasise a better interpretation of survey CPUEs, area-based indices (SI) as swept area estimates were calculated by stratum. The SI is a stratified abundance estimate calculated from catch-per-tow data using the stratum areas as weighting factor (Cochran, 1953; Saville, 1977). Respective confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

Sizes of the strata were calculated by ArcGIS 9.3.1 (Table 2.4.2) based on Mollweide projection. Four different stratification schemes were tested. By minimizing survey variance and applying kriging (exemplified by IBTS Q3) to delineate survey strata with homogeneous distribution of dab, (1) a dab stratification scheme was developed (Fig. 2.4.1 A). This scheme was further compared to the IBTS Q3 survey being (2) re-stratified according to ICES roundfish areas (roundfish stratification) (Figure 2.4.1 B) and according to (3) areas chosen for generating age-length keys for plaice (P- *Pleuronectes platessa*) and sole (S-*Solea solea*) (PS stratification) described in van Keeken et al., (2005) (Figure 2.4.1 C). Finally, (4) unstratified Sis were calculated.

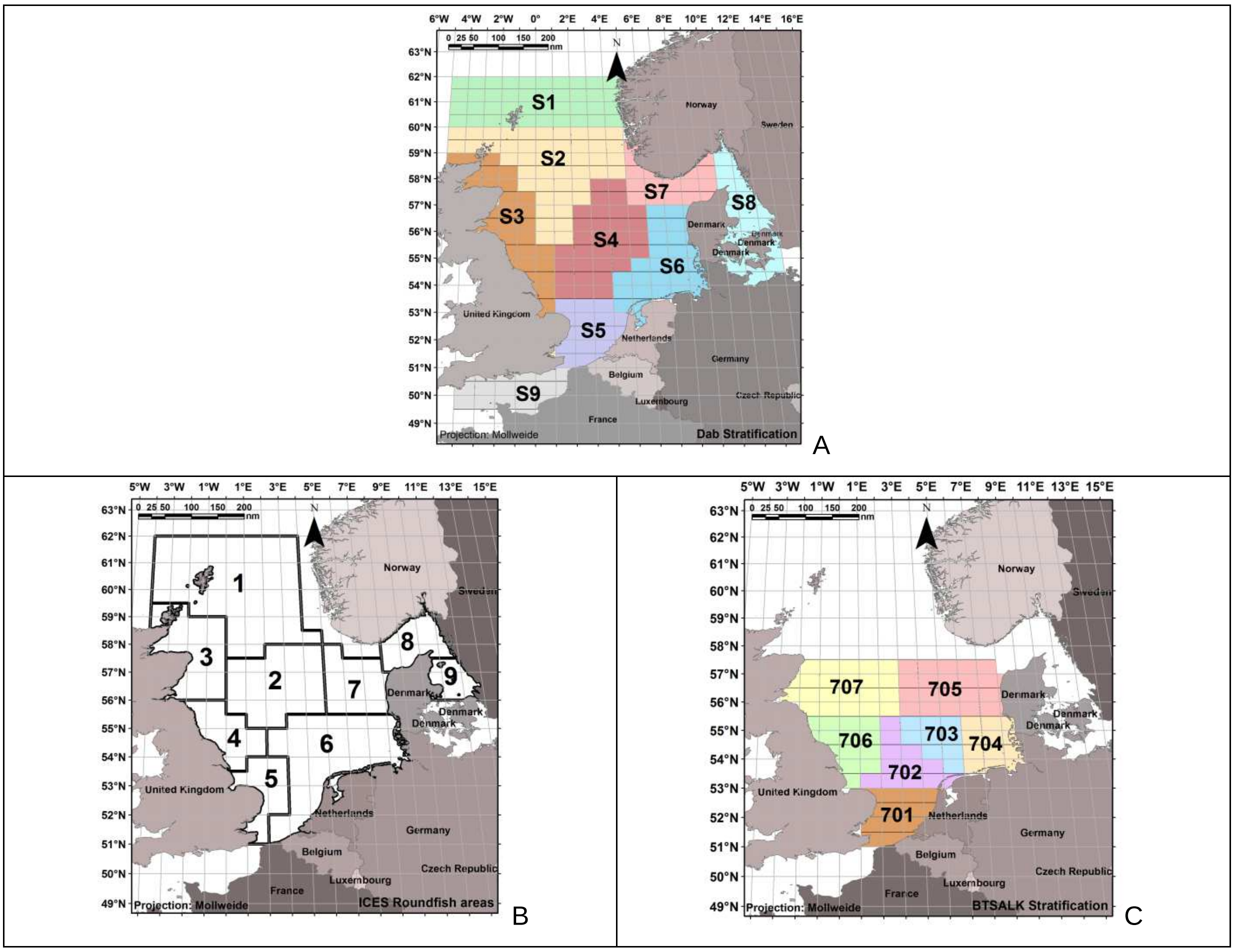

Figure 2.4.1 – Stratification schemes tested for the analysis of dab. Dab stratification (A), ICES roundfish stratification (B) areas and PS stratification (C) according to van Keeken *et al.* (2005).

Table 2.4.2 – Areas [nm2] for dab stratification, roundfish stratification and PS stratification.

Dab stratification		Roundfish areas		PS stratification	
Stratum	nm^2	Area	nm^2	Stratum	nm^2
1	34446.54	1	50833.73	701	11605.86
2	43227.10	2	24884.37	702	12277.08
3	24439.31	3	18713.77	703	9395.74
4	31614.74	4	11571.03	704	10767.47
5	14848.38	5	10413.95	705	20615.48
6	24849.86	6	35744.6	706	12463.28
7	13732.77	7	13610.16	707	20997.39
8	18096.21	8	10090.87		
9	14637.25	9	5812.38		

Data sources

For IBTS Q1 and Q3 the "ICES DATRAS CPUE per length per haul" dataset was used. This dataset does not include sex separated data. The mean length by sex was estimated from the "ICES DATRAS exchange" data. For IBTS Q1 and Q3 no age data were available. Hence, abundance index, biomass index, length frequency and mean length by sex has been analysed for sexes combined only.

For the Dutch BTS the "ICES exchange data" were used with the missing year 2007 being included. The year 2007 was missing in the ICES dataset, but was provided by IMARES. The abundance index, biomass index, length frequency, age frequency and sex frequency has been analysed. Data on age and sex were only available for the years 2005 and 2007.

For the English BTS "ICES exchange data" were used. Complete data over the time series were available for stratum 5 and 9. In stratum 3 only three years (1990, 1995-1996) were sampled, wherefore it was excluded from the graphic charts in the appendix.

The German BTS was analysed for the years with complete data availability i.e. 1997-2008. In 2000 only stratum 6 was sampled and in 2006 the German BTS was not carried out. Abundance Index, biomass index, length frequency, length at age, age frequency, length at sex and sex frequency have been analysed. Age and sex data were available for 1999-2008, excluding 2005 and 2006.

Swept area calculation

Different fishing gears vary in efficiency in catching individual species of fish, even in catching different sizes of fish within one species due to a multitude of factors (Gunderson, 1993). This is a big problem in comparing catch data from different surveys. Therefore, the analysis was restricted to using swept area for analysing catch rates. The area swept was estimated from the towing speed and the mean of the horizontal net opening for the IBTS surveys and the width of the beam trawl for BTS respectively. Mean towed distances were calculated by stratum and year. For the IBTS survey no proper weight data were available. For this reason the weight was determined from the length-weight relationship following:

$Tw\ [g]=a*L[cm]^b$

a=0.0103
b=2.9661

Length measurements refer to total length (standard: 1 cm below). Mean length calculations were weighted according to the stratum abundance. Age determinations were based on length-stratified otolith (sagitta) collections. Age data were only available for the bottom trawl surveys. No maturity data were available.

Stratification analysis

The dab stratification was chosen due to the best overall performance (Figure 2.4.2). In particular for the period 1998-2008 the dab stratification shows stability in CI and is slightly better than the unstratified mean. Only in 1997 with its remarkable high confidence interval observed under all stratification schemes, the dab stratification did not perform well. Here, it reached a CI of 42% as compared to the roundfish stratification with 28% and the PS stratification with 34%.

The high value in 1997 was caused by a very large catch recorded in stratum 8 (Kattegat/Skagerrak) with more than 100,000 individuals in one tow (Figure 2.4.3 C). In all further sections, reference is made to the strata outlined in Figure 2.4.1 under the dab stratification scheme.

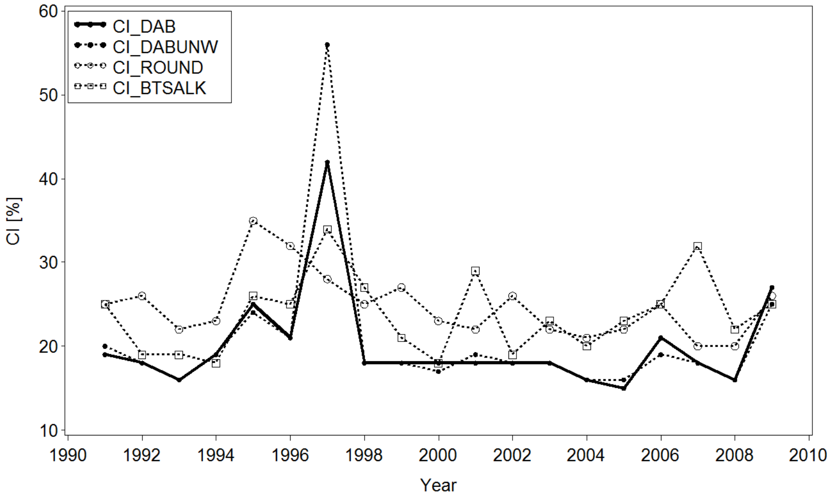

Figure 2.4.2 – Confidence intervals of the survey mean [%] of the dab stratification (CI_DAB), unstratified (CI_DABUNW), roundfish stratification (CI_ROUND) and PS stratification according to age-length-key stratification from IMARES (CI_BTSALK). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

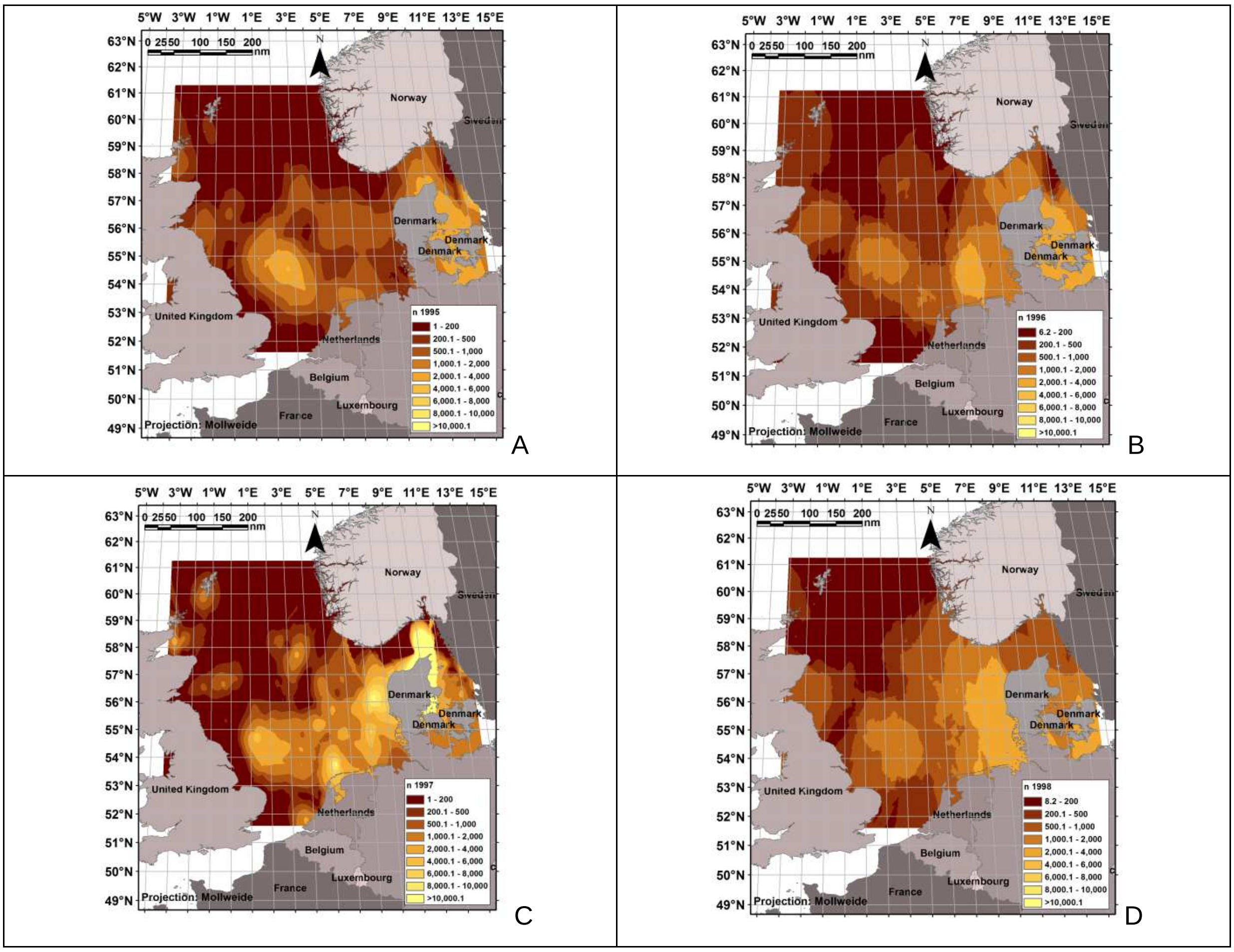

Figure 2.4.3 – Kriging of dab abundance for IBTS Q3, 1995-1998. In 1997 (C), one outlier in the Skaggerrak area (light yellow) caused considerable leverage and a correspondingly high survey CI. Dark shading – low abundance, light shading – high abundance.

Trends in abundance and biomass

Dab is widely distributed in the entire North Sea. Thus, with the complete coverage of the investigation area only IBTS Q1 and Q3 are capable to provide representative estimates of the stock abundance and biomass. All BTS surveys provide only local information of parts of the stock.

The results indicate a pronounced increase in abundance for IBTS Q1 and Q3 surveys for recent years (Figure 2.4.4 A, B). The abundance index for winter survey Q1 is lower than in summer survey Q3. From the mid sixties to the mid eighties the abundance index was at a relative low level with a maximum of 3.5 billion individuals in 1974. Since 1985 the abundance index increased remarkably with a peak of over 6 billion individuals in the year 2007. The maximum value was more than 10.5 billion individuals in the year 2008. This increase in trend is only partly visible in the BTS surveys likely due to the different spatial coverage of the surveys. The Dutch BTS also shows an increase since 2005 (Figure 2.4.4 D). Hardly any trend is observed in the German BTS, probably due to the small area sampled in this survey. However, a sharp increase was indicated at the start of the survey period in 1997 (Figure 2.4.4 C). The English BTS shows no increase in dab abundance in recent years, but a decline in the early 1990s (Figure 2.4.4 E). This decline was also observed in the IBTS Q1 and Q3 and the Dutch BTS.

The stratified analysis shows that stratum 4 and 6 have high abundances (exemplified by IBTS Q3, Figure 2.4.5). These strata also had the highest increase in abundance in recent years. Stratum 8 (Kattegat area) in particular in IBTS Q3 also had high abundance but the abundance was lower than in stratum 4 and 6. As mentioned before the abundance trend is influenced by the extreme value in 1997. The abundance of dab is low for stratum 9 and 5 (Figure App2.4.18). Stratum 9 refers to the area covered by the English BTS. Northwards, the abundance of dab decreases with lowest overall values for stratum 1. This is in accordance with findings from Bohl (1957) showing that dab abundance decreases with increasing depth. For stratum 2 and 3 the abundance is marginally higher than in the preceding strata.

In all surveys since 2005, higher abundances were observed in stratum 4 than in stratum 6, which inhabited the highest population density before. This is a likely westward shift.

Biomass indices for all surveys are presented in Figure 2.4.6. The biomass indices are linked to the abundance indices. Highest values were observed for the IBTS Q3 with a peak of over 535,000 t in the year 2008.

In stratum 5 and 9 the biomass indices were almost similar for the period of 1995 till 2002. Since then higher biomass indices were observed for stratum 5 (Figure App2.4.19), while there was no increase of the abundance index during the same period, except for the last two years (Figure App.2.4.18).

Figure 2.4.4a – Dab abundance indices (n*1 Mill) for IBTS Q3 (A) and IBTS Q1 (B). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

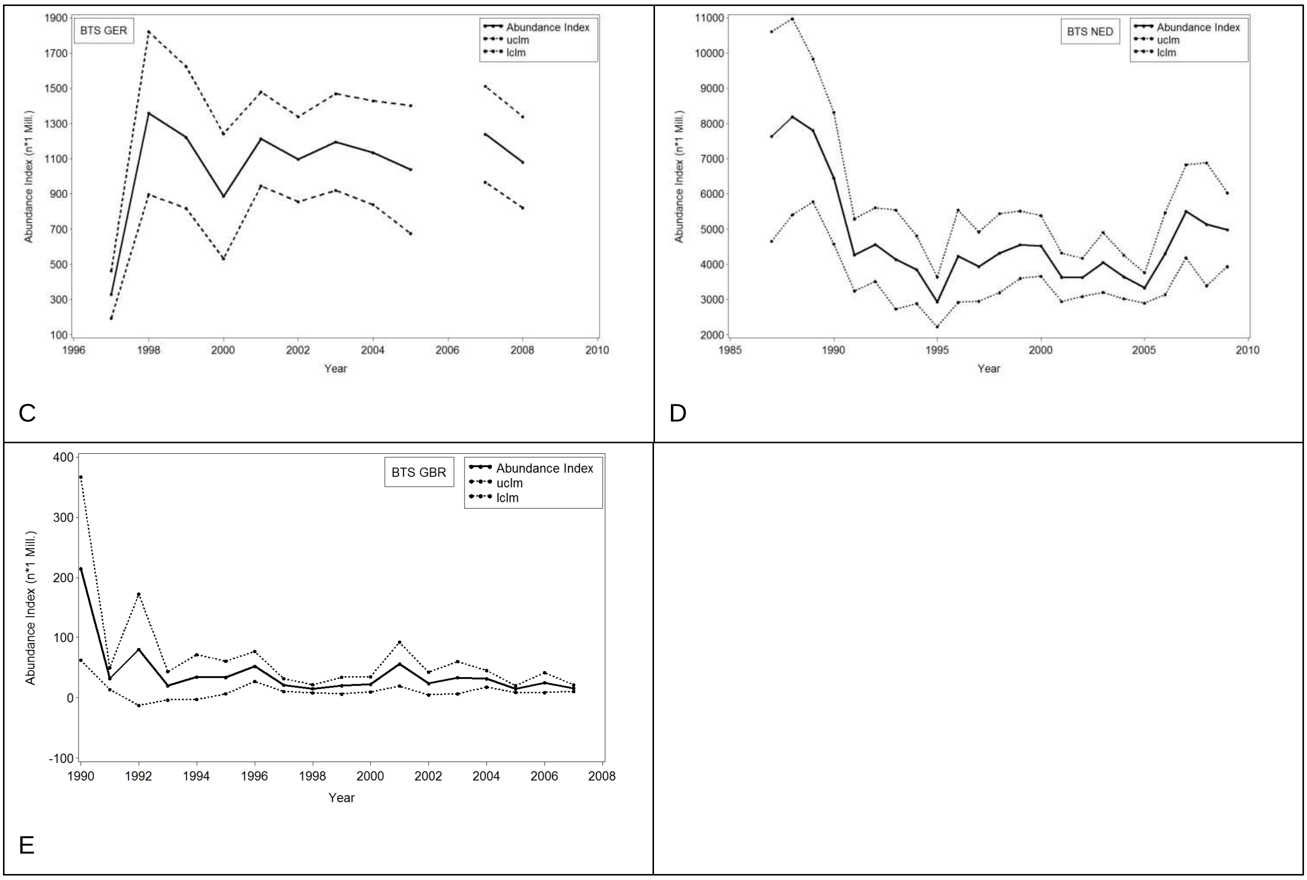

Figure 2.4.4b – Dab abundance indices (n*1 Mill) for German (C), Dutch (D) and English BTS (E). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

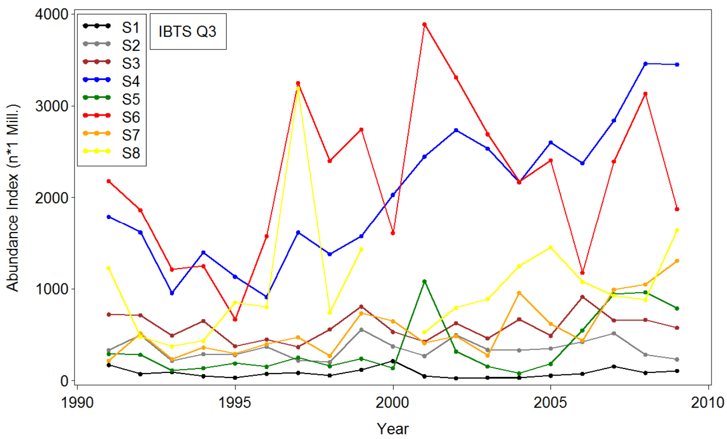

Figure 2.4.5 – IBTS Q3 Dab abundance indices (n*1 Mill.) by stratum for North Sea, 1991-2009.

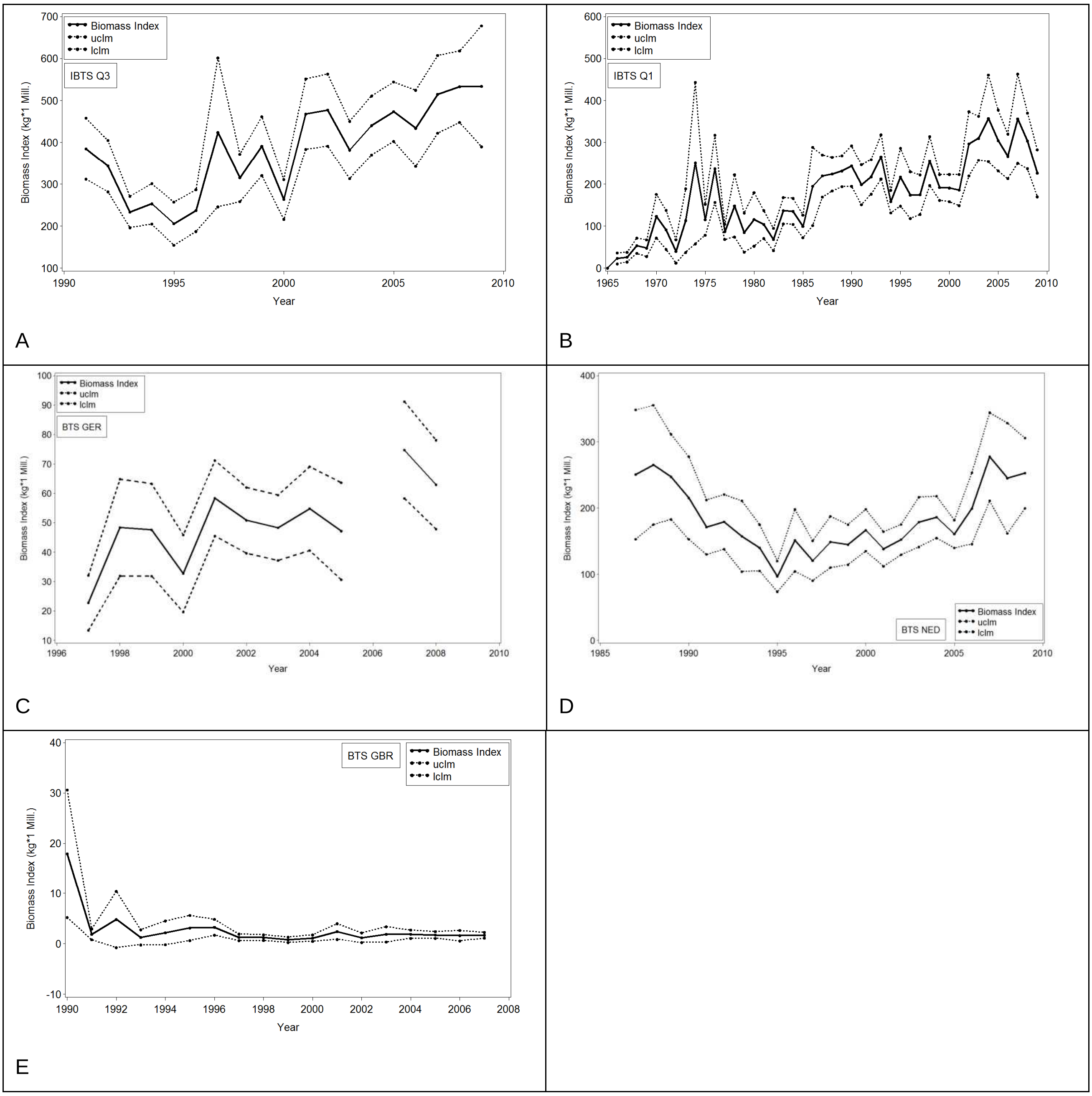

Figure 2.4.6 – Dab biomass indices (kg*1Mill) for IBTS Q3 (A), IBTS Q1 (B) German (C), Dutch (D) and English BTS (E). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

Length composition

Survey mean lengths are presented in Figure 2.4.7. The population was dominated by specimens of 12.5 to 22.5 cm. In general, females were larger than males (exemplified by IBTS Q3, Figure 2.4.7 F). There is no evidence of a trend in mean length for IBTS Q1, IBTS Q3 and German BTS. Little trend is observed in the Dutch BTS, with a slight increase in recent years. A comparatively low mean length was found for stratum 6 for all surveys (exemplified by IBTS Q3, Figure 2.4.8). This is due to the fact, that the Wadden Sea is an important nursery ground for juvenile dab. For 0-group dab highest densities are in shallow waters <20m, age 1 dab prefer the 10-20 m depth band and age 2 dab the 20-30 m depth band (Bolle et al. 2001). High values for the mean length were observed for the northern part of the North Sea (stratum 1 and 2), as well as for the central areas (stratum

4), southwesterly parts (stratum 9) and for the British coast (stratum 3). In stratum 5 comparatively high values were investigated during the winter period, while in summer the mean length was lower.

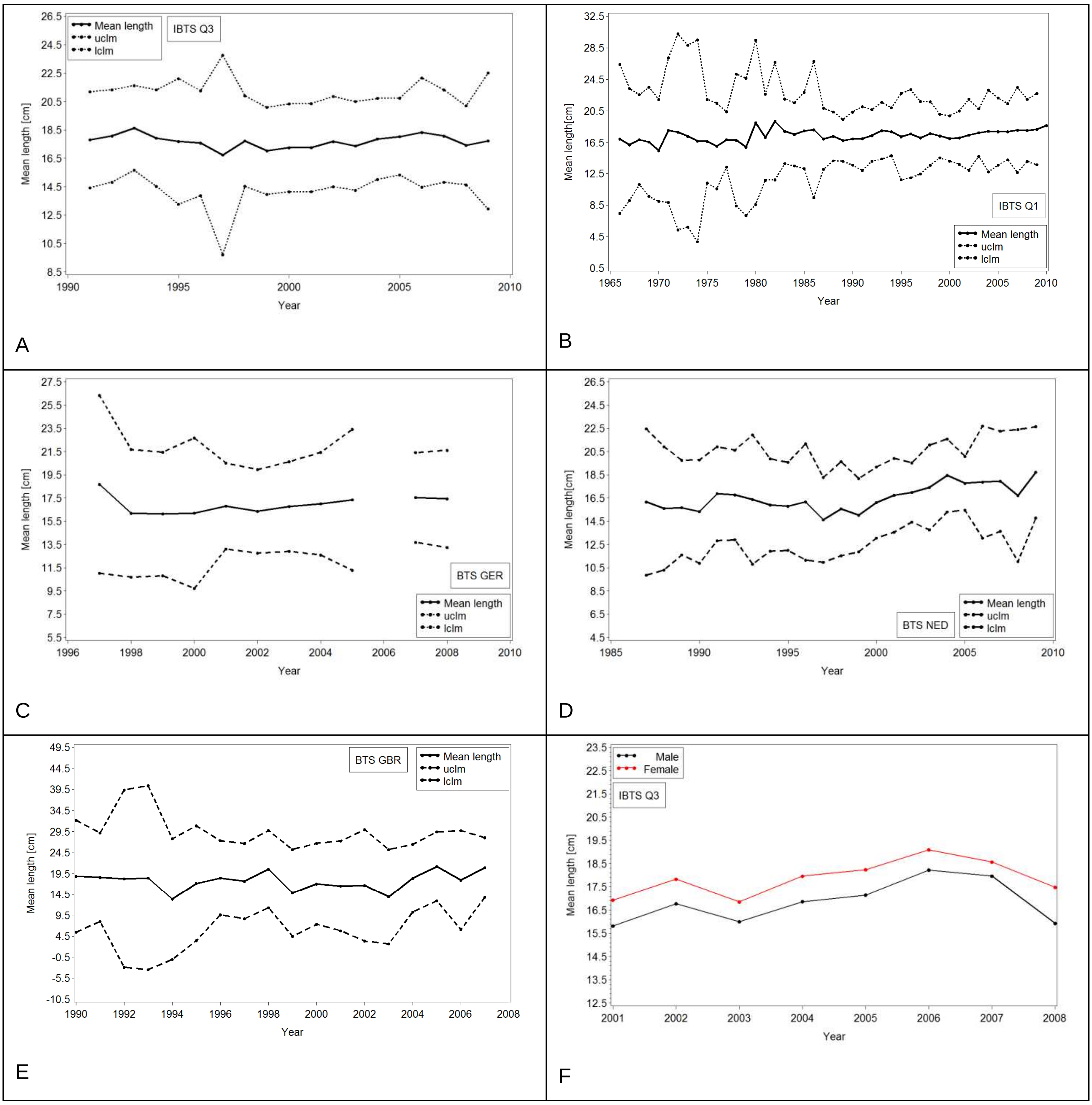

Figure 2.4.7 – Dab mean length [cm] for IBTS Q3 (A), IBTS Q1 (B) German (C), Dutch (D) and English BTS (E). Mean length by sex for IBTS Q3 (F). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

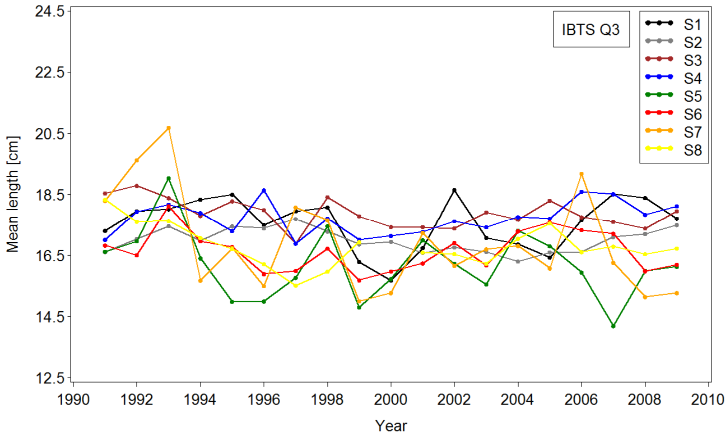

Figure 2.4.8 – IBTS Q3 Dab mean length [cm] by stratum for the North Sea, 1991-2009.

Age frequency
It has to be mentioned that the results for the age were not representative, due to insufficiently low number age readings undertaken so far.

According to the results of the Dutch (Table 2.4.3) and English BTS (Table 2.4.5), highest abundance indices were observed for age-1 dab. Whereas, for the German BTS the most abundant age group was age 2 (Table 2.4.4). With increasing age lower abundance frequencies were observed. Also for the 0-group the abundance indices were comparatively low, most lightly caused by the low catchability of the beam trawl.

Table 2.4.3 – BTS NED Dab age frequency (n*1 Mill.) for North Sea, 2005 and 2007.

Age	2005	2007
0	17.67	0.00
1	834.07	903.00
2	599.35	868.12
3	378.40	802.51
4	379.68	686.28
5	267.19	577.07
6	317.53	383.25
7	168.90	354.10
8	217.05	494.40
9	138.76	180.83
10	7.96	76.60
11	2.29	162.93
12	0.57	0.00
13	0.00	4.46
14	0.00	12.67
Sum	3329.43	5506.22

Table 2.4.4 – BTS GER Dab age frequency (n*1 Mill.) for east North Sea, 1999-2008.

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Sum
1999	0.00	267.07	552.25	265.76	99.79	33.36	1.60	0.74	0.09	0.00	0.00	0.00	1220.65
2000	0.00	334.46	213.84	221.25	59.34	45.25	8.51	3.61	0.67	0.00	0.00	0.00	886.94
2001	0.00	289.95	323.39	360.27	172.10	44.88	17.12	4.18	0.36	0.00	0.00	0.00	1212.25
2002	0.00	275.24	328.73	243.85	184.82	42.44	15.96	4.67	0.44	0.59	0.00	0.00	1096.74
2003	50.70	368.49	343.42	299.46	105.24	24.09	2.75	0.23	0.00	0.00	0.00	0.00	1194.38
2004	62.47	267.60	467.94	201.80	92.88	33.98	5.96	0.99	0.00	0.00	0.00	0.00	1133.61
2005	.	.	.	.	.	.	.	.	.	.	.	.	.
2006	.	.	.	.	.	.	.	.	.	.	.	.	.
2007	6.83	272.74	229.43	281.52	179.47	163.17	59.22	29.25	13.47	2.30	0.85	0.38	1238.65
2008	3.41	307.95	347.72	191.25	105.71	61.54	47.31	11.95	2.66	0.43	0.00	0.00	1079.91

Table 2.4.5 – BTS GBR Dab age frequency (n*1 Mill.) for stratum 3, 5 and 9, 1999-2008.

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Sum
1990	10.61	75.11	61.23	28.19	37.17	2.37	0.00	0.00	0.00	214.67
1991	2.59	9.80	8.85	7.58	2.24	0.64	0.00	0.00	0.00	31.69
1992	3.09	30.80	20.32	17.14	5.99	2.04	0.55	0.00	0.00	79.93
1993	0.73	8.64	4.50	2.49	1.79	1.04	0.29	0.24	0.05	19.76
1994	12.78	10.86	6.85	2.88	0.42	0.20	0.27	0.00	0.00	34.27
1995	1.47	16.57	4.34	6.48	1.60	1.92	1.01	0.27	0.00	33.66
1996	6.00	21.00	16.15	7.24	1.45	0.07	0.00	0.00	0.00	51.91
1997	0.65	3.75	4.42	4.18	1.77	0.23	0.00	0.00	0.00	15.00
1998	6.05	5.81	4.62	3.34	0.08	0.04	0.00	0.00	0.00	19.94

Sex frequency

Results for sex frequency are not representative, due to the low amount of collected data. In general, the population was dominated by females (Table 2.4.6-8). This is in agreement with results from Saborowski and Buchholz (1997)

Table 2.4.6 – BTS NED Dab sex frequency (n*1 Mill.) for North Sea, 2005 and 2007.

Year	Male	Female	Sum
2005	1590.383	1739.046	3329.429
2007	1825.141	3681.081	5506.222

Table 2.4.7 – BTS GER Dab sex frequency (n*1 Mill.) for east North Sea, 1999-2008.

Year	Male	Female	Sum
1999	606.14	614.51	1220.65
2000	427.27	459.67	886.94
2001	601.47	610.78	1212.25
2002	531.25	565.49	1096.74
2003	579.05	615.33	1194.38
2004	604.03	529.58	1133.61
2005	.	.	.
2006	.	.	.
2007	559.25	679.40	1238.65
2008	519.49	560.42	1079.91

Table 2.4.8 – BTS GBR Dab sex frequency (n*1 Mill.) for west North Sea, 1990-2001.

Year	Male	Female	Sum
1990	58.48	156.20	214.67
1991	3.48	28.21	31.69
1992	29.15	50.78	79.93
1993	8.59	11.17	19.76
1994	7.19	27.08	34.27
1995	16.84	16.82	33.66
1996	26.13	25.78	51.91
1997	.	.	.
1998	6.87	8.13	15.00
1999	8.00	11.93	19.94
2000	.	.	.
2001	9.49	46.31	55.80

Trends in abundance for the Baltic Sea

Two surveys were used to analyse trends in abundance and biomass in the Baltic Sea. To estimate the trend in abundance and biomass, the Baltic International Trawl Survey (BITS) for the first (Q1) and the fourth quarter (Q4) were used.

The Baltic cod stock has been monitored annually since 1982 through bottom trawl surveys carried out by most countries surrounding the Baltic. Different gears and design were applied and in 1985 ICES established a Study Group on Young Fish Surveys in the Baltic in order to standardize the surveys. After agreement a common standard gear (TV3) and standard sampling procedures were implemented from 2000 onwards. To calibrate the national surveys from before 2000 with the new gear, a set of conversion factors was produced by making comparative hauls. The TV3 trawl is used in two sizes for different sized research vessels. One has 520 meshes in circumference and one 930 meshes. The BITS is conducted as a depth-stratified survey. The strata are based on Subdivisions and depth layers. Standard haul duration is 30 minutes with a towing speed of 3 knots.

Data sources

To estimate the abundance and biomass indices for the Baltic Sea the "ICES DATRAS CPUE per length per haul" dataset was used. This dataset does not include sex separated data, since no sex analysis is done. Therefore, abundance index, biomass index and mean length has been analysed. The analysis was restricted to the ICES fishing areas c22 and d24.

Swept area calculation
Different fishing gears vary in efficiency in catching individual species of fish, even in catching different sizes of fish within one species due to a multitude of factors (Gunderson, 1993). Therefore, the analysis was restricted to using the swept area method for analyzing catch rates. The area swept by the gear was estimated from the towing speed and the mean of the horizontal net opening. Mean towed distances were calculated by stratum and year.

For the BITS survey no proper weight data were available. For this reason the weight was determined from the length-weight relationship following:

$Tw\ [g]=a*L[cm]^b$

a=0.0103
b=2.9661

Length measurements refer to total length (standard: 1 cm below). Mean length calculations were weighted according to the stratum abundance. No proper age, sex and maturity data were available.

Trends in abundance and biomass
The results indicate a pronounced increase in abundance since 1995 for the Baltic Sea. The abundance of the first quarter is lower than of the fourth quarter (Figure 2.4.9 A, B). Since 2007 a decline in abundance was observed. The increase of dab abundance occurred mainly in ICES fishing area c22, while abundance in ICES fishing area d24 was very low over the time period. Only a slight increase was indicated since 2002. The high value for BITS Q1 (Figure 2.4.9 A) is mainly caused by a very large catch with almost 40,000 individuals in one tow.

The biomass indices are linked to the abundance indices. Highest values were observed for the year 2009 in the fourth quarter with a peak of over 45,000 tons. While the abundance index is still comparatively low for ICES area c22 in the year 2010, the biomass index shows an increase for the same year.

Length composition
Survey mean lengths are presented in Figure 2.4.9 E and F. The population was dominated by specimens of 14.5 to 24.5 cm. A weak trend was observed with a slight increase in recent years. From 1991 to 1998 the mean length does not differ significantly between the two areas. Since 1999 a lower mean length was observed for ICES area c22 than for ICES area d24.

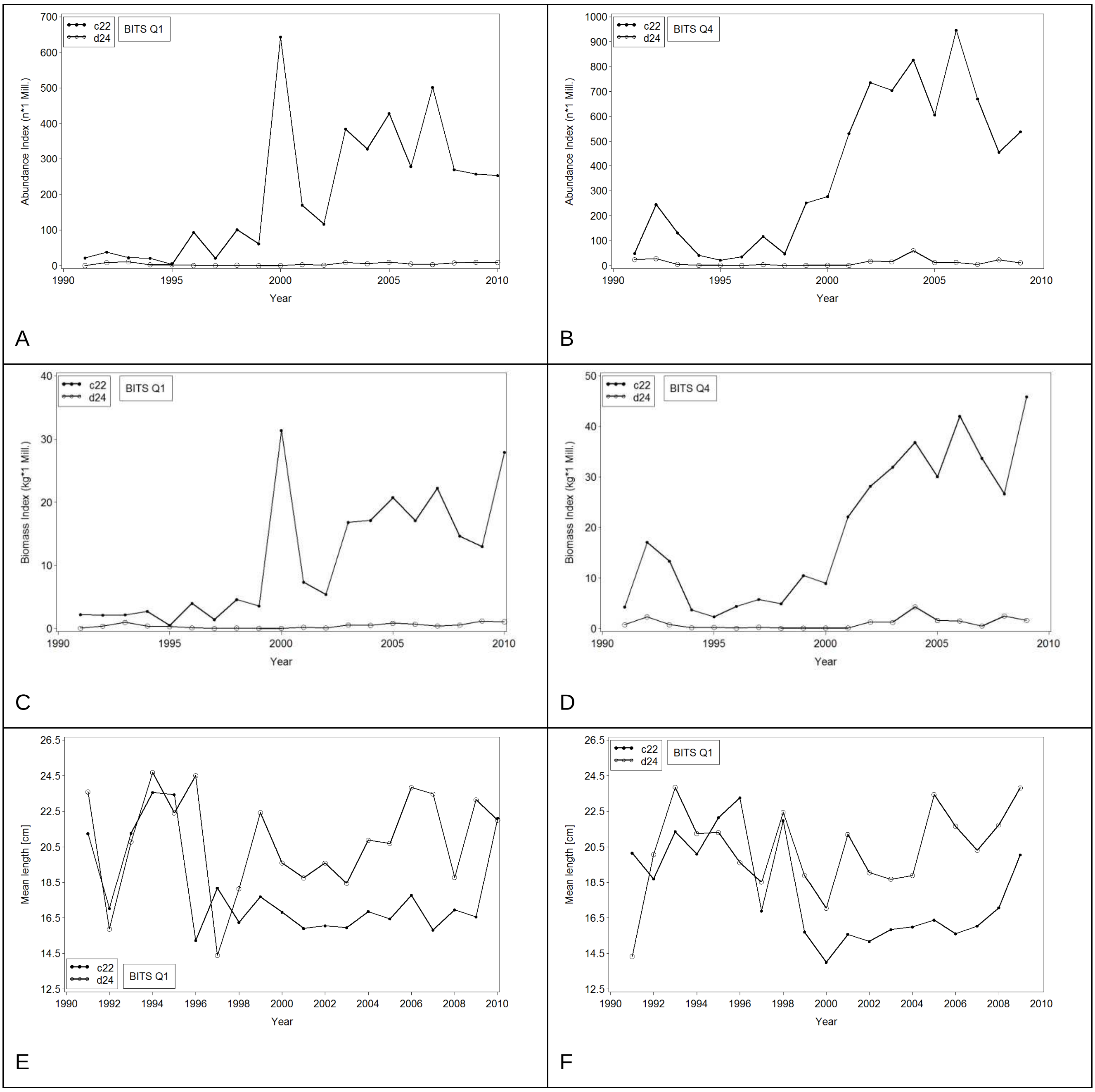

Figure 2.4.9 – Dab abundance indices (n*1 Mill) (A, B), biomass indices (kg*1 Mill) (C, D) and mean length [cm] (E, F) by ICES fishing areas c22 and d24 for BITS Q1 and Q4.

Conclusions
For the North Sea the population size has increased in the long term and had a considerably high level in recent years. High abundances can be found in the southeast along the German and Dutch coast and in the centre of the North Sea in the Doggerbank area. Biomass indices are linked to the abundance indices. Length composition is stable over the years, with a slight increase in recent years. Age 1 and age 2 dab are most abundant. The abundance decreases with increasing age. Female dab are more abundant than male dab.

In the Baltic, the dab population increased in abundance and biomass over the last years. High abundances can be found for the western Baltic, while abundance gets very low in the east. Biomass indices are linked to the abundance indices. In recent years a slight increase in mean length can be found. In the western Baltic the dab population has a lower mean length than in easterly parts.

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2.5 ILVO[6]

EV ILVO collected survey-data on turbot and brill from the Skagerrak (IIIa), the English Channel (VIId,e) and the Irish (VIIa) and Celtic Seas (VIIf,g,h) that were contained in its own database with information from the North Sea Beam Trawl Survey (BTS), and databases from other project partners. These combined survey-data enable the construction of time series of abundance (over all sizes and by size-class) and length frequency distributions (annual and average) for both species in all areas covered in this study. But, catches of turbot and brill are generally very low on surveys. A relatively low trawling speed allows bigger fish like turbot and brill to actively escape the nets more easily than smaller fish can. Also the generally short trawl durations on bottom trawl surveys add to a decrease in the chance to encounter an individual turbot or brill. Their piscivorous habits classify them as predators, that typically are distributed scattered over an area more than other species that target food resources that are more widely available (worms, molluscs, ….). Unfortunately, these low catch numbers very often result in an underrepresentation of some year-classes (mainly the older ones), leading to a poor quality of the resulting survey abundance series and indices, and poor agreement among different surveys.

6 Author: Kelle Moreau

2.6 IMR: Witch flounder in IIIa[7]

The survey data used in this study were collected during the Swedish International Bottom Trawl Survey (IBTS) since 1972, during the first (Q1) and third (Q3) quarter of the year. Previous studies showed that witch flounder are caught at different depths throughout the year and appear to follow fluctuations in temperature and salinity (Molander, 1935). In autumn, when temperatures rise in deeper waters (100-300 m) witch flounder move to shallower areas (50-150 m), only to return to deeper waters again in late winter/ spring (Molander,1925). Unfortunately, the majority of the tows during the Swedish IBTS are taken at depths between 26 -165 meters and 205-265 with sporadic ones outside these ranges. Therefore, the survey does not fully cover the whole natural range of this species. A first screening analysis investigated the distribution of different length classes at different depths. Individual data have been divided in four length classes and the depth at which they were caught was averaged within each length class (Figure 2.6.1). Results show that small individuals (<15cm) tend to be found together with the largest ones (>31cm) in deeper water, while individuals of medium size (between 16 and 30cm) are found at lower depths. This pattern is shown in both quarters of the year, although shifted at shallower waters during the autumn (Q3), confirming the results from the study by Molander (1925).

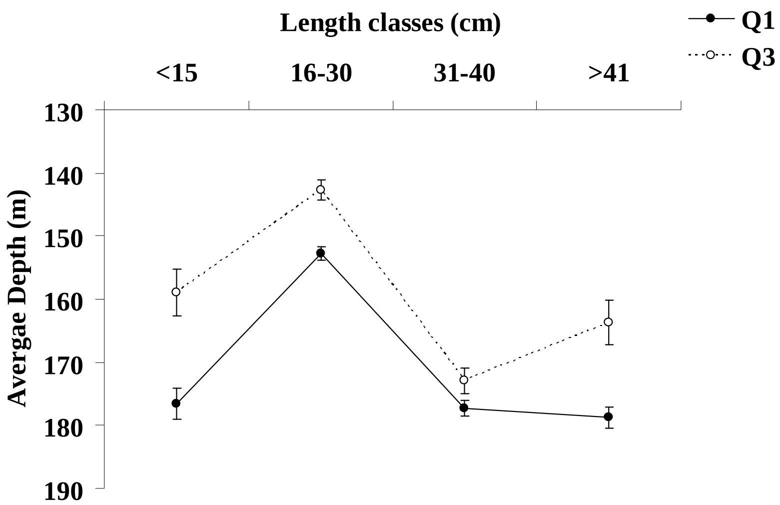

Figure 2.6.1 – Occurrence of different length classes at different depths. Bars represent standard errors.

A second aim of this study was to explore the possible variation in the Catch per Unit of Effort (CPUE) in different depth strata. The CPUE was calculated as number of individuals caught per hour divided by the number of hauls performed at a certain depth stratum in a certain year, in order to scale the effect of the unequal number of hauls between years.

The results from the first quarter surveys show an increase in CPUE with depth as well as an increase during the period 1998 - 2003 when the stock started to decrease again, at all depth strata (Figure 2.6.2).

Interestingly, the Q1 trend corresponds with a decrease in average length during the same period, investigated through a general linear model (GLM), with normal distribution (Figure 2.6.3). In the model, length was the dependent and year the independent variable, while depth and quarter were used as covariate, in order to scale their possible effects.

7 Author: Francesca Vitale

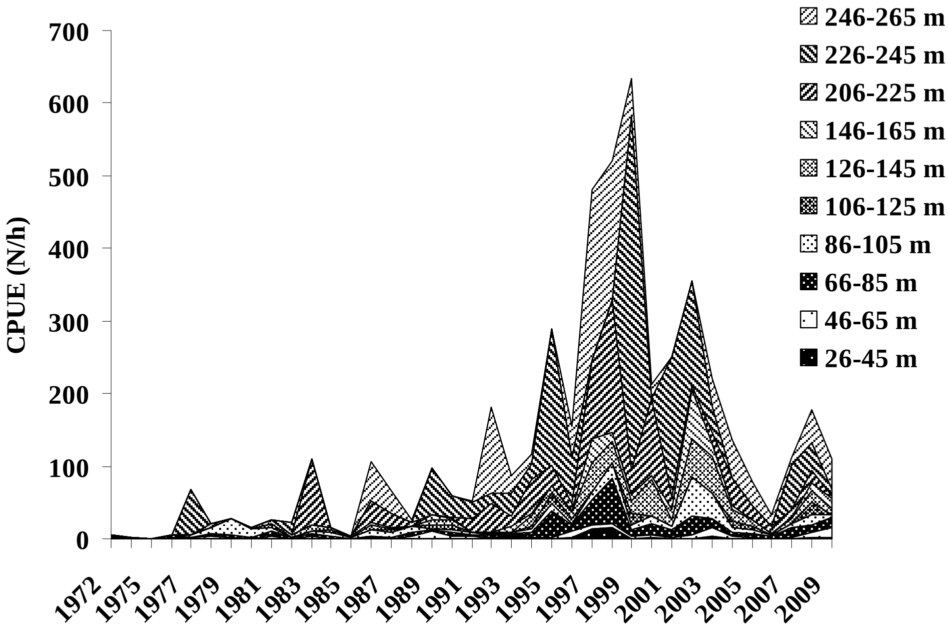

Figure 2.6.2 – Time series of CPUE at different depth strata in quarter 1.

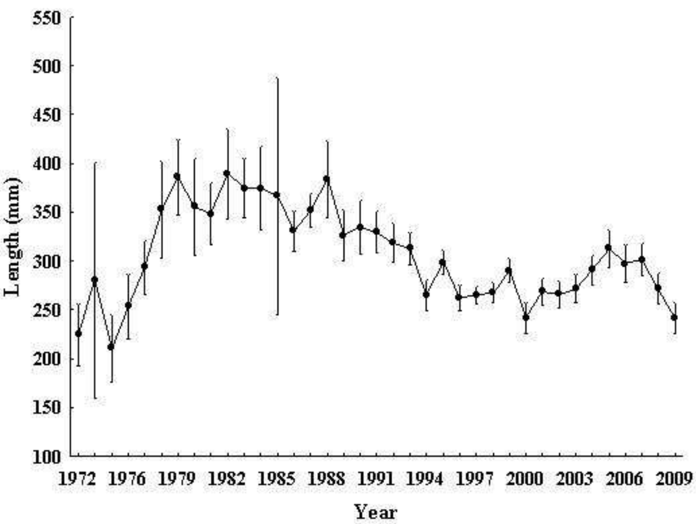

Figure 2.6.3 – Time series of average length distribution. Vertical bars denote 0.95 confidence intervals.

Furthermore a regression between CPUE and average length shows that there is a significant inverse relationship between the two variables (Figure 2.6.4).

During the same period an increase in effort and therefore in landings occurred (see Section 3.8). The observed trend could, therefore, be interpreted as either a result of fishing pressure, withdrawing larger individuals, or a consequence of a density dependent effect. The latter would occur as an outcome of increased stock size and thus increased competition for food, which reduces the per capita resources and consequently growth.

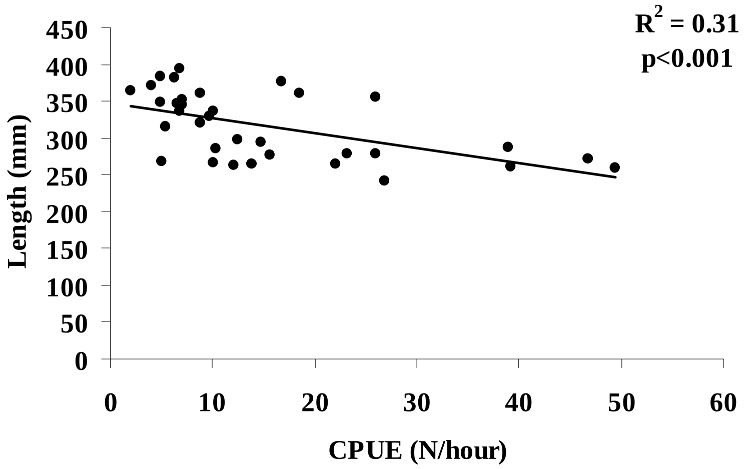

Figure 2.6.4 – Regression between yearly CPUE and average length.

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3 WP2 – Analysis of fisheries data

3.1 IMARES[8]

3.1.1 Observer data from the Dutch beam trawl fleet >300hp

The Dutch beam-trawl fishery is a bottom trawling mixed fishery, fishing with 80-89 mm mesh size in the cod-end, targeting a limited number of demersal species that are of commercial interest, in particular sole (Solea solea) in the southern part of the North Sea and plaice (Pleuronectes platessa) in the central North Sea. Consequently, a major part of the catch consists of other species that live on or near the seabed. In general part of the catch is of no commercial interest and is thrown overboard (discarded).

From 2002 onwards discard data for the 80mm beam-trawl-fleet (>300 hp) have been collected by on-board observers under the DCR. The results of this programme have annually been reported (e.g. van Helmond & Overzee, 2010). These data have so far only been analysed for a collection of commercial species: sole, plaice, dab (Limanda limanda), cod (Gadus morhua) and whiting (Merlangius merlangus). For this report the data for all WGNEW species were extracted from the database.

Methods
The number of sampled vessels and the number of sampled hauls per year were:

year	vessels sampled	hauls sampled	total days at sea	sampled days at sea
2004	10	310	20,170	34
2005	9	300	20,485	34
2006	9	263	17,995	36
2007	10	250	19,034	43
2008	10	293	14,208	43

Figure 3.1.1 shows the spatial distribution of the discard observations per year.

Raising procedures, 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 (Σu_h):

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

8 Authors: Edwin van Helmond and Henk Heessen

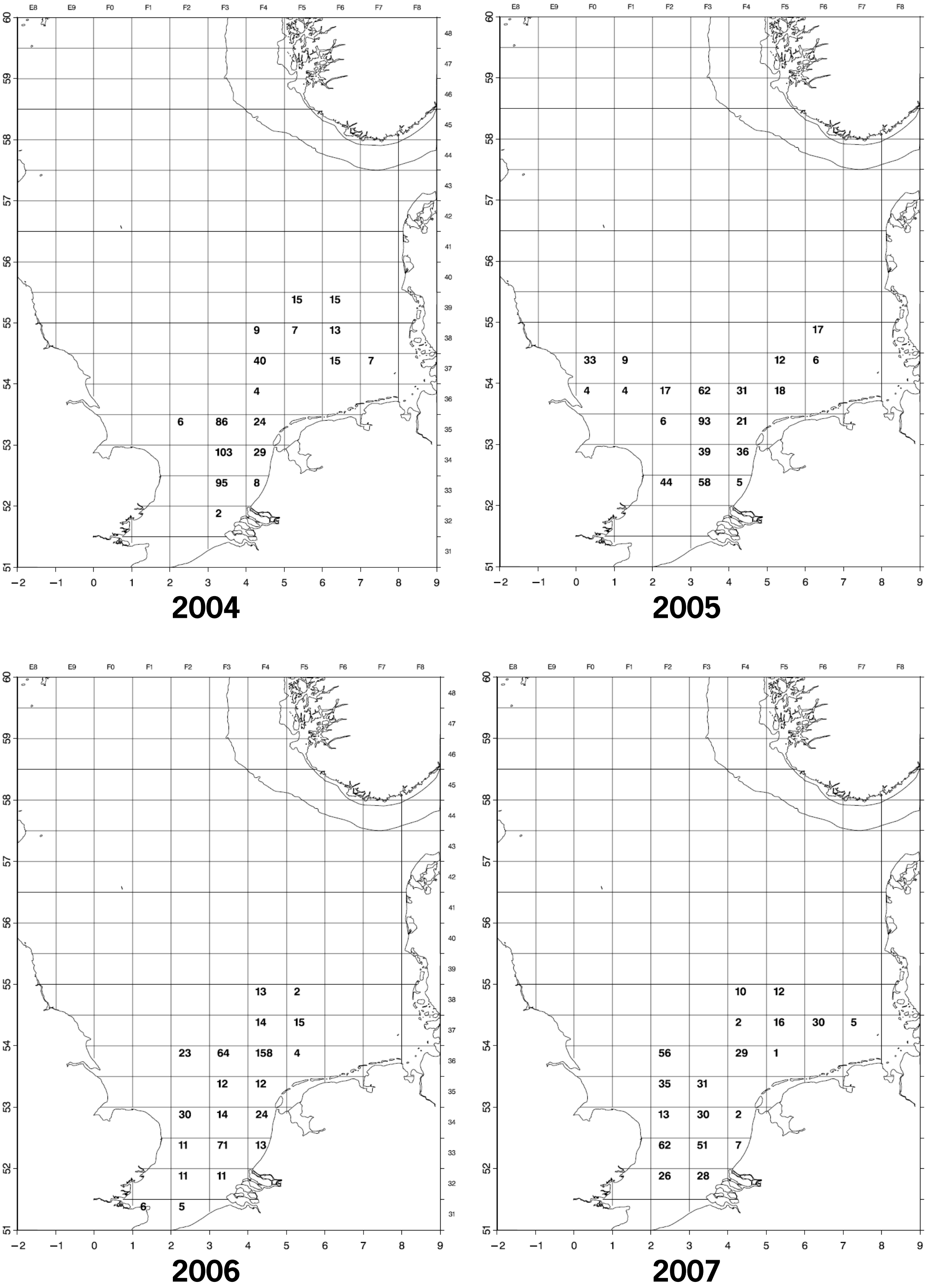
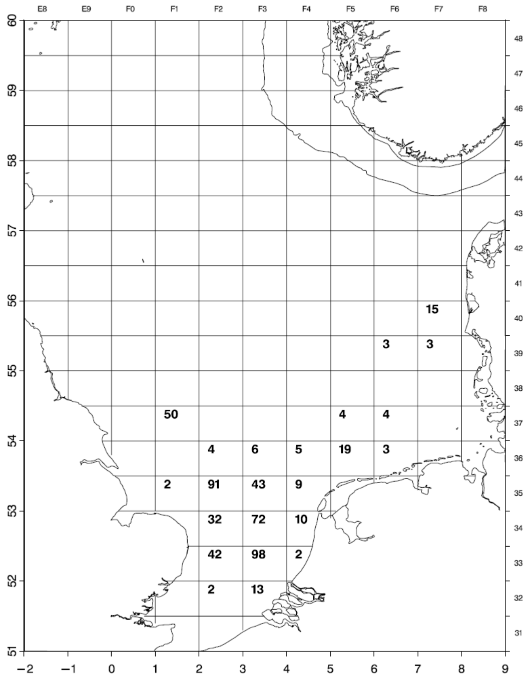


Figure 3.1.1 – The Dutch beam trawl fisheries > 300 hp: sampled number of hauls per year and by ICES rectangle.



2008

Figure 3.1.1 – Continued.

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).

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

Explanation of the abbreviations used in the formulas:

	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 in number of trips		
E	total fleet effort in number of trips		
T	Number of trips		
DN	total discard number		
LN	total landings number		
CN	total catch number (landings and discards combined)		

Results
The number of fish discarded, per hour and per length, are given in Figure 3.1.2 to 3.1.13.

Dab is the most common species in the discards of the Dutch beam-trawl fishery for flatfish. In 2008 95% of the number of dab caught was discarded. Per hour on average 49 kg was discarded compared to 8 kg landed (van Helmond & Overzee, 2010). The length compositions in the five years shown are all very similar.

The discarded numbers of sea bass, red gurnard, John dory, witch flounder, turbot and brill are all very low and the information is probably not very useful.

The number discarded for grey gurnard vary considerably between years with a factor of 4. In 2005 a peak in the length distribution can be seen between 10 and 15 cm, possibly due to a good year class. In 2007 the main amount of discards were between 15 and 25 cm in length, but also a smaller size group between 10 and 15 cm is visible.

The numbers of discards of tub gurnard show less variation between years than those for grey gurnards. The size range of the discards is from 5 to 30 cm.

Discards of flounder vary by a factor of 3, but the length distributions are broadly similar between years.

In lemon sole the numbers discarded vary by a factor of 5 between years, and the length composition of the discarded fraction varies considerably between years: e.g. in 2007 a peak occurs at a length of 13 cm, whereas in 2005 and 2008 the peak may be seen at around 20 cm.

In striped red mullet the numbers discarded vary by almost a factor of 37! The length compositions are quite different between years. In 2004 and 2005 two length groups can be distinguished, but only one in 2006 and 2007. In 2008 hardly any mullet was discarded.

REFERENCE
Helmond, ATM van & HJM van Overzee 2010. Discard sampling of the Dutch beam trawl fleet in 2008. CVO Report 10.001

SEA BASS

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6					
7			0.119		
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24				0.002	
25					
26					
27				0.007	
28					
29					
30				0.026	
31					
32					
33					
34					
35				0.118	
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	0.000	0.000	0.119	0.152	0.000

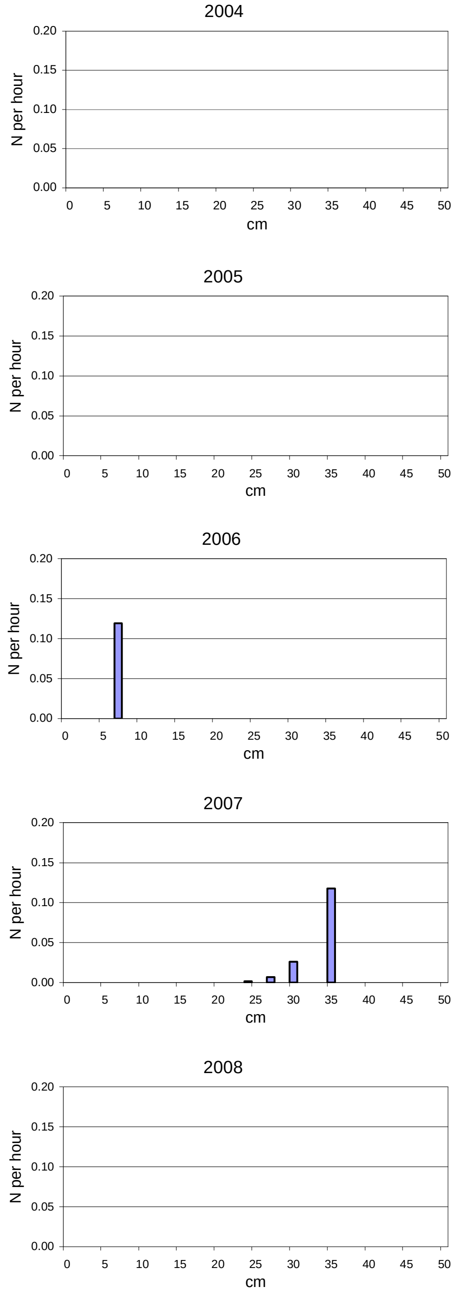


Figure 3.1.2 – Sea bass: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

STRIPED RED MULLET

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6					
7					
8	0.139				
9	0.055	0.044			
10	0.103	0.042			
11	0.103	0.117	0.048	0.015	0.047
12		0.101	0.235	0.013	
13		0.018	0.451		
14	0.025	0.070	0.232	0.093	
15	0.039	0.050	0.422	0.091	
16	0.034		1.366	0.096	
17	0.173		0.576	0.125	
18	0.363		0.166	0.068	
19	0.198			0.065	
20	0.102			0.020	
21	0.060	0.157		0.020	
22		0.030			0.046
23					
24		0.030			
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	1.393	0.658	3.496	0.607	0.094

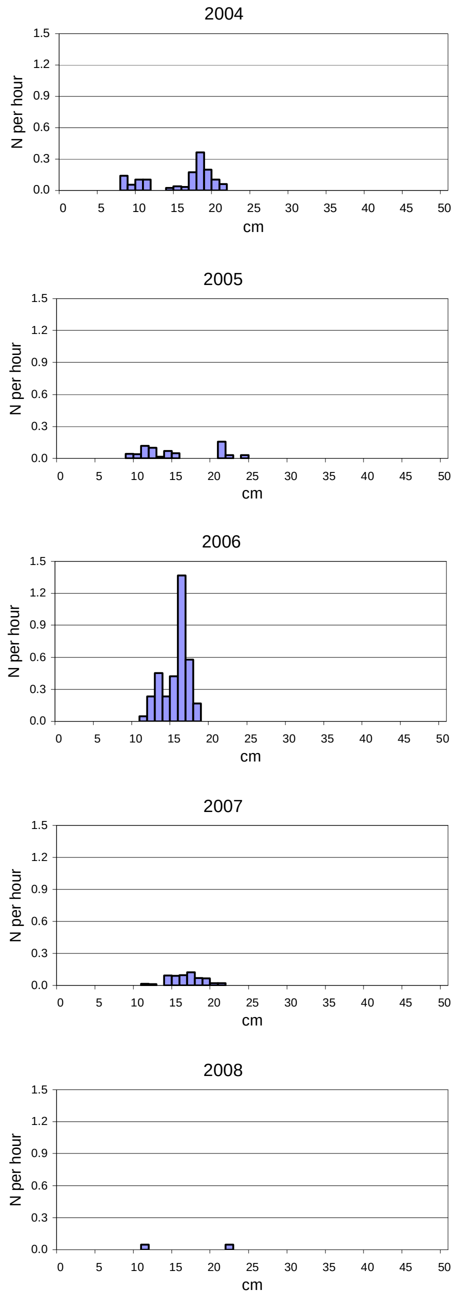


Figure 3.1.3 – Striped red mullet: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

RED GURNARD

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12				0.033	
13		0.017		0.047	
14				0.047	
15				0.033	
16				0.036	
17		0.025		0.036	0.040
18					
19		0.012			
20	0.047	0.025	0.048		
21			0.273	0.102	
22			0.796		
23			0.255		
24		0.034	0.606	0.016	
25	0.037	0.012			
26		0.017			
27					
28					
29		0.012			
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	0.084	0.155	1.978	0.351	0.040

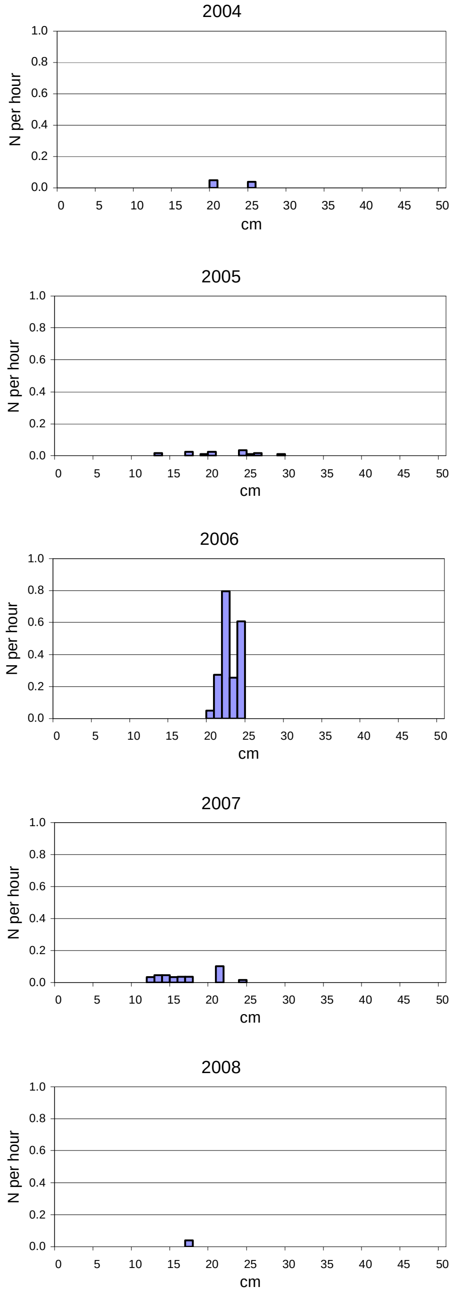


Figure 3.1.4 – Red gurnard: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

TUB GURNARD

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5				0.055	
6					
7					
8		0.085			
9	0.056	0.016			
10		0.062	0.148		
11	0.078	0.094	0.094	0.248	
12	0.286	1.710		0.358	0.026
13	0.662	2.188		0.060	0.067
14	0.300	1.209	0.246	0.453	0.153
15	0.186	1.304		0.446	0.134
16	0.312	1.823	0.145	0.253	0.217
17	0.332	1.443	0.523	0.742	0.229
18	0.319	2.041	0.559	0.586	0.457
19	0.559	0.716	1.000	0.556	0.405
20	0.354	0.303	1.001	0.571	0.288
21	0.414	0.340	0.843	0.467	0.359
22	0.436	0.262	1.156	0.586	0.686
23	0.943	0.519	0.948	0.933	0.274
24	0.663	0.793	1.367	1.517	1.285
25	0.718	0.501	1.061	0.727	0.431
26	0.245	0.137	0.667	0.384	0.365
27		0.278	0.225	0.475	0.539
28	0.112	0.056	0.059	0.091	0.020
29	0.030	0.024	0.043	0.167	0.019
30			0.197	0.081	0.078
31			0.058		
32					0.022
33					0.022
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	7.0	15.9	10.3	9.8	6.1

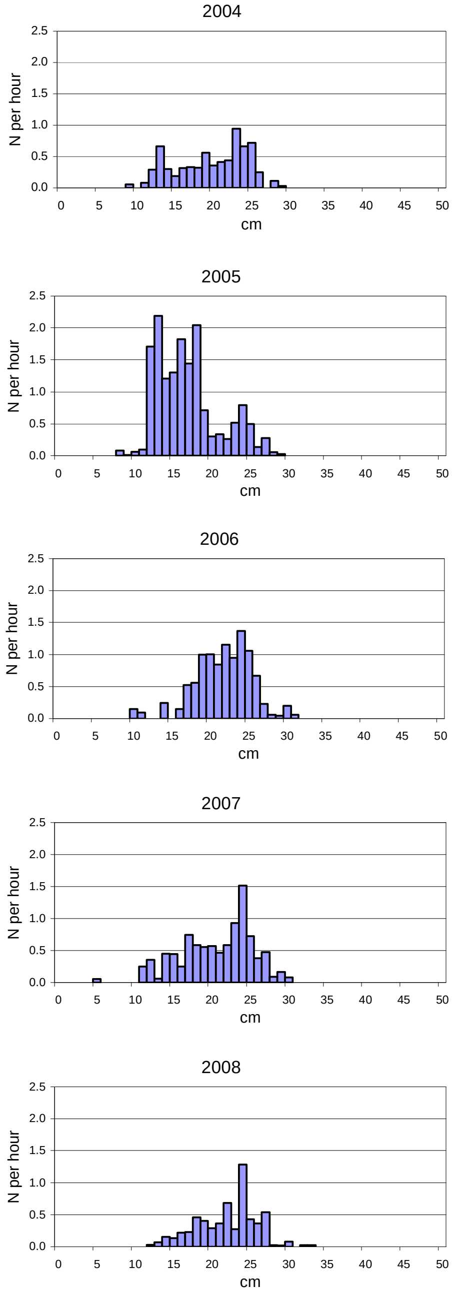


Figure 3.1.5 – Tub gurnard: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

GREY GURNARD

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6	0.065				
7					
8	0.119				
9	0.216	0.448		0.055	
10	0.356	0.302	0.048	0.052	0.074
11	0.472	3.000	0.310	0.749	0.173
12	0.488	8.815	0.335	1.120	0.476
13	0.269	11.668	1.729	1.824	0.462
14	0.948	14.059	2.611	1.619	0.553
15	1.313	10.963	6.989	1.370	1.641
16	1.711	5.799	8.983	2.586	1.807
17	2.135	5.043	10.285	3.649	2.822
18	2.156	4.953	8.997	5.463	4.339
19	0.867	3.929	6.717	6.029	4.973
20	1.327	3.226	3.533	8.022	4.879
21	1.073	2.319	2.686	7.086	3.340
22	1.131	1.910	2.946	5.408	2.480
23	1.179	2.275	1.225	4.998	1.284
24	0.728	1.476	1.292	3.153	2.012
25	0.511	1.313	1.085	1.935	0.709
26	0.605	0.692	0.704	1.106	0.680
27	0.472	0.789	0.258	1.038	0.332
28	0.420	0.097	0.362	0.271	0.173
29	0.221		0.289	0.832	0.304
30	0.082	0.068		0.825	0.103
31		0.125		0.072	0.138
32		0.097	0.057	0.339	0.222
33				0.060	0.083
34				0.203	0.014
35	0.013	0.129		0.312	0.256
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	19	83	61	60	34

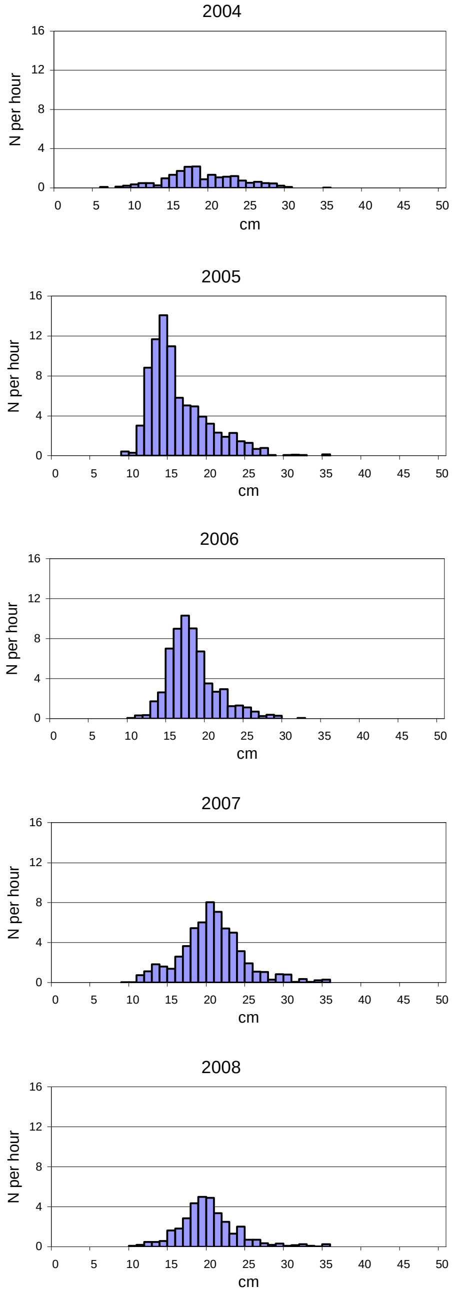


Figure 3.1.6 – Grey gurnard: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

JOHN DORY

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					0.052
11					0.100
12					0.052
13					0.098
14					0.024
15					0.099
16					
17					0.044
18					0.021
19	0.056				
20					
21					
22					
23					
24					
25					
26					
27					
28					
29			0.001		
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	0.056	0.000	0.001	0.000	0.490

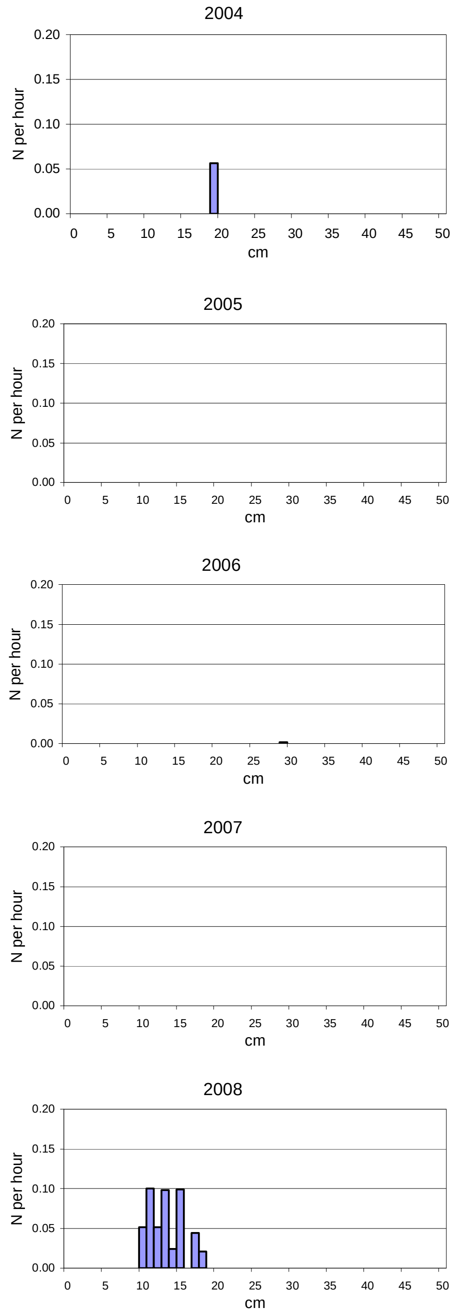


Figure 3.1.7 – John dory: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

DAB

length class	2004	2005	2006	2007	2008
0					
1					
2					
3			0.134		
4	0.075	0.042	0.006		
5	0.571	0.020			
6	0.556	0.217	0.324	0.846	0.411
7	1.656	1.350	1.192	1.679	0.130
8	4.486	1.392	4.429	2.647	0.870
9	7.895	2.724	6.117	6.312	2.082
10	15.236	13.611	12.423	11.527	7.238
11	28.044	41.551	32.954	22.521	16.470
12	41.617	54.865	70.980	39.672	34.473
13	51.102	60.315	103.191	58.227	47.809
14	64.726	89.611	137.678	99.773	66.240
15	104.482	124.279	159.474	143.459	89.728
16	116.041	147.779	181.783	142.874	110.227
17	130.748	173.690	209.710	154.392	132.014
18	114.295	169.142	193.543	138.675	118.745
19	87.813	121.415	139.432	117.486	86.991
20	57.941	84.463	102.357	83.542	66.752
21	37.201	48.949	48.561	57.610	42.981
22	17.966	29.339	22.613	32.437	30.620
23	10.494	15.058	8.931	20.227	15.786
24	4.860	5.921	5.007	13.149	10.201
25	1.667	2.509	1.811	4.421	3.498
26	0.936	0.651	0.265	1.446	2.076
27	0.141	0.248	0.113	1.692	0.528
28	0.219	0.168			0.227
29	0.030	0.336		0.210	
30					
31		0.113			0.096
32					0.038
33					0.061
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	901	1190	1443	1155	886

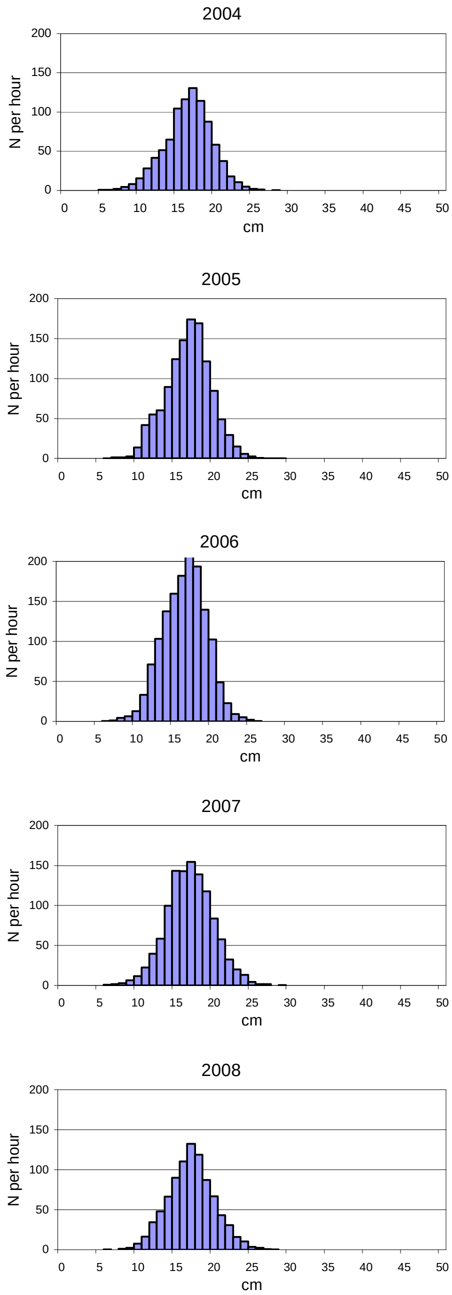


Figure 3.1.8 – Dab: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

FLOUNDER

length class	2004	2005	2006	2007	2008
0					
1					
2					
3			0.001		
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15			0.073	0.118	
16		0.084			
17					
18		0.095	0.110	0.072	0.040
19	0.022		0.027		
20	0.040	0.038	0.054	0.055	0.026
21	0.097	0.277	0.246	0.111	0.181
22	0.095	0.114	0.146	0.093	0.161
23	0.194	0.645	0.763	0.079	0.558
24	0.261	0.824	0.336	0.071	0.526
25	0.413	0.569	0.203	0.156	0.351
26	0.240	0.296	0.831	0.161	0.083
27	0.070	0.160	0.110	0.199	0.227
28	0.050	0.037	0.065	0.028	0.186
29	0.166	0.167	0.001		0.154
30		0.084			0.135
31			0.110		0.045
32		0.038			
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	1.650	3.427	3.079	1.143	2.673

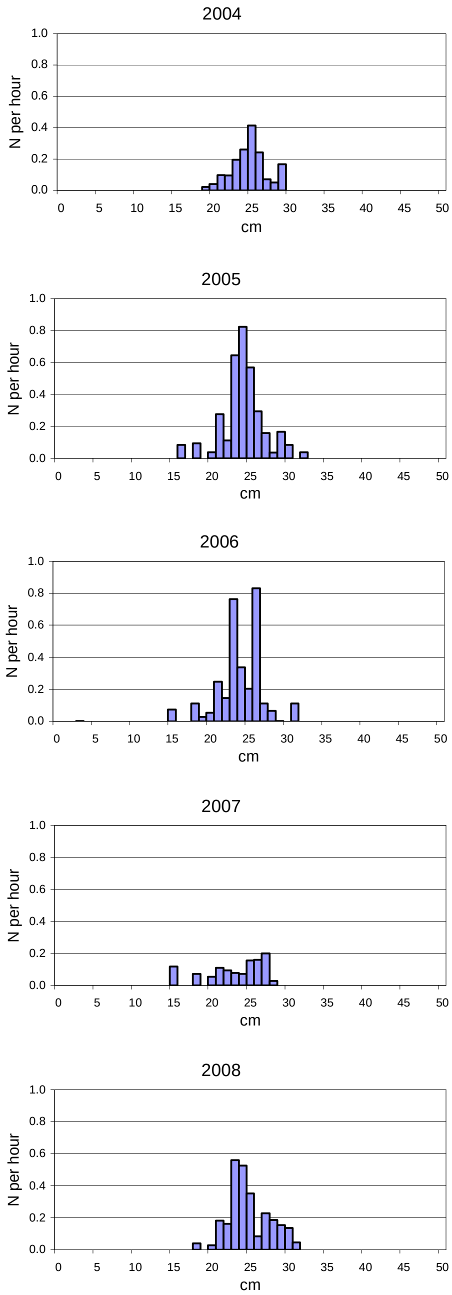


Figure 3.1.9 – Flounder: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

WITCH FLOUNDER

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28	0.022803				
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	0.023	0.000	0.000	0.000	0.000

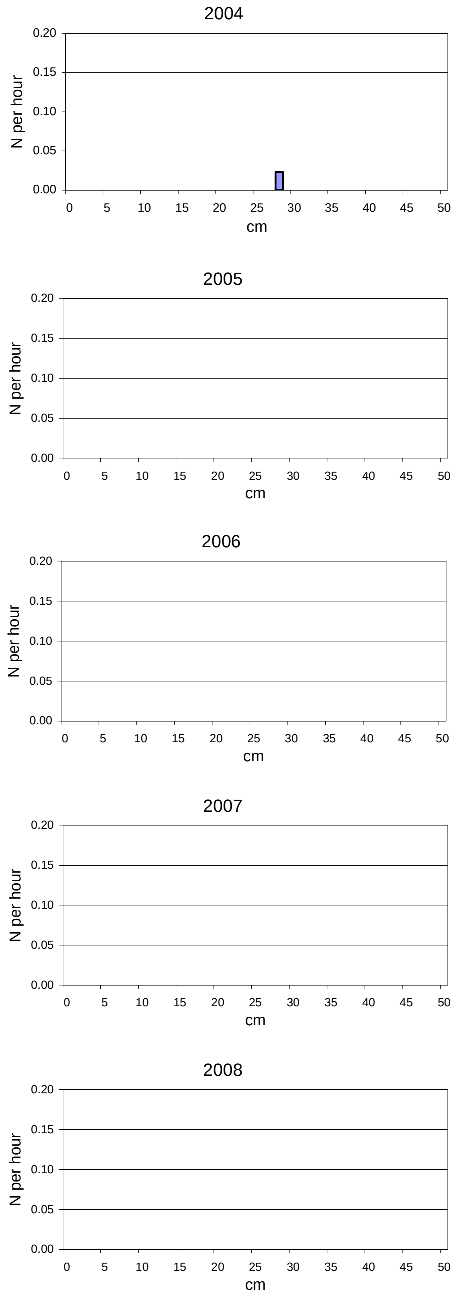


Figure 3.1.10 – Witch flounder: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

LEMON SOLE

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6					
7					
8					
9	0.053			0.050	
10					
11					0.014
12				0.057	0.032
13	0.026	0.102	0.156	2.357	0.041
14	0.024	0.144		2.174	0.106
15	0.512	0.308	0.075	1.541	0.222
16	0.653	0.380	0.058	1.202	0.521
17	0.400	0.958	0.179	0.615	0.662
18	0.476	1.464	0.701	0.236	0.655
19	0.659	1.685	0.358	0.114	0.828
20	0.476	2.130	0.398		0.991
21	0.484	1.646	0.246		0.580
22	0.657	2.016	0.079	0.047	0.442
23	0.449	1.089	0.096	0.002	0.230
24	0.084	0.639	0.079		0.183
25	0.017	0.244			0.155
26	0.020				0.037
27	0.022			0.017	
28					
29		0.088			
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	5.0	12.9	2.4	8.4	5.7

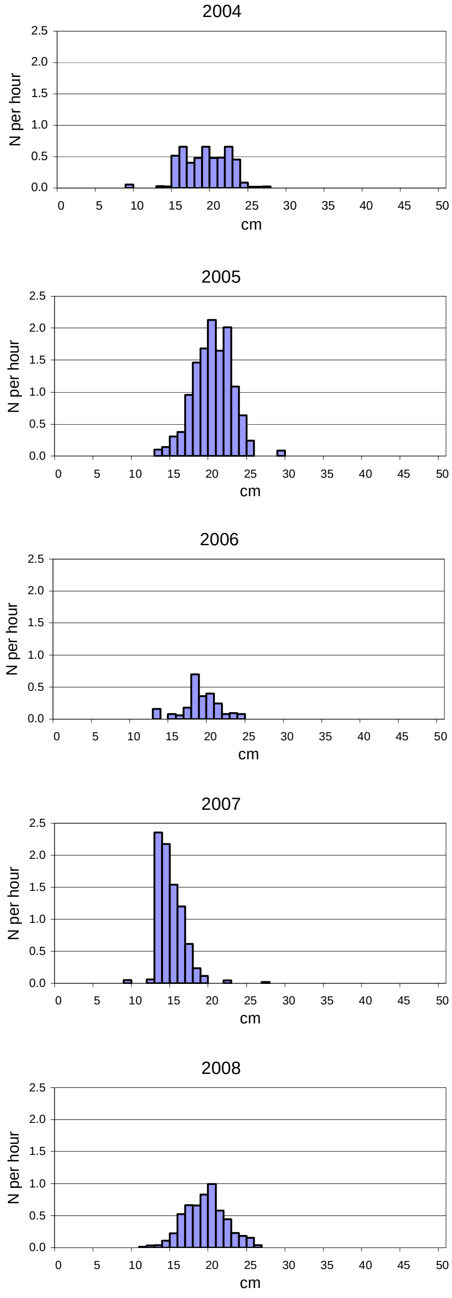


Figure 3.1.11 – Lemon sole: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

TURBOT

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					0.050
19					
20	0.053				0.050
21					0.195
22	0.139			0.002	0.087
23	0.085				0.098
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	0.276	0.000	0.000	0.002	0.481

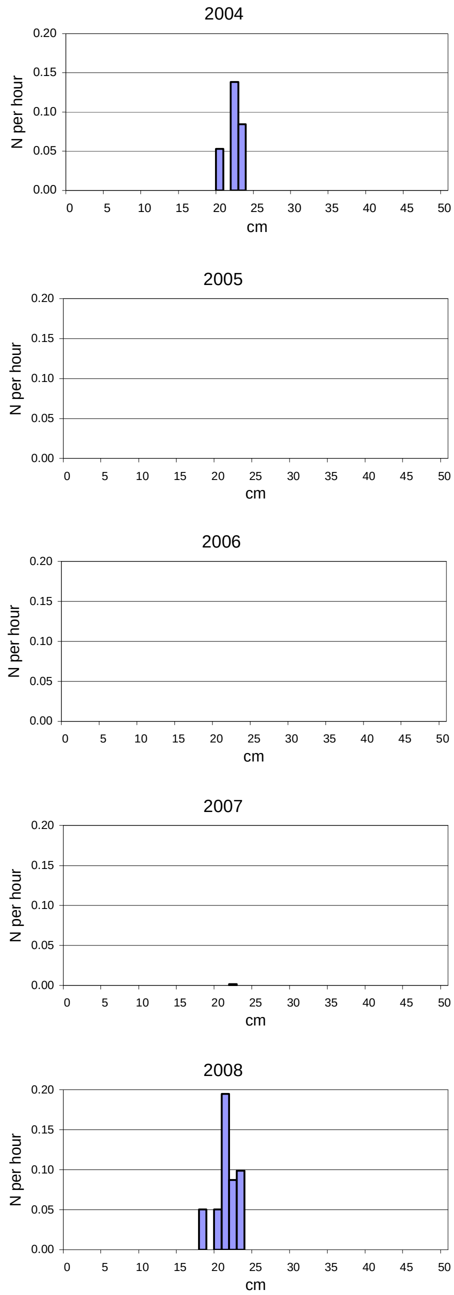


Figure 3.1.12 – Turbot: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

BRILL

length class	2004	2005	2006	2007	2008
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					0.052
17		0.044			
18	0.058	0.023	0.083		0.050
19			0.037		
20	0.168	0.016	0.073		
21			0.034		0.068
22	0.014		0.025	0.002	
23		0.083		0.003	0.051
24	0.138		0.033		
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
sum	0.378	0.166	0.285	0.005	0.221

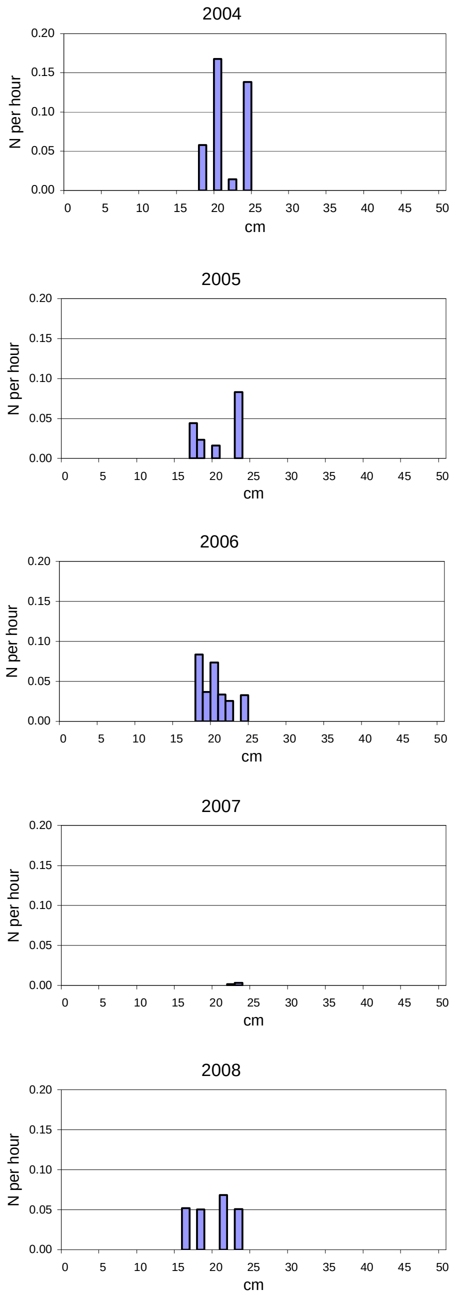


Figure 3.1.13 – Brill: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

3.1.2 Spatial catch statistics on turbot and brill

Dutch fisheries contribute a significant part to the total international landings for turbot and brill from the North Sea. In this section spatial landings data on the level of ICES rectangles are shown for two time periods: 1967-1983 and 1995-2009.

The data come from two different sources. The source for the oldest data (1967-1983) is the CBS (Central Bureau for Statistics) dataset. Data from 1995-2008 come from EU logbooks collected in VIRIS (Catch Information and Registration Input System). The years in-between these two sources have not been adequately registered, owing to misreporting problems and a change in registration system.

All data are recorded by trip, on the spatial level of the ICES rectangle. The data are aggregated to obtain annual total landings by ICES rectangle. The annual landings for brill and turbot per ICES rectangle are shown in Figures 3.1.14 and 3.1.15 respectively.

The Dutch brill landings are located mainly in the southern North Sea, with concentrations in the Southern Bight, the northern part of the German Bight, and a minor part of the catch comes from off shore areas such as the Oyster Grounds. The vast majority of the Dutch North Sea turbot landings also originate from the southern North Sea, though the largest landings are made more northerly, with concentrations of catches in the German Bight, the Southern Bight and the Oyster Grounds. The difference in spatial distribution of the total landings suggests that brill is a more southern and coastal species than turbot.

The inter-annual variability in the spatiotemporal distribution of the two species is visible as shifts between the main landings areas. For brill, the contribution of the German Bight to the total landings is larger than usual in the years 1973, 1974, 1982, 1999, 2000, 2007 and 2008. For turbot, landings have become more concentrated in the southern North Sea from 1967 onwards. In the most recent period (from 2005 onwards) the landings have concentrated in the eastern part of the German Bight.

The Dutch landings for turbot and brill show a strong spatial pattern, which differs for the two species. Because the Dutch landings encompass the majority of the total international landings for both species, they likely represent the spatial distribution of total international turbot and brill landings.

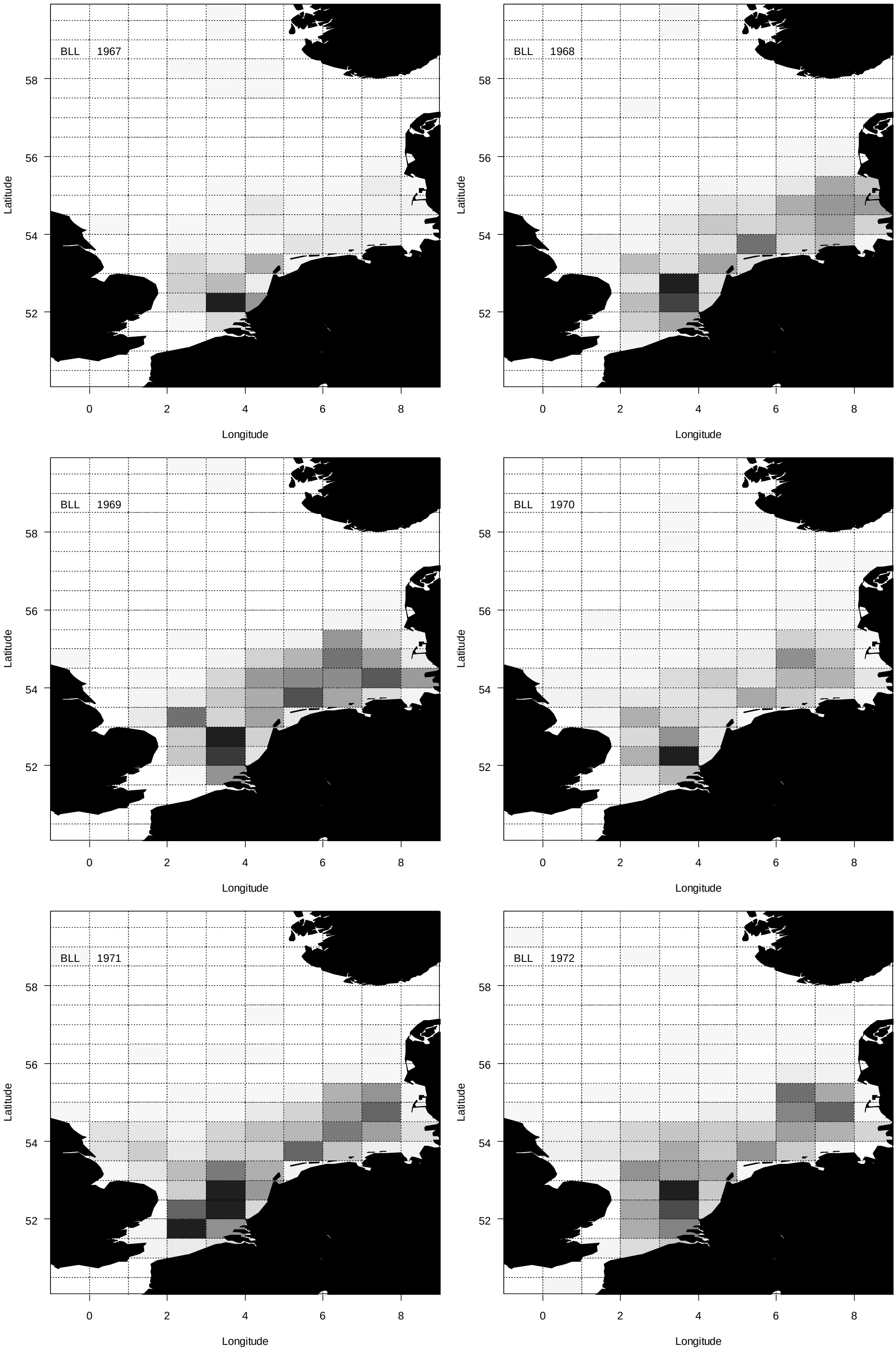


Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008.

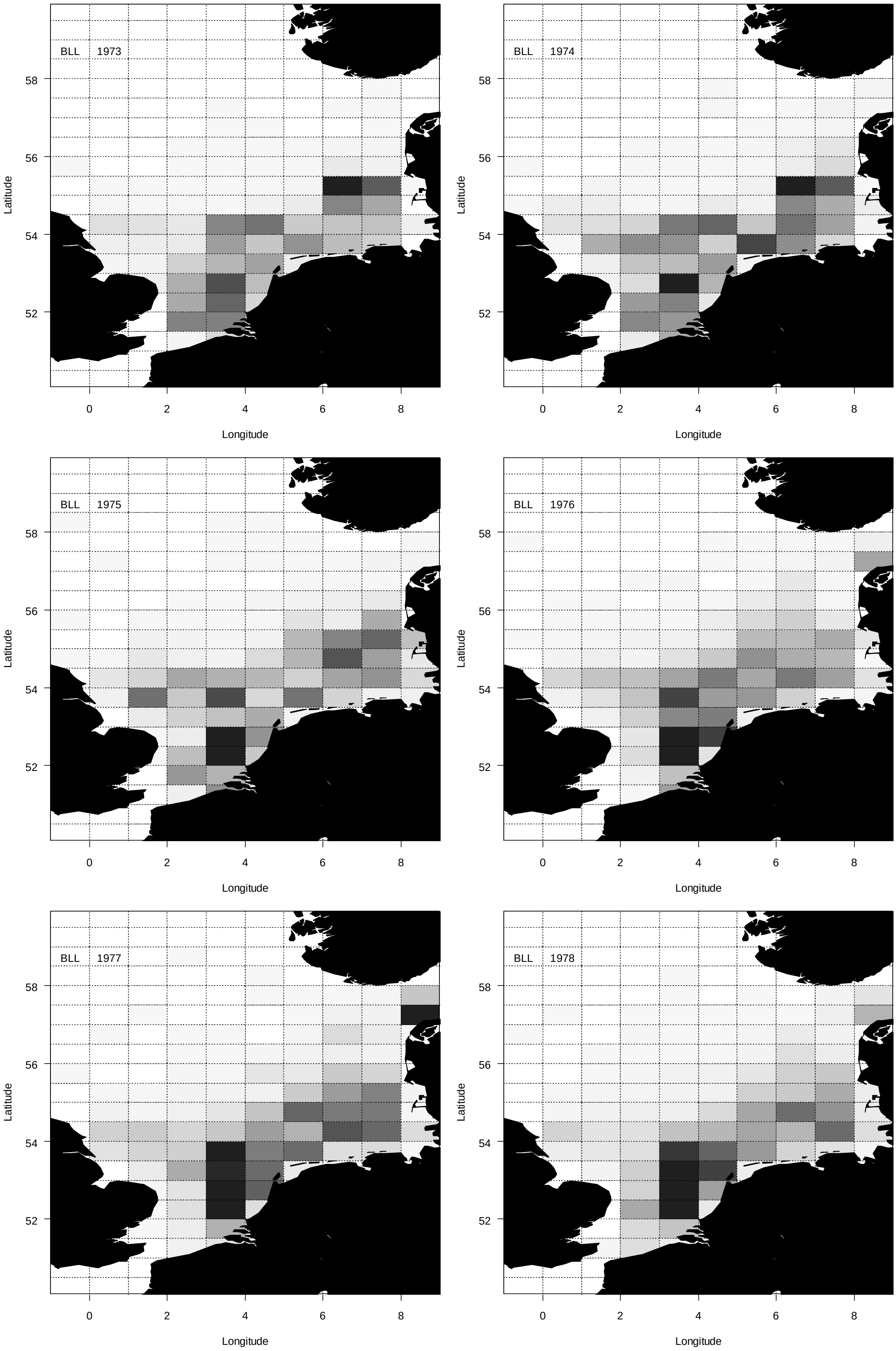


Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

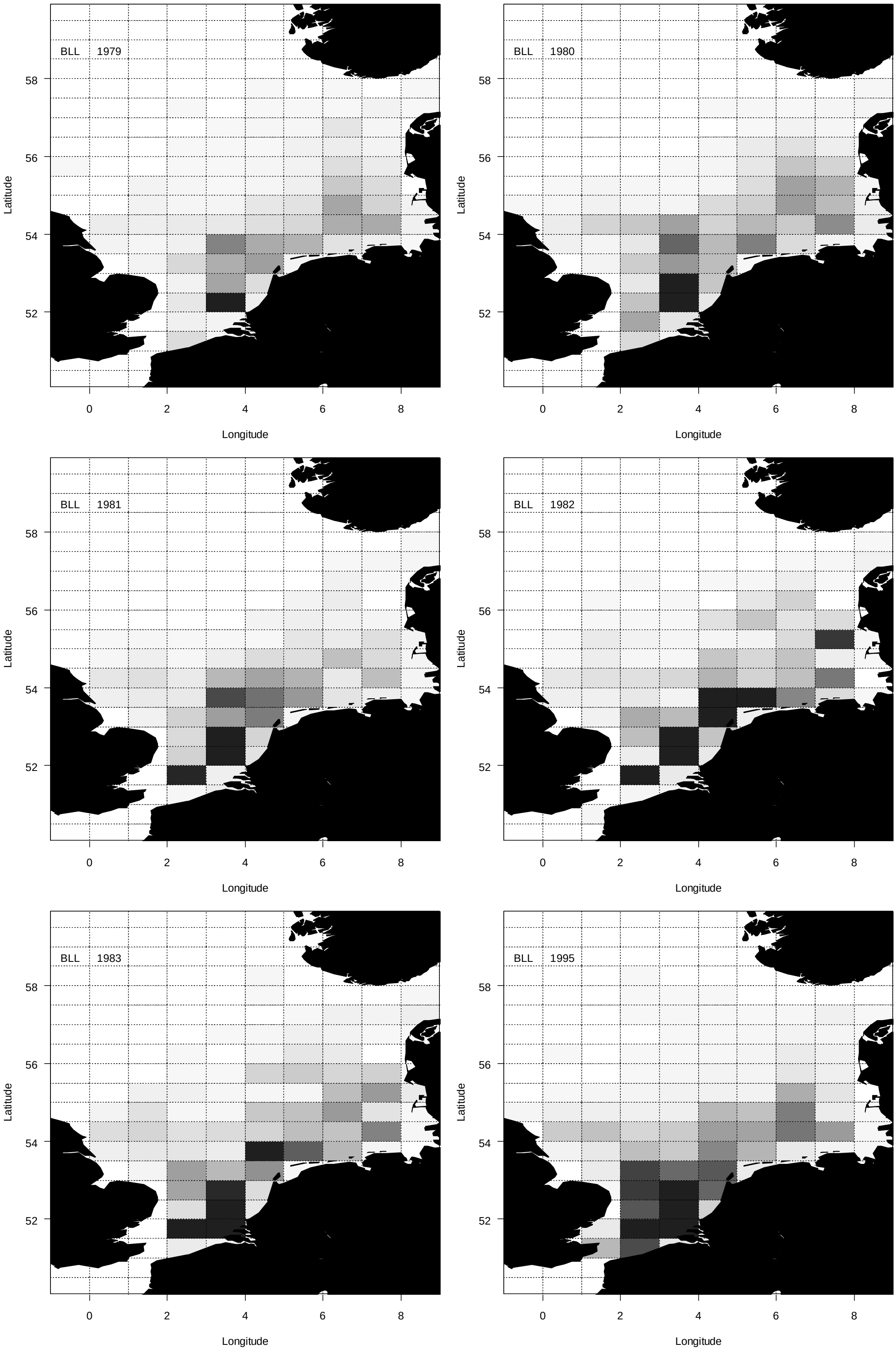


Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

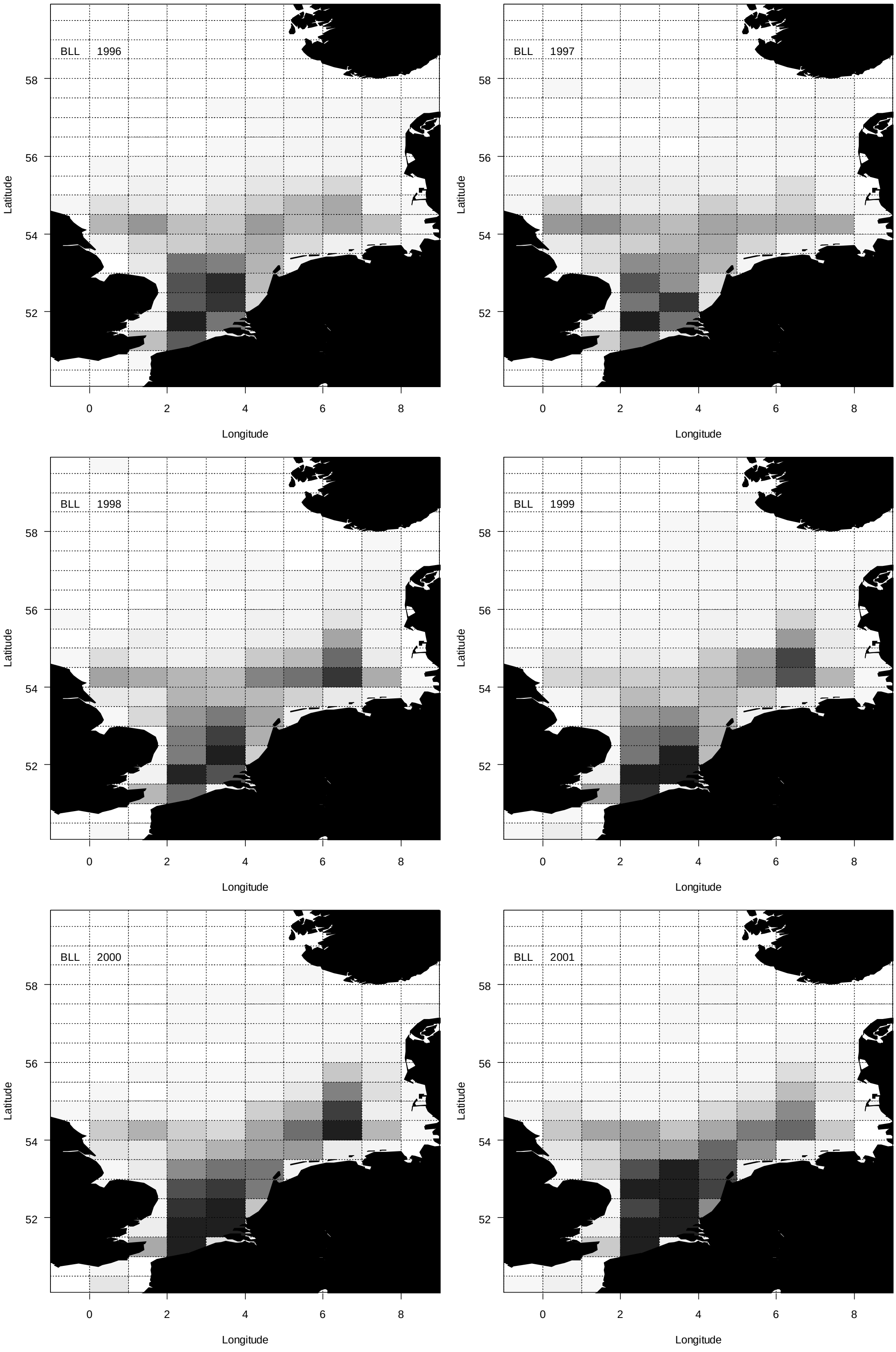


Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

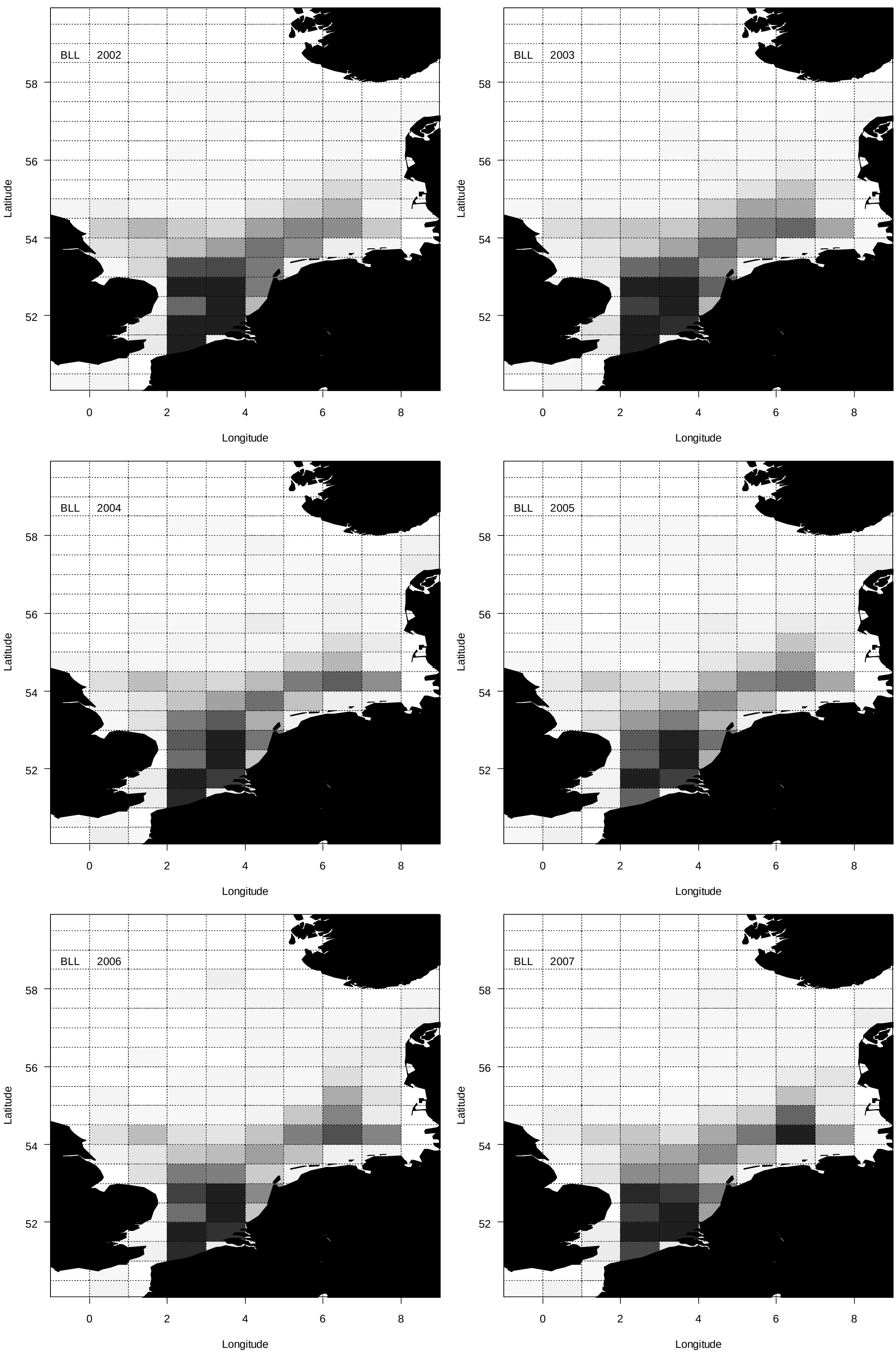


Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

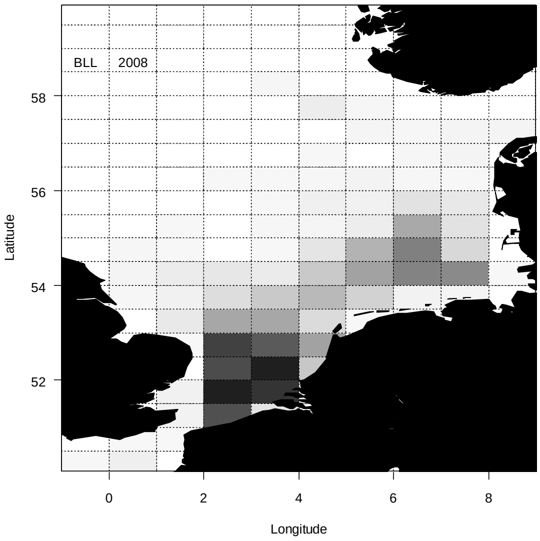


Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

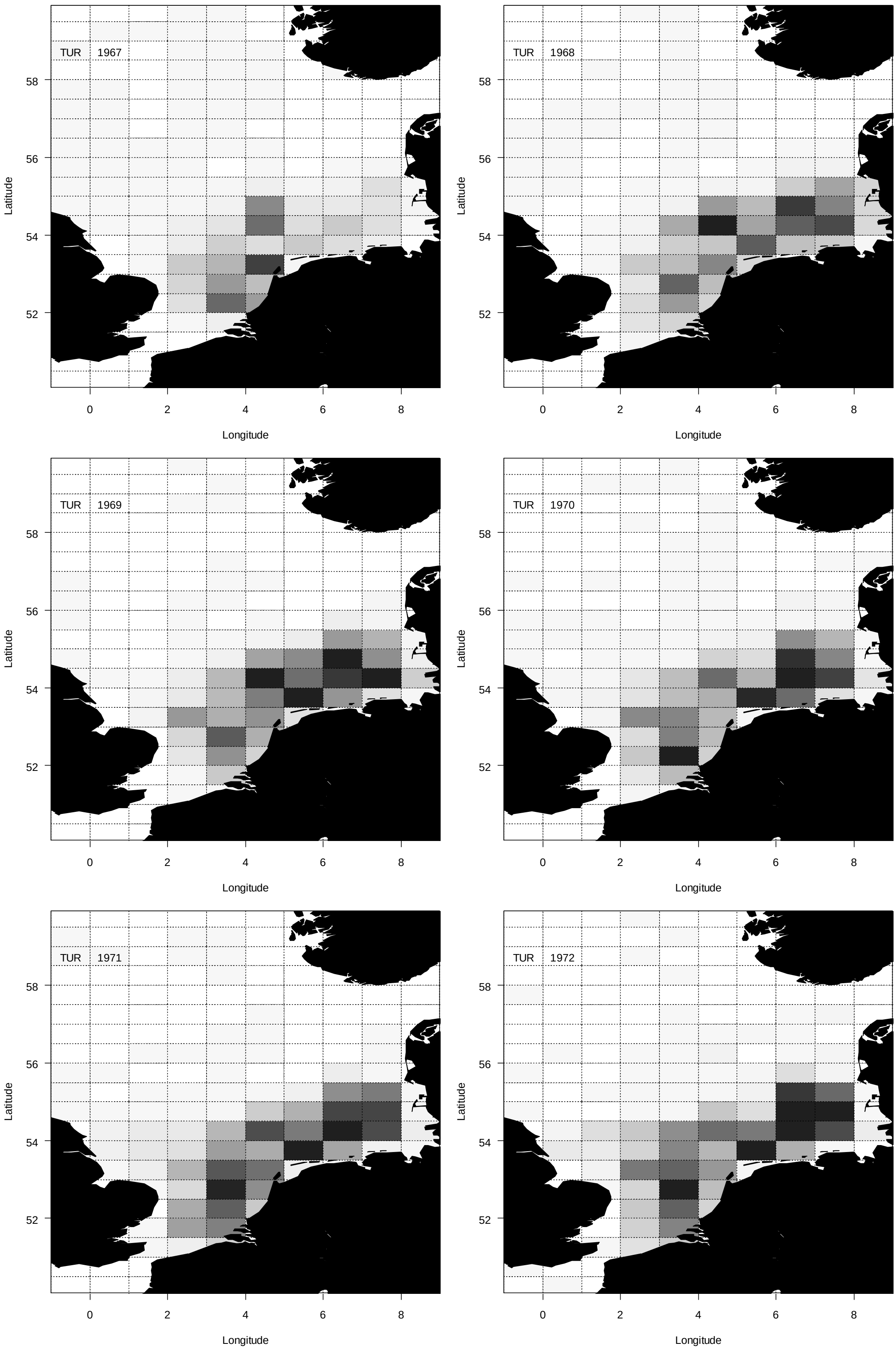


Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008.

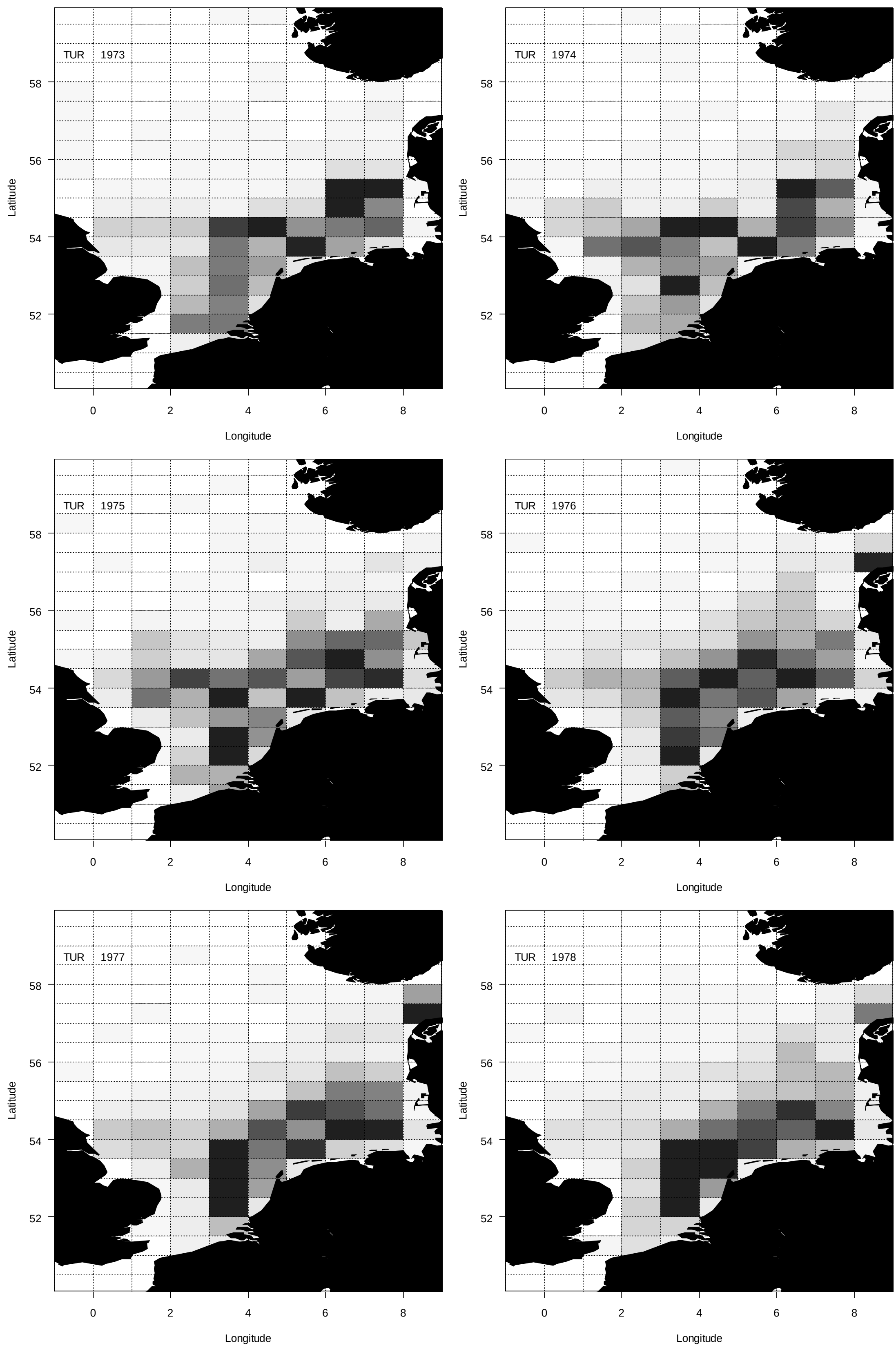


Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

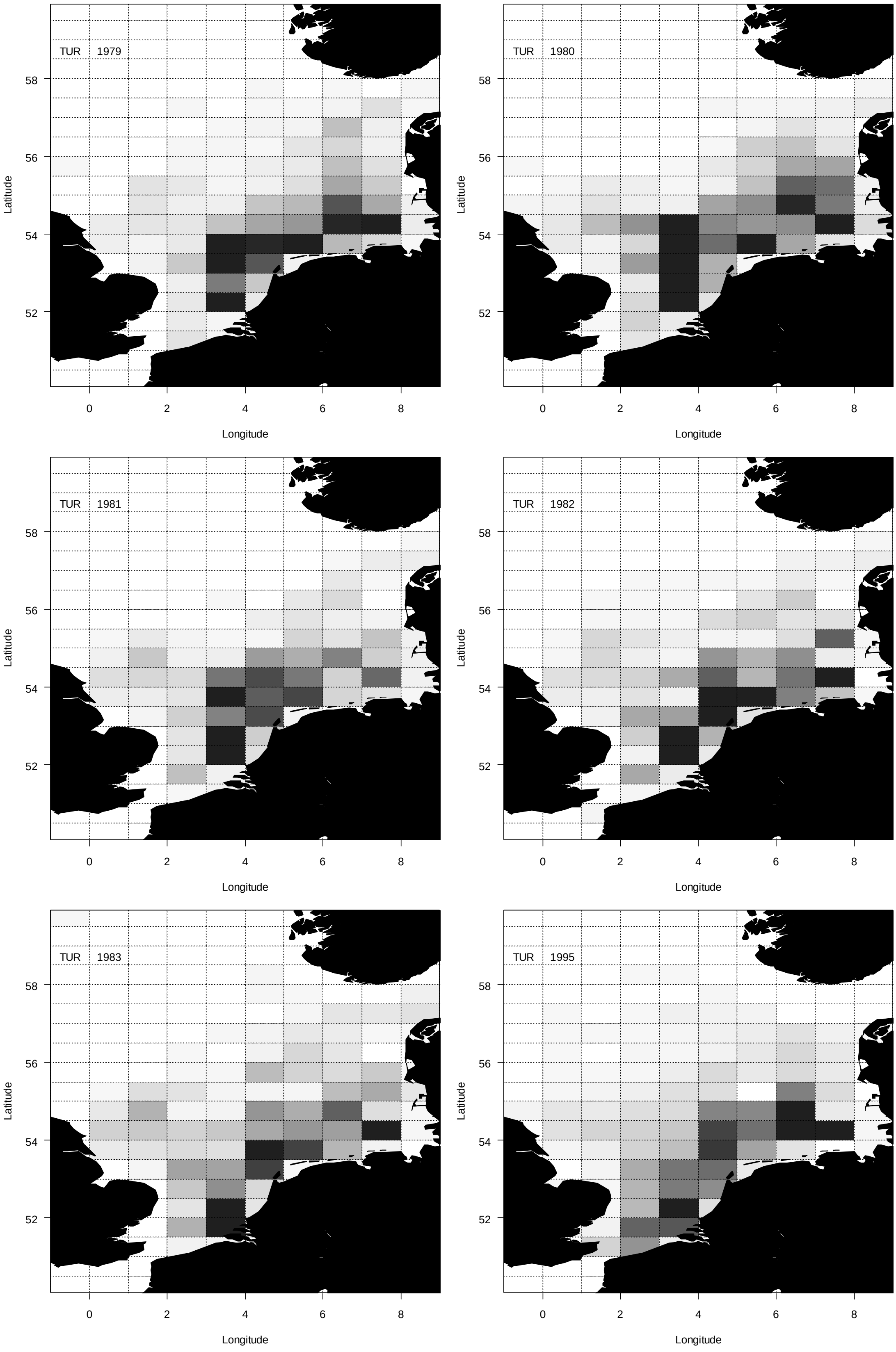


Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

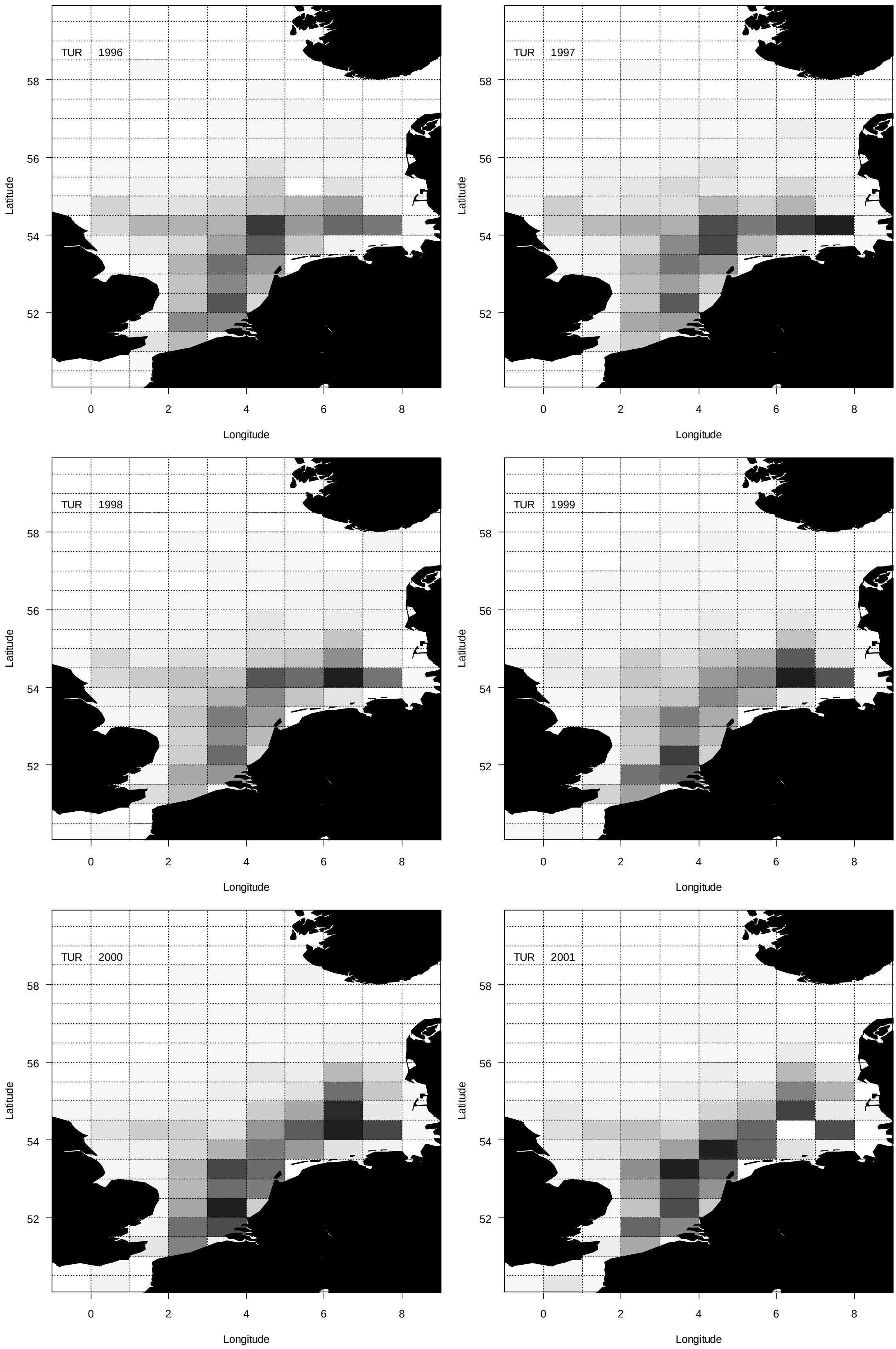


Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

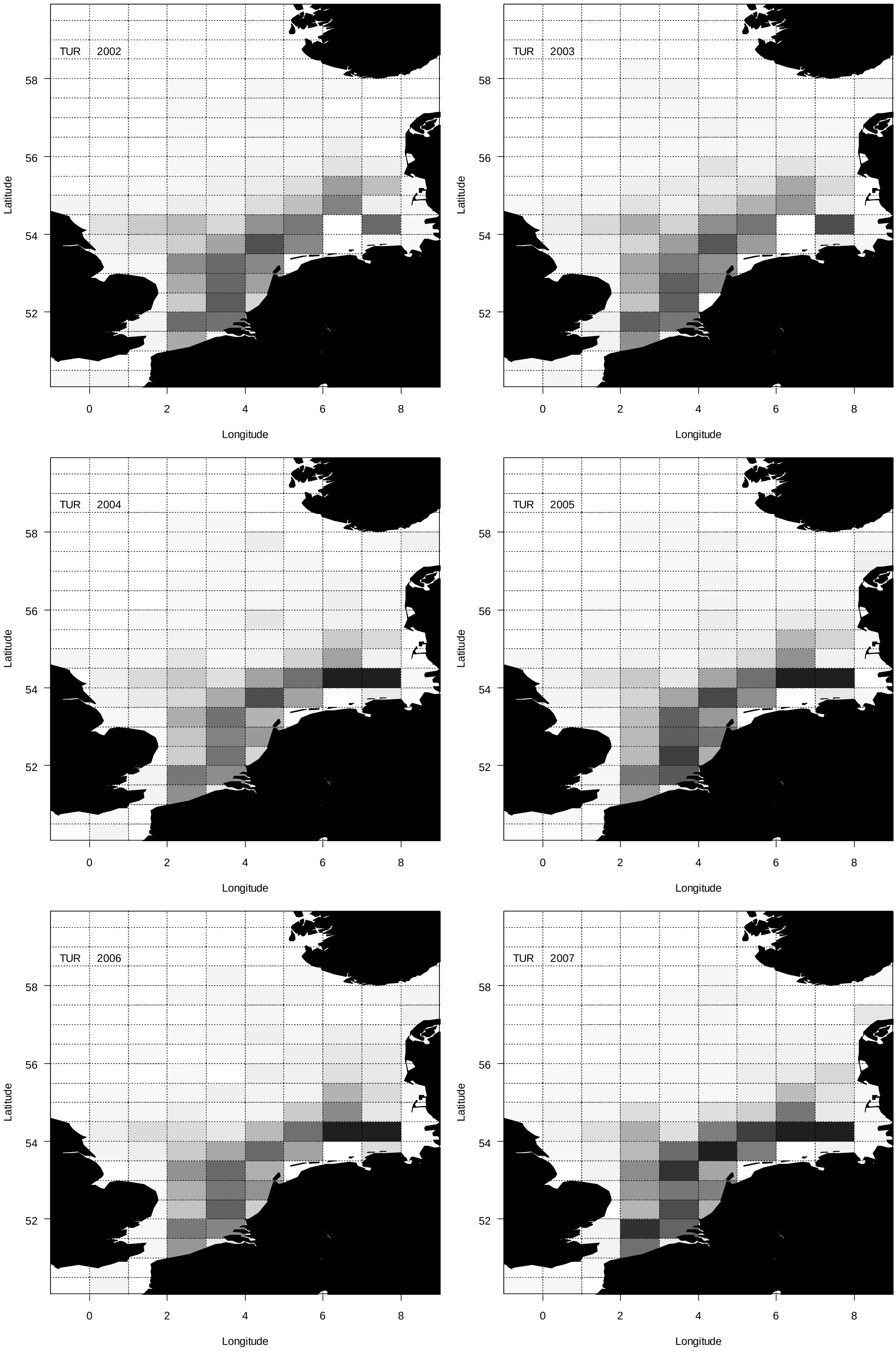


Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

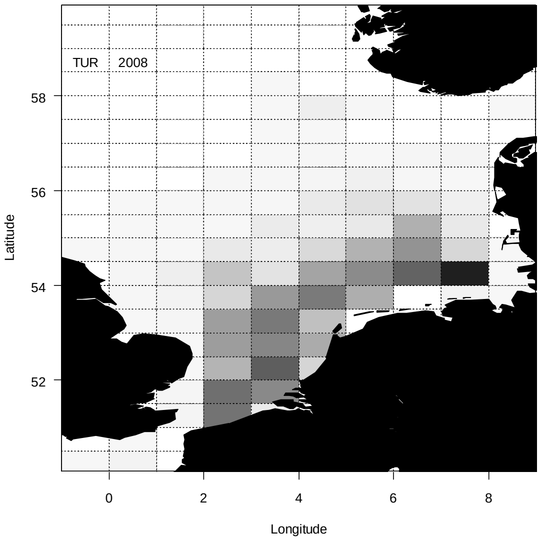


Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

3.2 CEFAS

3.2.1 Lemon sole: L and W at age, CPUE, age and size at maturity[9]

UK commercial lemon sole landings

Landings of lemon sole between 1985 and 2008 by UK vessels landing into England and Wales and by England and Wales vessels landing outside the UK are given by ICES Division in Table 3.2.1 and Figure 3.2.1 and by gear in Figure 3.2.2. Landings were at their highest at the beginning of the time series when they exceeded 3 800 t in 1985. In general, there has been a decline in landings since that time and the landings for 2008 (981 t), were the lowest of the time series. For the UK fleet, the majority of lemon sole are landed from ICES Divisions IVb and VIIe and caught by vessels using beam trawls, heavy otter trawls and unspecified otter trawls.

Annual catches of lemon sole between 1982 and 2008, by the UK fleet are plotted by ICES rectangle in Figure 3.2.3. It can be seen through the time series that catches in the North Sea in particular have become more confined to rectangles closer to the UK coast. In recent years, the majority of landings in the North Sea have come from only a few rectangles off the northeast English coast (around Scarborough). In the southwest, the majority of catches are made off the south Devon and Cornwall coasts in the Western English Channel, generally in mixed fisheries for other flatfish species.

Lemon sole in ICES Area IV and Division VIId (the North Sea and eastern Channel)

Annual catch numbers at length for lemon sole in the North Sea and eastern Channel (ICES Area IV and Division VIId) between 1985 and 2008 are given in Table 3.2.2 and Figure 3.2.4. Data for 1986, 1987 and 1992-1997 are missing due to a lack of market sampling.

Mean length in catches is given in Table 3.2.3. In general, mean length declined at the beginning of the time series from 31.9 cm TL in 1985 to 28.3 cm in 1991. Since 1998, mean length has been relatively stable.

Annual catch numbers at age for lemon sole in the North Sea and eastern Channel for the years 2005-2008 are given in Table 3.2.4 and Figure 3.2.5. Cefas only started to age lemon sole otoliths in 2005, so the time series of age information is short.

Cefas routinely calculates the LPUE (kg/h) of lemon sole in ICES Divisions VIIe-k for otter trawlers and beam trawlers of <24 m length. Similar processing is run in the North Sea for several species, but lemon sole has historically not been among them. For this project the North Sea processing routine was amended to include lemon sole and was run for the time period 1983-2008. For the North Sea, LPUE was processed in 10 rectangle groups (Figure 3.2.6), and beam trawlers and otter trawlers were processed separately. Full results (by rectangle group) are given in Table 3.2.5 for the North Sea. However, not all results were plotted, rather results for the rectangle groups representing areas from which the majority of the lemon sole catch is landed were plotted. For the North Sea, results for rectangle groups 1, 2, 8 and 10 are given in Figure 3.2.7.

Trends in the otter trawl LPUE for rectangle groups 1, 2 and 8 were similar, showing a slight decline throughout the time series. These three rectangle areas cover much of ICES Division IVb, in which landings have also decreased during the same time. In rectangle group 10 however, which covers the eastern Channel (ICES Division VIId), the LPUE trend is more of an upward one. For beam trawlers, LPUE is generally less than that of otter trawlers.

Lemon sole in ICES Divisions VIIe-k ('westerly', 'the southwest')

Annual catch numbers at length for 'westerly' lemon sole (ICES Divisions VIIe-k) between 1983 and 2008 are given in Table 3.2.6 and Figure 3.2.8. Mean length in catches for 'westerly' lemon sole are given in Table 3.2.3. Mean length has decreased from 32.4 cm TL in 1983 to 27.6 cm TL in 2008. Annual catch numbers at age for 'westerly' lemon sole for the years 2005-2008 are given in Table 3.2.7 and Figure 3.2.9.

The LPUE of 'westerly' lemon sole was updated to 2008. Processing was carried out by ICES Division, and Divisions were further split geographically (north, south, east or west) (Figure 3.2.10). As with the North Sea, beam trawlers and otter trawlers were processed separately. Full results (by area) are given in Table 3.2.8.

[9] Authors: Sarah Walmsley, Alison Holmes and Joanne Smith

However, as with the North Sea and eastern Channel, only results for the rectangle groups representing areas from which the majority of the lemon sole catch is landed were plotted. The results for Division VIIe west (7EW), south (7ES) and north (7EN) are given in Figure 3.2.7. The LPUE of otter trawlers is generally higher than that of beam trawlers in all rectangle group areas. For otter trawlers, in 7EW and 7EN the LPUE trend is similar, showing an overall decline through the time series. For all three groups, beam trawl LPUE values have generally decreased since 1983, and showed a small peak in 1995-1997, before becoming relatively steady for the last few years.

Lemon sole size at maturity
Size at maturity was estimated using data from three Cefas stock monitoring surveys – the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E), the eastern Channel Beam Trawl Survey (BTS7d), and the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl Survey (NWGFS). Data were extracted for the years 2005-2009 only, to minimise any changes in size at maturity that may have occurred through the whole time series. During the surveys, maturity stages were assigned based on the standard Cefas 5-stage maturity key. For fitting the maturity ogives, fish recorded as Maturing, Hyaline, Running and Spent were classed as Mature, with all others classed as Immature. Length-at-50%-maturity (L50) was estimated by fitting a maturity ogive using a linear model with the logistic link function and a binomial error structure. Ogives were fitted for each survey and sex separately.

The fitted maturity ogives are given in Figure 3.2.11. Males appear to mature at a smaller size than females in all three surveys, but there would appear to be difference in the L50 in the three surveys for males and females. L50 for both sexes was higher in the eastern Channel, than either the North Sea or the Irish Sea and Bristol Channel. For all surveys and both sexes, the L50 is at approximately 2-3 years of age. It should be noted however, that all three surveys take place in either quarter 2 or quarter 3, which may not be the best time of year for maturity sampling.

Lemon sole spawning seasonality
Data on maturity stage were obtained from the Biological Sampling Programme database. Information on length, weight, sex, maturity stage (according to the standard Cefas 5-stage key), was extracted along with information on sample location and time of the year. Data were extracted for the years 2004-2008. Of the two fishing areas that Cefas uses to process lemon sole data, North Sea (ICES Area IV and Division VIId) and 'westerly' (ICES Divisions VIIe-h), biological samples were available from ICES Areas IVb, VIIe, f & g only. Due to the low number of samples available annually, data for the years 2004 – 2008 were aggregated. The proportion of fish at each maturity stage was plotted monthly for males and females separately for Area IVb and for Areas VIIe, f & g. A total of 1328 individuals (male = 246; female = 1082) and 1428 individuals (male = 444; female = 984) were sampled in Division IVb and Divisions VIIe, f & g, respectively.

Results are given in Figure 3.2.12. In general, few immature individuals were landed or sampled between 2004 and 2008. For males in Divisions VIIe, f & g, maturing individuals were generally seen throughout the year, though an increase in the proportion of fish classed as maturing was seen between August and January. An extremely high proportion of males classed as running was observed, which was lowest in February, increased until around June and July, and then decreased until November. Spent males were recorded through the year. In contrast, for males in the North Sea (Division IVb), maturity appeared to lag behind that seen in the southwest. The highest proportion of maturing fish was seen in December to April. Again, a high proportion of the males were classed as running throughout the year, with high proportions running in March to August. As with Division VIIe, f & g, spent males were recorded through the year.

For female lemon sole, again there were few immature individuals recorded in the samples. The proportion of maturing females in the southwest was at its lowest in May, but then increased to a peak in January. The majority of hyaline individuals were observed between January and May, with the majority of running females sampled between April and May. The highest proportion of spent females was observed in July, after which a decrease in the proportion was noted. As with males, spawning in the North Sea would appear to lag behind the southwest, with hyaline and running females sampled between April and September.

3.2.2 Observer data on lemon sole and dab[10]

Discard data were extracted from the Cefas discard database for 2003-2008 for all hauls recorded as targeting dab and lemon sole; had caught dab and lemon sole; or were from ICES Areas IV and VII. Where the fish from a given tow were sub-sampled, the numbers at length were raised using the appropriate raising factor. Discard estimates were obtained for two fishing areas, namely the North Sea and eastern Channel (ICES Area IV and Division VIId), and for the 'southwest' (ICES Divisions VIIe-k). These area groupings were chosen because these are the same area groupings used by Cefas to process lemon sole data. Estimates were obtained for two gear groupings only, namely beam trawl and all other gears. This was because of the number of discard samples available for raising the data.

Data were aggregated upwards by grouping samples in the following order to provide ratios of retained and discarded dab and lemon sole:

Group1: Year, ICES Division, gear grouping, vessel length grouping;
Group2: Year, ICES Division, beam/not beam gear grouping, vessel length grouping;
Group3: Year, stock area (IV & VIId, or VIIe-k, or ICES Division for all other samples), beam/not beam gear grouping, vessel length grouping;
Group4: Year, stock area (IV & VIId, or VIIe-k, or ICES Division for all other samples), beam/not beam gear grouping;
Group5: Year, stock area (IV & VIId, or VIIe-k, or ICES Division for all other samples).

For each aggregate length distribution the number of fish at length was converted to weight at length using the following length weight regressions

Dab Wt (g) = 0.00545 L3.195 (cm)
Lemon sole Wt (g) = 0.01035 L3 (cm)

The total weight was obtained by summing the resulting weight distribution.

Next, the weight of fish landed in each year, ICES division, gear group and vessel length combination was obtained from the Fishery Activity Database. To obtain the estimated discard component the five groups were merged onto the landings in turn until all landings had an associated ratio of landings to discards.

The number of fish measured by the discard programme between 2003 and 2008 is given in Table 3.2.9 As can be seen, few lemon sole or dab were measured for gears other than beam trawls, though sampling has increased in recent years. This may be as a result of discard samplers obtaining access to vessels <10 m length in that year, which they had previously been unable to do. In general, the discard rate for dab was high, with a high proportion of the dab caught being subsequently discarded in all areas and years. In contrast, the discard rate for lemon sole was notably lower.

Raised estimated numbers of lemon sole and dab discarded between 2003 and 2008, are given in Tables 3.2.10-3.2.13. Raised discard estimates for dab caught in beam trawls show that discarding can be high in the North Sea, and in 2006, the number of dab discarded was the highest of the time series. The modal size of dab discarded was at around 18-22 cm TL, and this was consistent through the time series and in both areas.

For lemon sole, the modal size of fish discarded was at around 21-23 cm TL, and as with dab, this was consistent through the time series and in the two areas. Few lemon sole were discarded at lengths larger than 30 cm TL.

Raised estimates for both species and for gears other than beam trawls were limited due to the low number of samples available.

[10] Author: Lisa Readdy

Table 3.2.1. Landings of lemon sole by UK vessels landing into England and Wales and by England and Wales vessels landing outside the UK between 1985 and 2008, by ICES Division

	IIa	IIb	IIc	IId	IIe	IIf	IIg	IIIa	IVa	IVb	IVc	Va	Vb	Vc
1985	0	0	0	0	0	0	0	0	64	2192	66	0	0	0
1986	0	0	0	0	0	0	0	0	22	1731	30	0	0	0
1987	0	0	0	0	0	0	0	0	26	1767	47	0	0	0
1988	0	0	0	0	0	0	0	0	21	1795	73	0	0	0
1989	0	0	0	0	0	0	0	0	31	1791	37	0	0	0
1990	0	0	0	0	0	0	0	0	39	1803	47	0	0	0
1991	0	0	0	0	0	0	0	0	28	1646	51	0	0	0
1992	0	0	0	0	0	0	0	0	47	1690	39	0	0	0
1993	0	0	0	0	0	0	0	0	42	1690	24	3	0	4
1994	0	0	0	0	0	0	0	0	41	1454	35	5	0	0
1995	0	0	0	0	0	0	0	0	40	1329	84	0	0	0
1996	0	0	0	0	0	0	0	0	40	1197	76	3	0	0
1997	0	0	0	0	0	0	0	0	44	1362	47	1	0	0
1998	0	0	0	0	0	0	0	0	37	1304	88	1	0	0
1999	0	0	0	0	0	0	0	0	40	1155	53	1	0	0
2000	0	0	0	0	0	0	0	0	41	990	26	0	0	0
2001	0	0	0	0	0	0	0	0	31	831	22	1	0	0
2002	0	0	0	0	0	0	0	0	15	566	10	3	0	0
2003	0	0	0	0	0	0	0	0	7	521	11	0	0	0
2004	0	0	0	0	0	0	0	0	2	425	8	0	0	0
2005	0	0	0	0	0	0	0	0	2	425	7	0	0	0
2006	0	0	0	0	0	0	0	0	3	348	4	0	0	0
2007	0	0	0	0	0	0	0	0	1	452	4	0	0	0
2008	0	0	0	0	0	0	0	1	145	172	2	0	0	0

Table 3.2.1 – Continued

	VIa	VIb	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIId	XIVb	Total
1985	2	3	21	0	0	66	1208	86	27	101	12	0	0	0	0	0	5834
1986	3	3	24	1	0	41	934	97	22	108	7	0	0	0	0	0	5010
1987	9	3	32	5	0	44	809	133	15	115	6	0	0	0	0	0	4998
1988	29	3	36	0	0	29	803	118	16	140	2	0	0	0	0	0	5053
1989	16	1	41	0	0	44	701	61	8	70	0	0	0	0	0	0	4790
1990	7	2	21	0	0	82	858	62	12	193	0	0	0	0	0	0	5118
1991	3	0	23	0	0	73	910	94	13	98	2	0	0	0	0	0	4933
1992	3	0	38	0	0	119	1005	101	30	77	4	0	0	0	0	0	5147
1993	2	0	34	0	0	67	703	105	34	85	5	0	0	0	0	0	4794
1994	6	29	0	1	0	93	538	105	27	155	6	0	0	0	0	0	4490
1995	15	0	23	2	0	150	1070	133	24	138	32	1	0	0	0	0	5037
1996	2	0	13	6	0	209	1495	122	25	166	80	2	0	1	0	0	5433
1997	2	0	24	0	2	110	1572	158	25	161	55	0	0	0	0	0	5561
1998	2	9	19	9	7	91	885	151	24	107	77	1	0	0	0	0	4812
1999	2	0	11	16	5	89	514	121	34	67	55	1	0	0	0	0	4163
2000	0	9	10	5	0	122	535	131	27	59	51	0	0	0	0	0	4009
2001	0	0	12	14	3	186	620	125	30	52	62	0	0	0	0	0	3990
2002	1	0	8	3	1	116	665	124	16	60	34	0	0	0	0	0	3624
2003	3	4	21	3	5	112	656	118	23	54	60	0	0	0	0	0	3600
2004	3	0	9	0	108	754	112	0	28	61	73	1	0	0	0	0	3588
2005	1	0	6	11	1	71	718	103	20	81	26	0	0	0	0	0	3476
2006	1	0	2	8	0	48	652	82	17	73	39	0	0	0	0	0	3283
2007	0	0	1	3	0	21	580	87	20	72	51	0	0	0	0	0	3298
2008	0	1	5	2	0	43	457	65	8	58	22	0	0	0	0	0	2989

Table 3.2.2 – Catch numbers at length (cm) for lemon sole landed into ICES Area IV and Division VIId, by UK vessels landing into England and Wales and by England and Wales landing outside the UK between 1985 and 2008. For some years, no market sample lengths were available.

Length	1985	1988	1989	1990	1991	1998	1999	2000	2001	2002
19										
20								57		362
21								5154	1856	2651
22						2308	955	22685	33304	5729
23						10574	5665	70595	102592	45112
24					15926	168037	87575	176950	232503	105664
25	123096	33222	15584	302968	78355	717777	564125	422879	351584	248829
26	205160	33222	62334	496868	187289	864126	780224	499907	347836	217962
27	287225	99665	62334	1114924	234429	809556	916164	548730	388202	243663
28	492385	249163	155836	727124	66252	667352	847786	500973	355241	227814
29	492385	382050	124669	387800	142696	417270	564981	408524	291961	181707
30	328257	315607	202586	618056	117215	346210	336142	321296	278193	174198
31	615481	697657	210378	145425	38222	255448	189566	228075	217195	119367
32	943738	465105	498674	496868	45230	197112	137285	163677	158155	90368
33	369289	431883	553217	278731	35037	140343	65527	119281	148317	68368
34	492385	431883	475299	302968	22296	102271	40034	85450	98556	52740
35	328257	298996	397381	230256	15289	82956	37738	56857	76239	32281
36	451353	298996	264921	157544	3822	43205	16366	45192	60725	24598
37	205160	199331	272712	96950	1274	28801	9055	28235	41463	11409
38	123096	149498	350630	157544	1911	14696	5448	19453	25408	5519
39	0	49833	155836	36356	637	13029	2493	9616	15918	2220
40	82064	99665	77918	36356	0	2532	320	5245	9240	1339
41	82064		38959		637	1982	0	3889	3206	649
42	41032		0			2046	119	1730	2103	214
43			0			75		467	209	422
44			0			100		233	231	118
45			38959			100		110	47	40
46								31	24	62
47								41	18	
48								58	2	
49								13	0	
50								6	0	
51								5	0	
52								6	2	

Table 3.2.2 – Continued.

Length	2003	2004	2005	2006	2007	2008
19	45			56		
20	7		307	165		480
21	14	2623	5449	1730	2303	2672
22	6842	17681	32992	13338	23537	6548
23	30777	54596	90714	35717	68316	21124
24	60814	179953	184378	78181	104672	58721
25	214429	405505	276149	160281	157515	122956
26	191231	248713	217782	172770	164015	152614
27	198638	203389	173507	186167	157199	151229
28	185491	160851	112890	136959	141934	118776
29	169960	97406	84923	100187	82976	100365
30	127868	89341	79973	74982	64079	82031
31	97741	71468	56071	51413	42865	45704
32	66635	39868	40106	24542	23958	29045
33	40845	38888	33979	15927	13088	18729
34	30722	20347	12967	15080	10649	8795
35	12998	11907	7348	8924	5895	4911
36	6201	8517	2486	5855	3795	3191
37	3692	2512	1301	1988	4214	1804
38	1118	2181	2004	2001	2402	1389
39	180	912	511	242	382	176
40	179	479	92		149	272
41	112	165	89			
42	129	33	0			
43	296		84			
44						
45						
46						
47						
48						
49						
50						
51						
52						

Table 3.2.3 – Mean length (cm) of lemon sole caught in the North Sea and eastern Channel (ICES Area IV and Division VIId), and in the 'southwest' (ICES Divisions VIIe-k), between 1983 and 2008. For the North Sea, no samples were available for 1983, 1984, 1986, 1987 and 1992-1997.

	1983	1984	1985	1986	1987	1988	1989
North Sea			31.9			32.5	33.9
Westerly	32.4	31.7	31.1	31.9	31.5	31.5	32.7

	1990	1991	1992	1993	1994	1995	1996
North Sea	29.9	28.3					
Westerly	30.3	30.8	32.2	31.3	30.9	30.0	30.8

	1997	1998	1999	2000	2001	2002	2003
North Sea		28.0	27.8	28.2	28.5	28.2	27.9
Westerly	31.0	30.6	31.7	30.1	29.5	29.7	29.3

	2004	2005	2006	2007	2008
North Sea	26.9	26.6	27.3	26.9	27.5
Westerly	28.3	28.5	27.7	29.0	27.6

Table 3.2.4 - Catch numbers at age for lemon sole landed into ICES Area IV and Division VIId by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 2005 and 2008.

Age	2005	2006	2007	2008
2	23883	14070		
3	161209	105762	76595	14641
4	235085	239847	158641	53906
5	418111	274550	204710	111794
6	258913	238933	199642	128871
7	102593	93661	257043	132216
8	96748	45895	73899	160478
9	48564	17673	54423	150854
10	12957	37723	13914	64469
11	21981	8148	14665	67763
12	13024	3038	3876	22729
13	1072	682	8056	4819
14	2161	0	315	4197
15	629	674	5806	7250

Table 3.2.5 – Lpue of lemon sole in the North Sea and eastern Channel, for otter trawlers and beam trawlers between 1983 and 2008, by rectangle group.

	Rectangle group 1		Rectangle group 2		Rectangle group 3		Rectangle group 4		Rectangle group 5		Rectangle group 6		Rectangle group 7		Rectangle group 8		Rectangle group 9		Rectangle group 10	
Year	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)
1983	2.45	0	3.49	0	0.41	0.46	1.56	2.81	0.05	0	12.44	0	1.41	0	1.32	4.46	0.64	0	2.54	5.11
1984	4.2	8.23	6.4	5.7	1.27	1	2.2	1.88	4.65	0.95	14.34	7.63	1.72	0	2.25	2.63	1.09	5.89	2.15	2.63
1985	5.84	3.12	5.43	4.58	1.06	0.6	1.32	1.27	0	0	9.13	6.97	3.22	2.21	2.79	2.35	0.91	1.19	2.27	1.63
1986	3.82	3.9	3.75	2.48	0.39	0.26	0.75	0.69	1.35	0	10.82	3.9	1.86	1.94	2.18	1.96	0.67	1.15	0.54	0.85
1987	3.83	3.98	4.14	4.28	0.41	0.74	0.93	0.75	1.25	3.7	5.27	4.34	1.94	1.47	3.17	2.77	1.1	0.7	0.49	0.67
1988	4.51	2.69	4.38	1.38	0.39	0.56	1.13	0.69	0.67	1.91	5.68	5.47	1.63	0.68	3.88	2.33	0.48	0.76	1.02	0.69
1989	3.98	2.65	3.6	1.05	0.44	0.77	0.31	0.58	0	0.02	6.91	2.62	1.97	1.13	3.78	1.9	1.6	1.64	0.97	0.79
1990	3.75	3.67	4.09	1.37	0.59	1.15	1.11	0.11	0.34	1.29	5.23	1.45	2.88	1.35	3.77	2.09	3.01	0.94	1.37	0.66
1991	3.2	3.1	3.45	2.13	0.57	0.29	1.13	0.53	0.68	0.1	4.95	1.37	2.49	1.07	4.63	1.5	0.99	0.89	1.5	0.71
1992	3.14	4.07	3.25	4.4	0.54	0.66	0.55	0.63	5.09	1.88	2.87	3.41	2.5	1.75	3.64	2.11	5.01	1.85	1.58	0.92
1993	2.87	4.73	3.11	3.3	0.25	0.66	0.61	0.7	0.46	0	3.18	1.72	2.49	1.83	3.38	2.06	2.74	1.59	0.4	0.91
1994	3.5	4.93	2.27	3.55	0.22	0.34	0.88	0.75	1.92	0	4.48	7.98	3.3	1.91	5.48	1.82	0.57	1.84	1.26	0.8
1995	4.8	5.89	3.39	2.03	0.56	0.68	1.16	1.53	0.42	0.58	6.22	27.82	3.08	1.26	5.33	0.93	1.08	1.23	2.6	1.78
1996	5.26	4.72	4.04	2.86	0.77	1.07	2.52	1.29	1.06	1.49	5.46	0	3.95	1.52	4.3	1.08	0.39	1.53	4.5	1.34
1997	5.26	5.35	4.48	2.81	0.6	0.58	1.48	1.1	0	0	5.13	6.52	3.91	1.81	7.32	1.97	2.47	0.92	0.91	0.96
1998	4.26	6.57	4.3	4.57	0.57	2.11	1.21	3.66	1.05	0	4.59	2.95	4.98	2.02	5.23	1.1	1.55	1.17	1	0.94
1999	4.9	8.84	3.73	4.33	0.21	0.9	1.51	2.57	1.52	0.12	3.69	2.93	4.38	1.66	3.91	0.85	0.68	0.97	1.22	1.52
2000	3.75	4.76	2.81	0.29	0.61	0.43	0.9	1.2	0.21	0	6.02	0	6.38	1.64	3.88	1.33	0.55	0.79	4.46	2.66
2001	3.41	9.5	2.96	0.91	0.59	0.54	1.97	2.55	0	0	8	0	8.4	1.53	4.29	1.36	0.51	0.62	1.41	3.53
2002	2.98	1.34	2.55	0.32	0.56	0.13	4.47	0.87	1.56	0	2.68	3.36	4.5	1.05	2.39	0.68	0.94	0.65	1.59	1.91
2003	3.64	1.28	2.8	0.79	0.78	0.05	2.29	0.19	0	0	0.87	0	2.05	0	3.65	1.64	4.98	0	4.76	2.16
2004	4.45	1.21	3.36	0.27	1.86	0.01	0.91	0.03	0	0	0.63	0	8.38	0	3.19	1.16	10.9	0	1.89	1.94
2005	3	3.48	2.37	0.25	0.21	0.07	0.51	3.01	0	0	0.15	0	18.06	0	2.08	0.74	0	0	13.04	1.88
2006	2.17	6	1.7	0.24	0.1	0.96	0.6	0.46	0	0	0.59	0	21.33	0	3.69	1.72	0.6	0	6.51	1.27
2007	1.99	0	2.49	0.1	0.06	0.06	0.35	0.01	0	0.3	0.74	0	14.37	0	2.31	1.4	2.26	0	3.26	0.57
2008	2.31	0	1.45	0	0.04	0.06	0.04	0.87	0.16	0	1.4	0	10.29	0	0.95	0	0.26	0	4.96	1.1

Table 3.2.6 - Catch numbers at length (cm) for lemon sole landed into ICES Areas VIIe-k, by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 1982 and 2008.

Length	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
18													
19													
20													
21	19	1268	1582								2709		
22	353	6039	7381	3117	261	361		2774			4884	704	192
23	1277	12687	32486	7170	9637	3231	711	13253	857	5	13223	11420	10265
24	3902	30761	67470	42609	35381	30809	2914	46715	10188	1438	32135	52064	72041
25	8340	83123	115827	79186	86984	85844	19279	206665	48866	44564	99425	112136	211354
26	12208	134436	157464	86412	128533	125282	67279	248004	90685	47875	145293	168187	295815
27	21894	207931	228071	127036	181763	168784	81401	291898	107502	85621	168832	171515	435712
28	32693	220505	254928	177737	227719	237365	110792	327523	156088	105147	141334	163056	439254
29	42524	282685	317333	203117	238959	208691	132358	326633	134802	119085	167711	181152	403463
30	46860	256854	375745	266673	268884	229923	161164	312567	159605	164097	194505	184626	400359
31	53725	256848	372826	269023	239777	242341	173959	251519	155192	226504	178900	159700	307044
32	58829	279654	374750	269870	233482	233904	197249	262041	161042	191548	177196	146201	282565
33	56717	233076	348080	260377	203805	204303	185895	218847	131253	208054	183909	131174	252018
34	54391	233849	299033	261915	173234	187647	177643	162901	105571	157375	156470	132929	171295
35	49840	219029	217168	203641	156404	151299	169053	105978	92070	178823	156329	100806	120579
36	32806	162763	137538	178860	128941	130829	138511	88928	44838	141835	121618	91267	84709
37	24119	137700	97946	118409	93118	85652	102759	72066	32997	89214	92081	75164	53442
38	14287	100477	53740	62044	77143	68753	81492	46643	18834	45335	61660	47963	46703
39	9791	76198	33186	50127	55575	42884	49206	27788	8896	16601	29923	34248	23841
40	7253	34350	25025	38048	36268	32131	38032	24205	7037	12542	26453	25585	21891
41	4082	18728	11592	19775	21816	19986	17625	16547	3673	6882	10262	14209	13688
42	2664	10133	4700	6880	17849	14294	10784	13183	2051	5107	6769	13904	12135
43	1549	7001	2119	5038	9479	7722	7225	9617	2581	3845	5744	5302	8809
44	582	4090	3350	2847	4861	2765	4575	6532	1658	1689	605	3769	6284
45	927	4211	1861	687	2125	3032	2460	2041	340	1348	1850	2310	4235
46	262	676	1186		2458	872	1161	1704	823	546	388	1792	3715
47	248	1535	999		859	2975	687	1507	31	1580	490	387	1325
48	306	387	434		181	738	253	1742	23	1925	68	752	100
49	50	303	373		386		757	255	23	0	130	0	1056
50	201		746				0	185	31	595	68	832	239
51			746				0				0	75	
52			386				74				41	75	
53			373									75	
54			0									0	
55			0									0	
56			746									0	
57			0									0	
58			0									75	
59			0									0	
60			373									0	
61			373									0	
62												75	
63												0	
64												0	
65												0	
66												0	
67												75	

Table 3.2.6 – Continued.

Length	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
18												30	
19										2033		191	
20					419		554	1769	261	6466	22119	6038	3308
21					452	2664	3504	4863	20170	13479	30435	16194	29584
22		3154		257	3686	13141	11198	27283	65647	43933	134397	48183	73791
23	4080	4653	18278	616	27970	52485	40718	69751	132336	89779	167170	96992	124216
24	41331	34239	61079	11268	76075	118528	115844	85749	223241	197785	253496	133296	196876
25	148305	153431	110434	44319	104357	185010	174184	138825	275062	262872	302755	168596	223972
26	236199	225935	212405	88378	144155	222956	223686	159148	305832	310197	336768	201991	252674
27	343099	383856	269271	114331	191427	232597	223725	184754	393515	320821	277757	185117	229906
28	430579	399688	315757	151255	197978	240745	205247	163722	309075	319129	300887	224981	189631
29	509227	433793	338768	145152	212306	226078	258684	165250	288782	289939	225033	219834	174094
30	500880	485417	272936	162406	184470	217526	229125	161091	260376	232289	169196	211816	134739
31	524847	483173	241820	156406	194598	188786	195483	128516	222873	234821	153168	206925	105754
32	480711	532189	244314	151117	168461	170077	180678	130723	165960	177752	123187	165017	103693
33	394740	465168	208219	141897	137748	124747	159373	90001	128768	135612	89442	119390	67002
34	317975	389908	182139	133267	111066	103478	102011	69422	87105	96042	76703	100873	54680
35	220308	246718	156869	108438	94786	75657	83129	51289	60009	49708	61078	52371	42527
36	138087	188276	128987	79826	69146	50101	60094	43465	39870	35074	31481	42271	18880
37	76291	114625	77134	65433	40327	37907	39132	26461	29276	26167	28426	28390	14584
38	43827	66227	52121	43457	29437	33563	28586	28804	20488	12260	24888	16391	5536
39	24494	32950	42423	30371	18123	19242	15465	10510	9824	13841	10478	13761	3900
40	24485	18476	17068	21239	8585	14651	16452	9912	4957	6131	4845	8132	1239
41	17134	11144	9214	19861	4339	13745	6518	9777	4801	5841	5420	6907	1615
42	10889	6527	9145	5290	4938	7863	13863	6353	2490	2202	5532	5684	845
43	9984	4562	3083	4864	3636	6339	10045	3343	4791	2585	2095	1497	1578
44	6785	1250	1953	4241	1403	1921	4909	1342	1682	1904	3095	375	829
45	1914	3309	1600	2952	323	3089	4573	5171	1427	658	817	1722	0
46	2097	284	1366	4955	341	390	746	657	239	243	1718	0	200
47	2391	742	209	2195		1512	733	210	636	709	422	371	
48	1087	0	0			158	40	251	352			165	
49	352	219	1366				95	0	0			0	
50	318	0					1466	196	15			730	
51	76	46										0	
52	318											165	
53													
54													
55													
56													
57													
58													
59													
60													
61													
62													
63													
64													
65													
66													
67													

Table 3.2.7 - Catch numbers at age for lemon soles landed into ICES Division VIIe-k by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 2005 and 2008.

Age	2005	2006	2007	2008
1				
2	154023	4834	8858	22180
3	537391	654108	139890	280910
4	1211680	550814	803387	332952
5	398553	1021921	637638	287966
6	299785	230746	355075	462154
7	90847	204289	121358	362700
8	46709	43805	97936	149921
9	61970	70391	29593	82760
10	22559	20428	38355	21064
11	25584	11200	11872	11499
12	29213	8241	3571	23424
13	8717	8657	18428	6361
14	663	4132	6359	10075
15	2834	8734	12319	1991

Table 3.2.8 - Lpue of 'westerly' lemon sole, for otter trawlers and beam trawlers between 1983 and 2008, by ICES Division (7E, 7F, 7G and 7H). Some ICES Divisions have been further separated into North (N), South (S), East (E) or West (W).

	Rect Group 7EW		Rect Group 7EN		Rect Group 7ES		Rect Group 7F		Rect Group 7GE		Rect Group 7GW		Rect Group 7HE		Rect Group 7HW	
Year	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)	Otter trawl (kg/hr)	Beam trawl (kg/hr)
1983	9.6	4.02	7.76	2.29	6.1	3.03	1.16	3.68	0.66	3.43	0	4.21	4.88	2.28	4.63	4.39
1984	7.24	4.01	9.06	2.3	3.68	2.62	1.75	2.89	0.53	3.26	0	5.52	3.35	2.88	3.16	2.54
1985	7.64	3.83	9.55	2.41	0.46	2.44	1.25	2.49	0.51	2.56	0.74	4.17	9.75	3.39	0.12	2.59
1986	6.36	3.75	5.92	1.64	12.59	1.7	1.01	2.54	0.35	2.37	1.18	3.32	3.91	3.48	0	3.19
1987	5.22	3.55	3.67	1.24	7.02	1.41	1	2.1	0.34	1.17	0.29	1.64	3.08	2.7	2.09	1.95
1988	4.51	3.25	3.62	1.3	3.13	1.45	0.9	3.12	0.32	2.71	0.13	2.34	2.33	2.85	0	1.87
1989	3.49	1.8	5.42	1.24	2.76	1.31	1	1.46	0.38	1.35	0.25	0.2	2.87	1.28	0	1.15
1990	3.69	1.59	4	1.18	0.97	1.03	1.02	0.84	0.29	0.48	0.21	1.72	1.46	0.65	0	0.56
1991	4.25	1.32	7.17	1.1	1.82	1.1	0.81	1.09	0.29	0.6	0.23	0.64	1.45	0.67	0.27	0.23
1992	4.68	1.9	7.42	1.04	4.87	1.15	1.17	2.03	0.2	1.54	0.43	1.16	1.82	1.33	0.12	1.03
1993	3.37	1.47	4.84	0.89	1.05	0.81	0.96	1.7	0.14	1.35	0	0.85	0.57	1.36	0	1.18
1994	2.45	1.96	3.41	0.87	0.16	0.89	0.78	2.25	0.35	2.06	0.3	1.95	1.1	2.17	0	1.09
1995	4.26	2.36	6.61	1.53	0.87	1.44	1.05	2.36	0.49	1.53	1.48	0.82	2.54	1.63	0.88	1.31
1996	7.07	2.46	9.35	1.62	0.03	1.21	1.57	2.11	1.32	0.99	0.81	0.65	2.37	1.86	0.52	1.08
1997	7.76	2.51	8.59	1.47	0.49	1.42	1.53	2.47	0.58	1.46	0.08	0.62	2.77	1.72	2.11	0.98
1998	3.89	2.17	5.19	1.13	0.2	0.93	1.42	2.15	0.68	1.51	0.28	0.93	0.8	1.43	1.06	0.72
1999	2.69	1.6	2.44	0.77	0.83	0.62	1.76	1.95	0.44	1.22	0.2	0.57	3.23	1.07	0.26	0.75
2000	2.06	1.41	3.31	1.07	4.31	0.71	0.61	2.27	0.43	1.28	0.23	0.7	1.46	0.91	0.08	0.51
2001	2.53	1.64	3.3	0.99	3.06	1.03	0.84	2.19	0.28	1.19	0.49	1.09	2.4	0.93	0.01	0.52
2002	1.93	1.98	5.46	1.22	1.66	0.84	0.84	2.48	0.24	1.56	0.25	1.24	2.29	1.06	0.04	0.54
2003	2.46	1.7	4.67	1.27	3.09	0.76	0.93	2.2	2.57	1.36	0.4	0.29	4.27	0.86	0.55	0.42
2004	3.07	1.83	5.94	1.24	2.04	0.67	0.52	2.76	0.57	1.54	0.23	0.57	2.78	1.05	0.79	0.43
2005	4.72	1.67	5.41	0.99	10.44	0.77	0.68	2.81	0.19	2.29	0.74	0.29	3.64	1.18	0.27	0.48
2006	4.83	1.58	3.9	0.84	11.16	0.58	0.59	1.84	0.08	2.48	0.74	0.93	2.15	1.32	0.45	0.66
2007	3.51	1.86	4.66	0.79	0.41	0.58	0.42	3.48	0.31	2.26	1.62	0.3	2.37	1.28	0.56	0.82
2008	2.9	1.4	3.52	0.76	1.09	0.61	0.5	2.9	0.29	1.51	1.15	0	0	1.1	0.32	0.74

Table 3.2.9 - Number of lemon sole and dab retained , discarded and the % discarded between 2003 and 2008 in the Cefas discard sampling programme, by area grouping and gear type

		Lemon sole				Dab			
		IV and VIId		VIIe-k		IV and VIId		VIIe-k	
		Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears
2003	Discarded	686	4	1,098	8	5,802	0	4,562	4
	Retained	3,491	6	7,204	32	4,451	0	681	0
	% discarded	16.4	40.0	13.2	20.0	56.6		87.0	100.0
2004	Discarded	1,588	7	1,271	10	9,887	52	4,767	2
	Retained	11,647	3	8,881	151	4,291	9	2,215	0
	% discarded	12.0	70.0	12.5	6.2	69.7	85.2	68.3	100.0
2005	Discarded	505	0	1,194	6	2,682	0	1,820	2
	Retained	4,448	0	5,950	51	690	0	933	0
	% discarded	10.2	-	16.7	10.5	79.5		66.1	100.0
2006	Discarded	388	2	675	0	3,479	170	3,431	6
	Retained	3,499	0	9,655	3	780	0	840	2
	% discarded	10.0	100.0	6.5	0.0	81.7	100.0	80.3	75.0
2007	Discarded	786	6	643	0	5,623	1,011	8,415	3
	Retained	4,590	48	13,033	14	977	238	1,169	1
	% discarded	14.6	11.1	4.7	0.0	85.2	80.9	87.8	75.0
2008	Discarded	1,122	1	1,552	0	8,379	313	7,951	4
	Retained	5,227	8	11,133	6	566	37	1,837	0
	% discarded	17.7	11.1	12.2	0.0	93.7	89.4	81.2	100.0

Table 3.2.10 - Estimated number of lemon sole discarded at length by beam trawlers and other gear groups in ICES Area IV and Division VIId between 2003 and 2008.

	2003		2004		2005		2006		2007		2008	
	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears
100	0		0		0		0		2,870		0	
110	19,095		0		0		0		1,188		0	
120	22,174		0		0		0		396		0	
130	11,582		10,731		0		1,062		3,530		1,487	
140	3,071		11,756		883		1,274		594		4,974	
150	66,245		17,672		6,787		32,058		5,403		55,496	
160	113,345		26,981		12,340		13,163		6,829		184,054	
170	145,792		77,358		52,599		9,341		13,869		300,196	
180	188,442		114,545		68,337		62,222		41,536		430,974	
190	355,150		208,586		156,089		96,014		52,187	136	357,017	
200	605,544		341,835		183,755		155,969		117,707		391,457	
210	696,444		453,833		95,525		225,247		148,748	156	465,626	
220	770,035		494,999		130,868		241,800		212,233	214	403,004	
230	566,966		431,773		141,099		220,151		213,188		470,318	
240	210,294		337,127		106,139		102,795		138,347	272	261,700	283
250	140,460	59	138,042		156,665		79,620		79,269	136	195,353	
260	109,950	59	84,247	58	50,119		22,951		32,113		43,864	
270	19,038	0	18,117	116	14,868		7,730	2	19,027		60,285	
280	12,915		5,061	116	1,051		0		0		8,482	
290	0	59	1,228	58	1,057		14,795		2,739		482	
300	0	0	1,637		180		0		0		0	
310		0										
320												
330		59										
340		0										
350		0										
360												
370								2				

Table 3.2.11 - Estimated number of lemon sole discarded at length by beam trawlers and other gear groups in ICES Divisions VIIb-k between 2003 and 2008.

	2003		2004		2005		2006		2007		2008	
	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears
100	0		1,453		411		1,559		0		0	
110	0		0		2,195		0		0		0	
120	0		0		3,566		0		0		3,037	
130	993		0		7,133		1,114		0		0	
140	1,575		3,001		5,075		1,114		545		117	
150	3,491		7,314		7,270		4,455		3,270		0	
160	4,294		17,502		13,031		18,650		1,908		3,856	
170	14,196		9,794		13,091		13,782		5,927		10,694	
180	22,998		34,719		19,305		17,800		14,511		24,715	
190	41,143		76,139		30,116		55,675		33,725		41,727	
200	115,358		173,495	13	52,474		126,726		50,954		88,885	
210	168,204		257,051		70,112		234,782		80,621		189,667	
220	164,247		244,394		94,380		268,271		83,724		160,735	
230	213,536		172,617		78,702		212,053		77,551		160,421	
240	118,735	0	157,618	0	51,113		146,561		44,864		88,686	
250	80,082		91,166	26	27,304		56,723		37,565		42,348	
260	40,835	0	40,743	0	15,512	0	37,589		12,856		29,518	
270	22,075	75	18,575	0	5,279	73	9,935		14,942		19,835	
280	23,759	75	11,809	26	4,585	0	10,582		474		5,725	
290	7,265	75	3,159	26	1,674	73	0		0		1,287	
300	3,443	75	625	0	0	0	6,592		0		0	
310	662	75	875	0	0	145	1,433		273		497	
320	0	75	0	0	0	145	3,726		0		0	
330	0	0	0	0	0		0		0		0	
340	0	0	0	0	0		0		0		0	
350	0	151	0	0	0		0		0		0	
360 to 400	0		0	0	0		0		0		0	
410	0		0		0		2,293		0		0	

Table 3.2.12 - Estimated number of dab discarded at length by beam trawlers and other gear groups in ICES Area IV and Division VIId between 2003 and 2008.

	2003		2004		2005		2006		2007		2008	
	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears
70	239		4,962		178,936		0		483		0	
80	18,144		7,339		87,780		0		1,933		0	
90	312		9,073		56,004		758		2,335		99	
100	17,146		12,821		21,250		9,027		4,027		986	
110	19,443		12,905		22,853		12,690		11,657		3,084	
120	6,316		12,193		14,876		40,705		38,152		9,282	
130	14,102		20,749		18,681		73,870		53,915		18,673	
140	31,242		29,879		40,179		134,690		117,595	791	35,241	
150	76,448		53,818	0	64,951		610,125	10	273,321	2,175	81,733	263
160	118,017		93,100	0	78,222		1,614,611		396,589	3,362	166,372	1,315
170	162,356		134,792		104,125		3,459,057	29	687,814	5,735	302,374	3,157
180	231,985		199,478	0	127,712		4,990,019	67	855,961	13,545	353,354	6,840
190	200,430		190,811		161,057		8,467,590	95	794,490	19,609	386,653	10,523
200	224,242		192,787	0	149,040		9,468,743	200	678,091	25,838	231,488	8,945
210	142,515		129,545	0	154,987		12,380,996	197	480,467	17,797	142,155	10,523
220	113,034		90,899	0	124,111		9,928,247	171	326,065	21,455	96,895	11,312
230	86,528		63,281	1	111,738		8,609,046	190	226,650	18,192	54,066	7,629
240	64,048		55,014	1	95,367		6,910,288	200	123,635	12,853	28,692	9,471
250	39,595		39,571	0	84,715		4,646,397	152	70,136	9,788	33,677	3,946
260	18,724		31,019	0	43,880		3,068,518	133	47,402	6,328	16,326	4,209
270	20,047		28,560	0	25,290		1,666,670	51	24,722	4,778	20,443	2,894
280	7,756		16,444	0	17,422		928,008	76	17,200	3,658	4,265	789
290	5,764		11,496	0	14,328		484,272	38	8,949	1,186	4,610	526
300	2,693		7,861	0	5,234		196,121		6,402	989	1,544	263
310	606		7,660		2,837		22,398		617	198	102	526
320	316		1,799		1,311		33,258	10	93	0	95	0
330	393		1,161		999		0	10	3,221	297	168	
340	131		233		0		0		4,201		2	
350	0		89		1,165		0		1,047		0	

Table 3.2.13 - Estimated number of dab discarded at length by beam trawlers and other gear groups in ICES Divisions VIIe-k between 2003 and 2008.

	2003		2004		2005		2006		2007		2008	
	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears	Beam trawl	Other gears
40	4,774		0		0		0		1,637		0	
50	0		0		7,517		0		4,364		437	
60	2,604		0		16,308		2,852		4,978		0	
70	0		71		30,506		27,222		3,360		437	
80	0		99		660		4,148		5,275		1,094	
90	9,319		694		9,135		10,370		4,566		0	
100	0		443		2,223		10,111		10,293		700	
110	3,103		996		2,674		27,222		38,680		2,668	
120	6,282		2,172		0		129,637		41,227		5,135	
130	44,228		3,884		19,067		144,220		74,810		12,527	
140	54,820		4,419		132,165		321,883		180,707		20,585	
150	109,008		6,803		285,049		319,292		329,059		31,461	
160	307,144		10,830		599,257		358,241		492,051		88,937	
170	994,169		26,322		792,936		539,666		644,045		174,981	
180	1,598,838		42,692		1,499,246		647,166		850,225		187,764	
190	1,968,824		79,566		1,587,164		967,980		832,720		404,745	
200	1,721,207		105,506		1,535,010		1,143,298		750,377		495,148	
210	1,449,106		101,940		1,023,617		1,219,851		525,482		422,758	
220	834,292		87,752		559,657		1,112,246		360,890		304,575	
230	638,776		75,122		455,519		752,608		281,842		223,569	
240	414,947		54,010		275,511		586,276		154,949	51	207,281	
250	278,070		37,797	50	151,159		564,190	88	71,612	51	107,144	38
260	141,440		22,062		85,860		383,657	176	53,596	51	68,685	
270	67,595		15,121		25,684		259,440	88	35,755		101,070	38
280	39,297		5,002		4,618		127,456		16,773		32,125	
290	12,969		3,825		396		9,168		1,330		23,393	
300	3,645		1,350		429		25,444	176	1,773		1,704	
310	3,853		155		0		8,296		546		21,123	
320	1,493		844		0		0		750		262	
330	0		659		429		0		0		149	

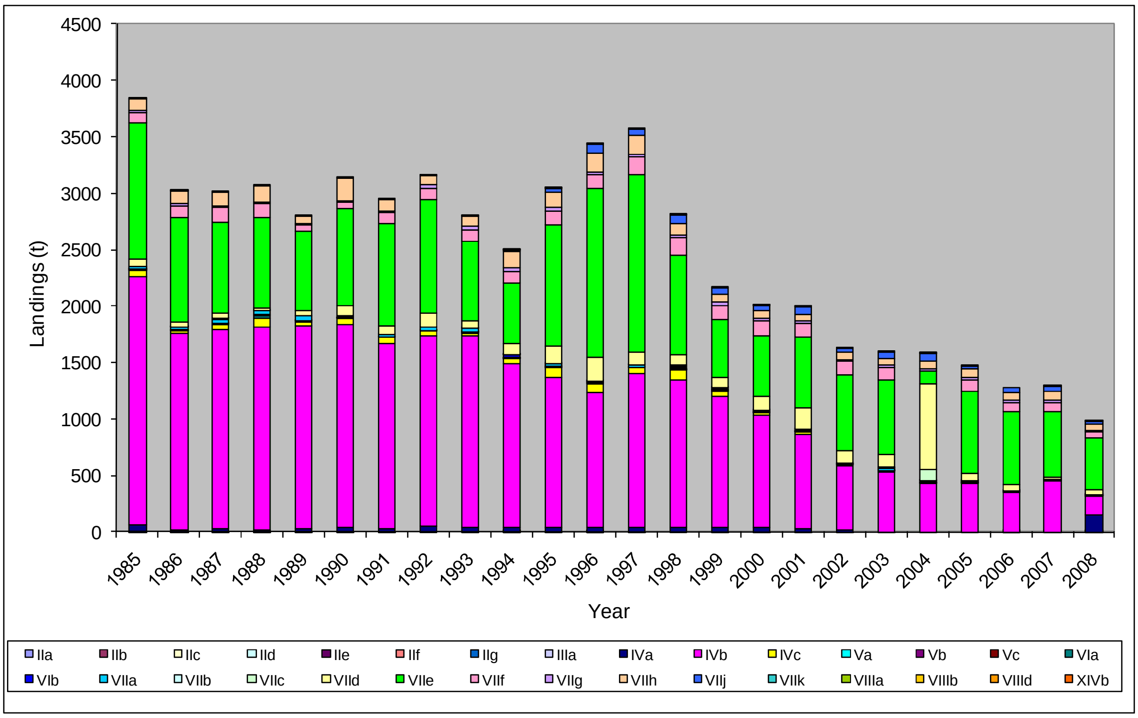


Figure 3.2.1 – Landings of lemon sole (t) by UK vessels landing into England and Wales and by England and Wales vessels landing outside the UK between 1985 and 2008, by ICES Division.

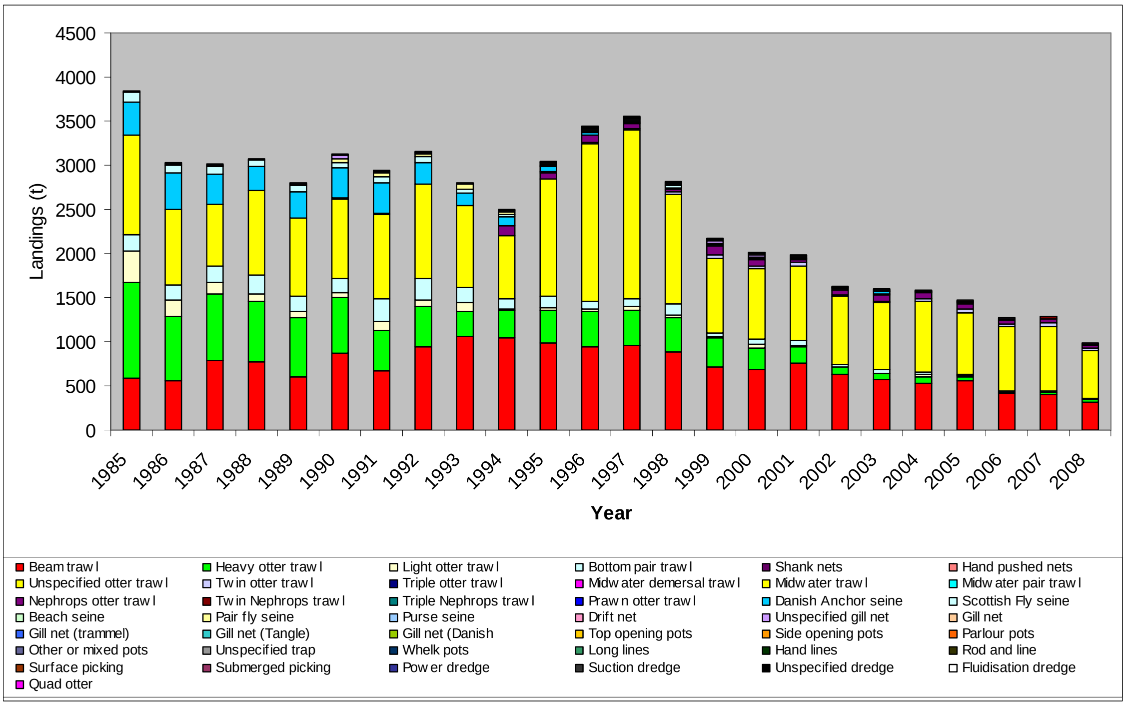


Figure 3.2.2 – Landings of lemon sole (t) by UK vessels landing into England and Wales and by England and Wales vessels landing outside the UK between 1985 and 2008, by gear type.

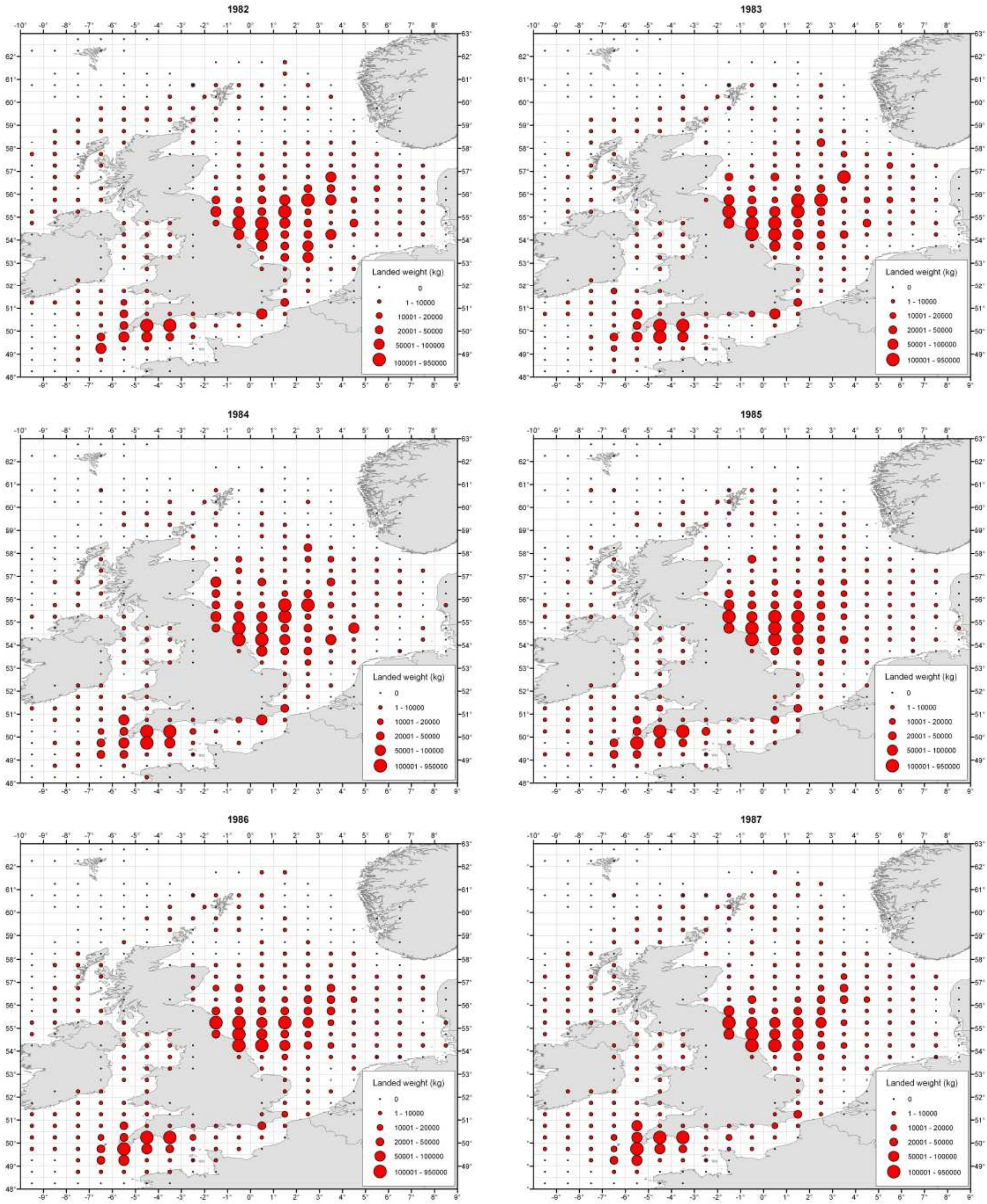


Figure 3.2.3 - Landings of lemon sole by UK vessels into England and Wales and by England and Wales vessels outside the UK, by ICES Rectangle.

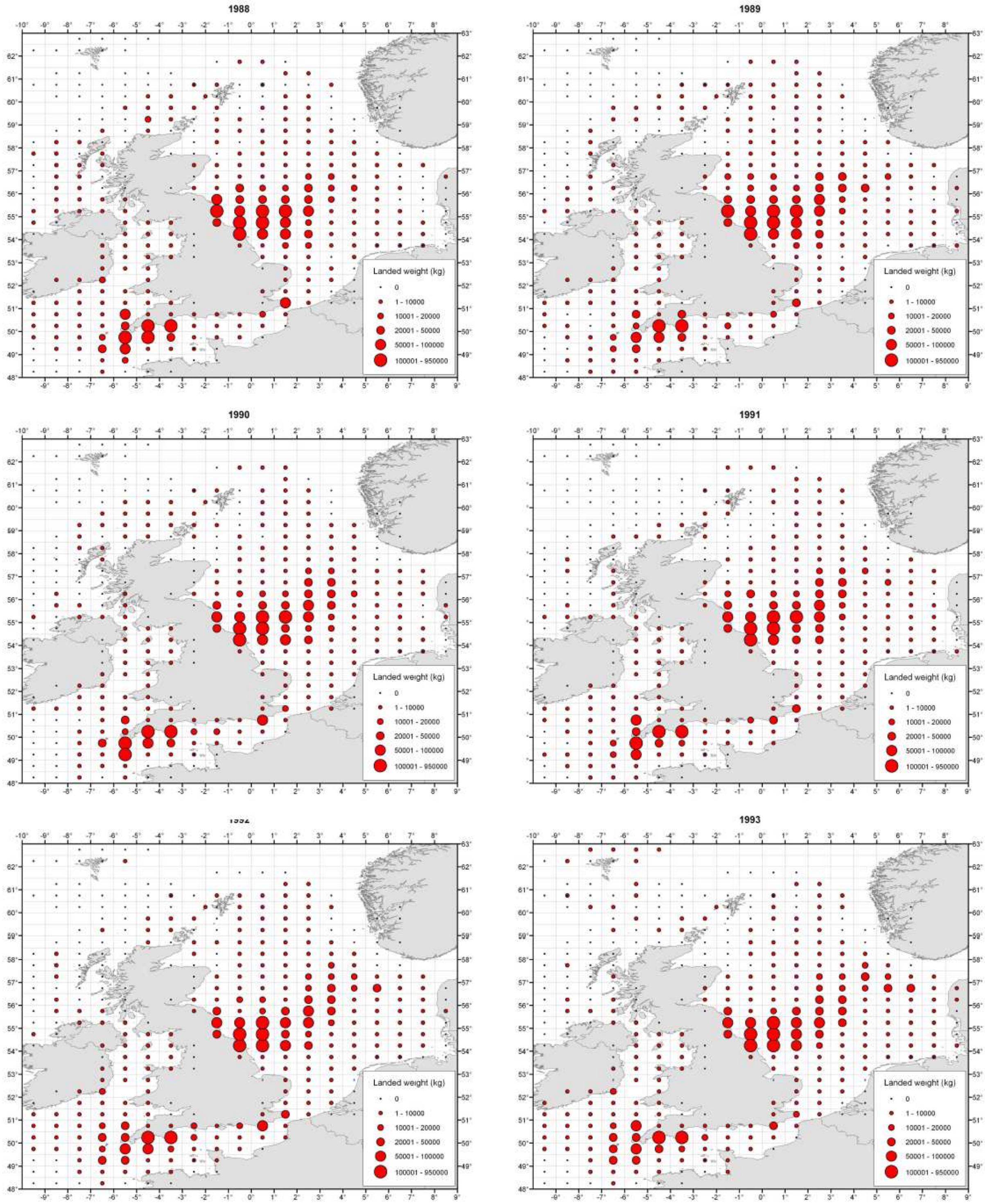


Figure 3.2.3 – Continued.

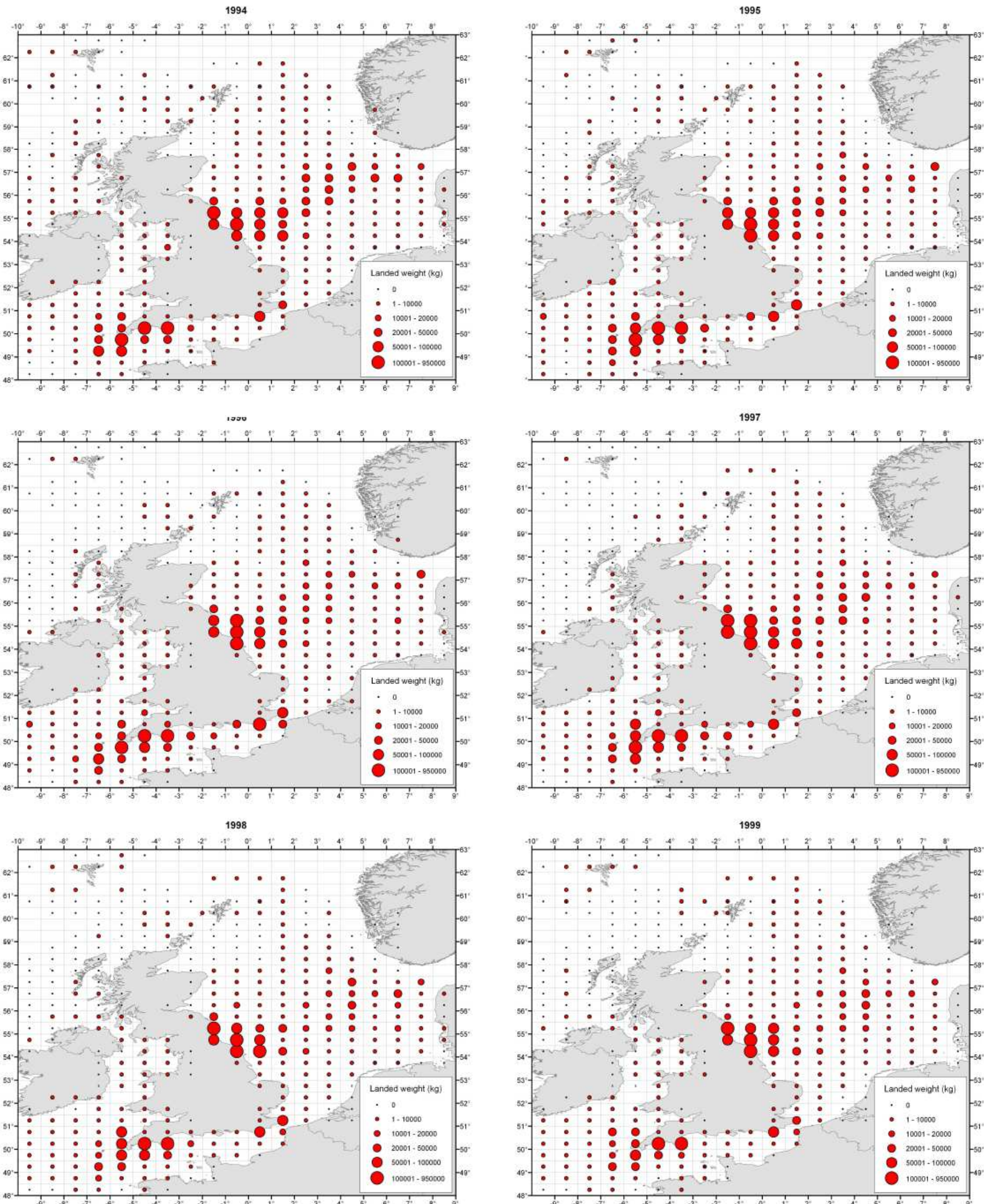


Figure 3.2.3 – Continued.

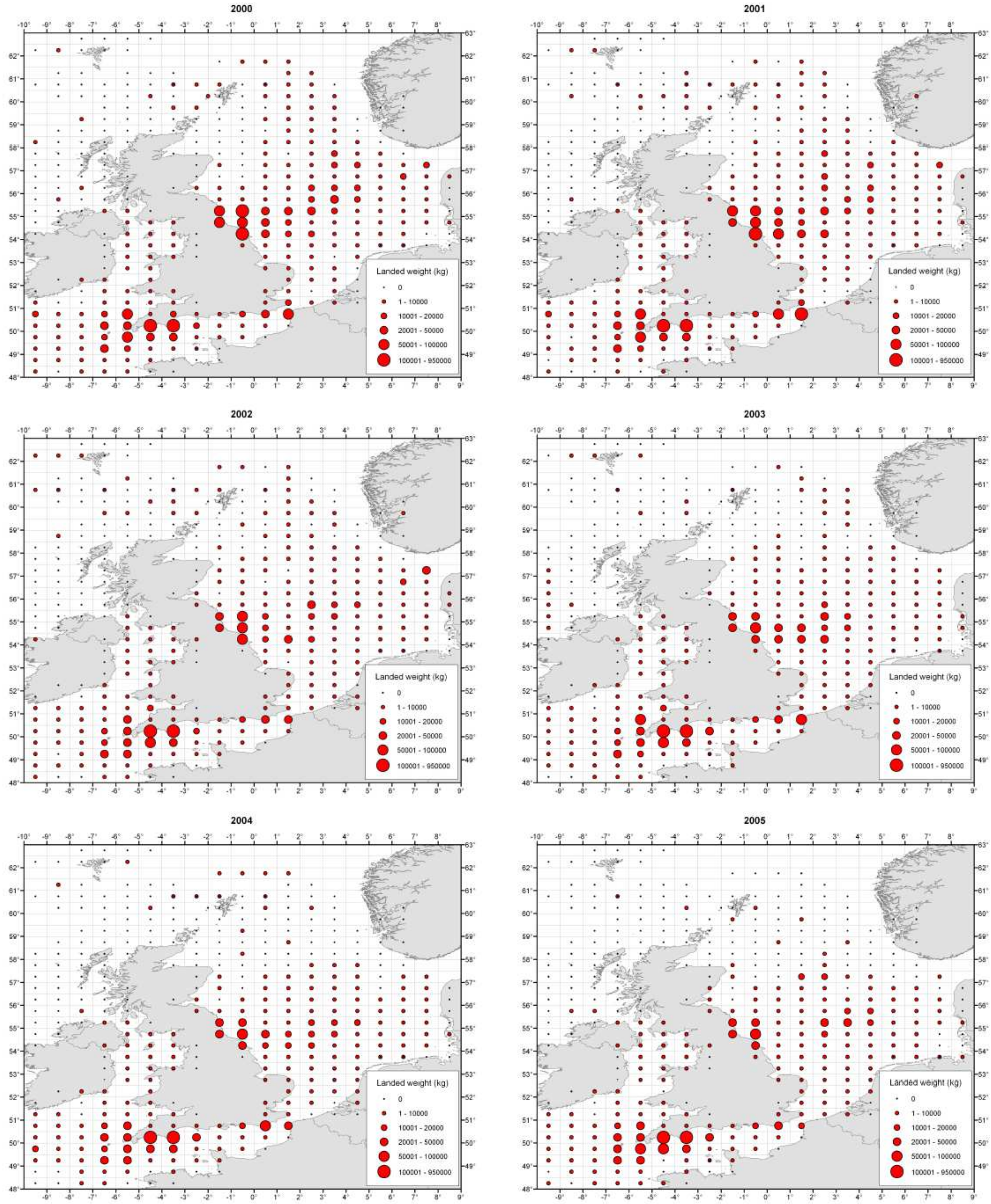


Figure 3.2.3 – Continued.

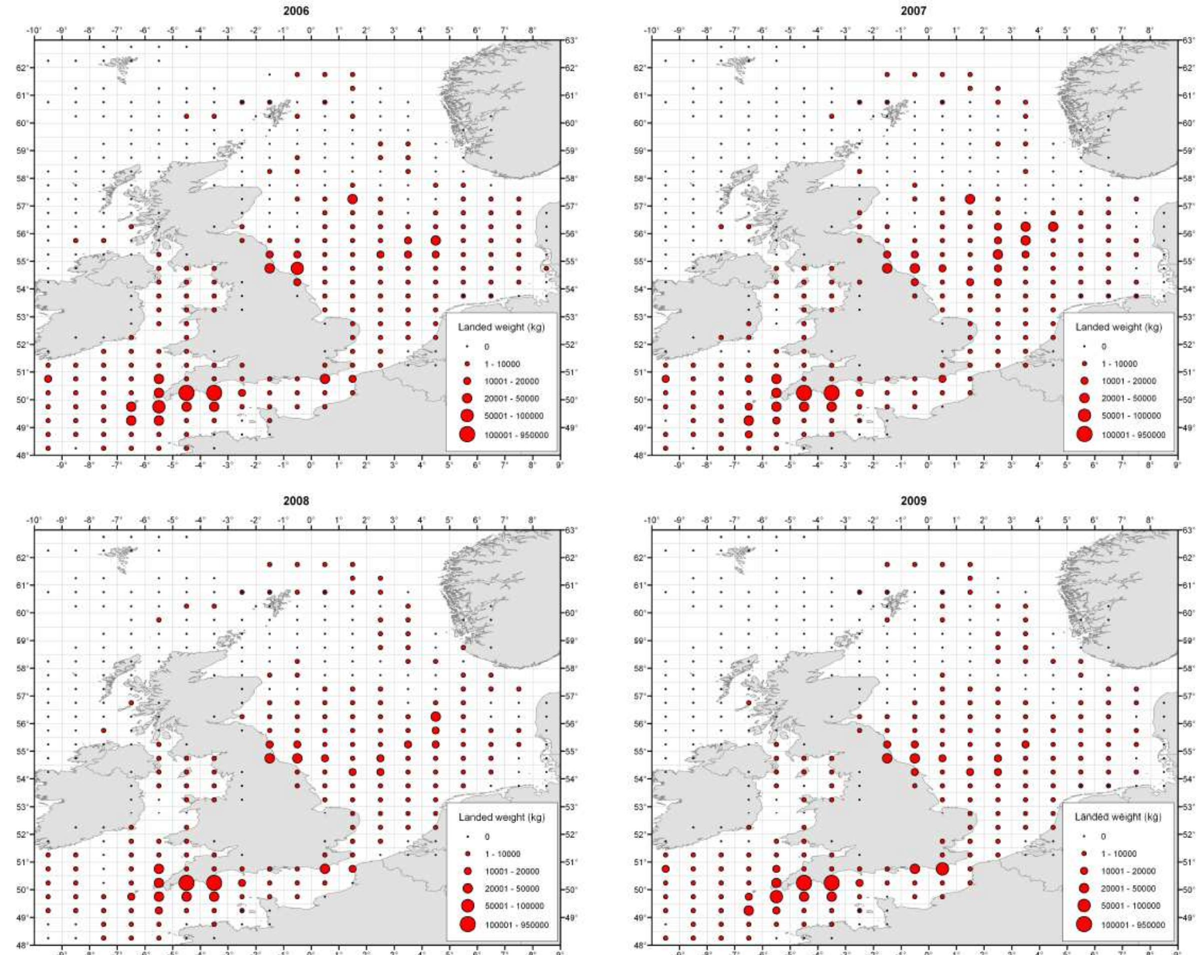


Figure 3.2.3 – Continued.

Figure 3.2.4 - Catch numbers at length (cm) for lemon sole landed into ICES Area IV and Division VIId by UK vessels landing into England and Wales and by England and Wales landing outside the UK. For some years, no market sample lengths were available.

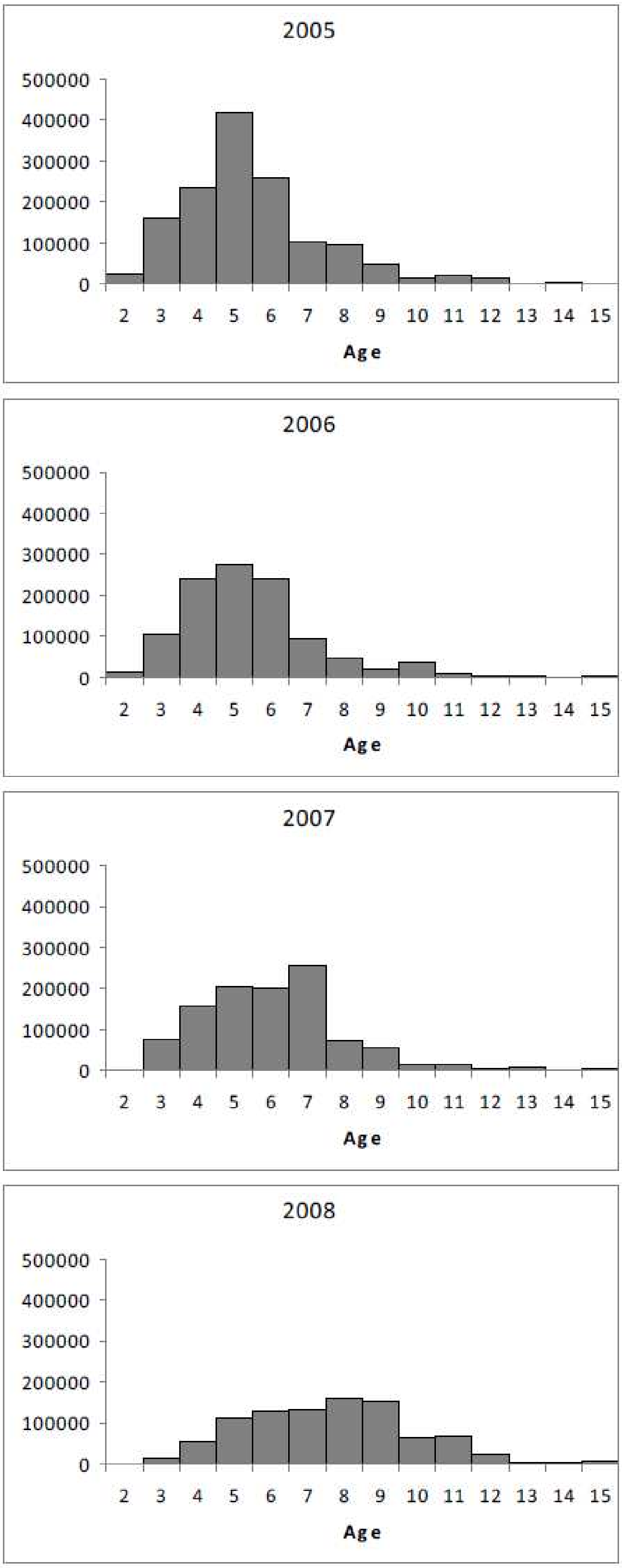


Figure 3.2.5 - Catch numbers at age for lemon sole landed in Area IV and Division VIId by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 2005 and 2008.

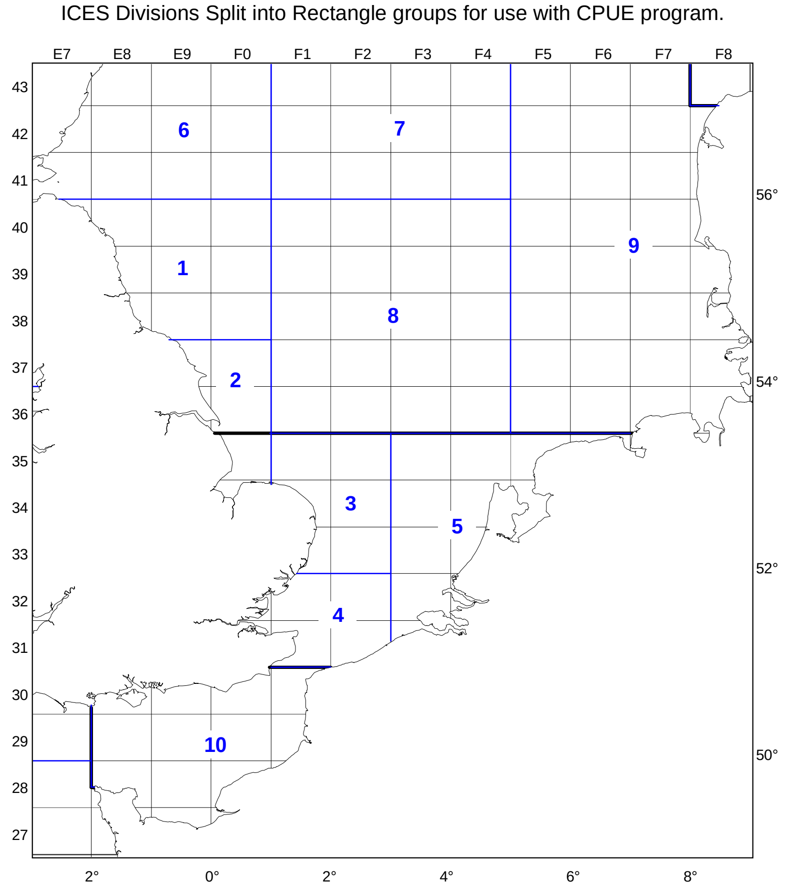


Figure 3.2.6 - North Sea rectangle groups, used for processing lemon sole LPUE.

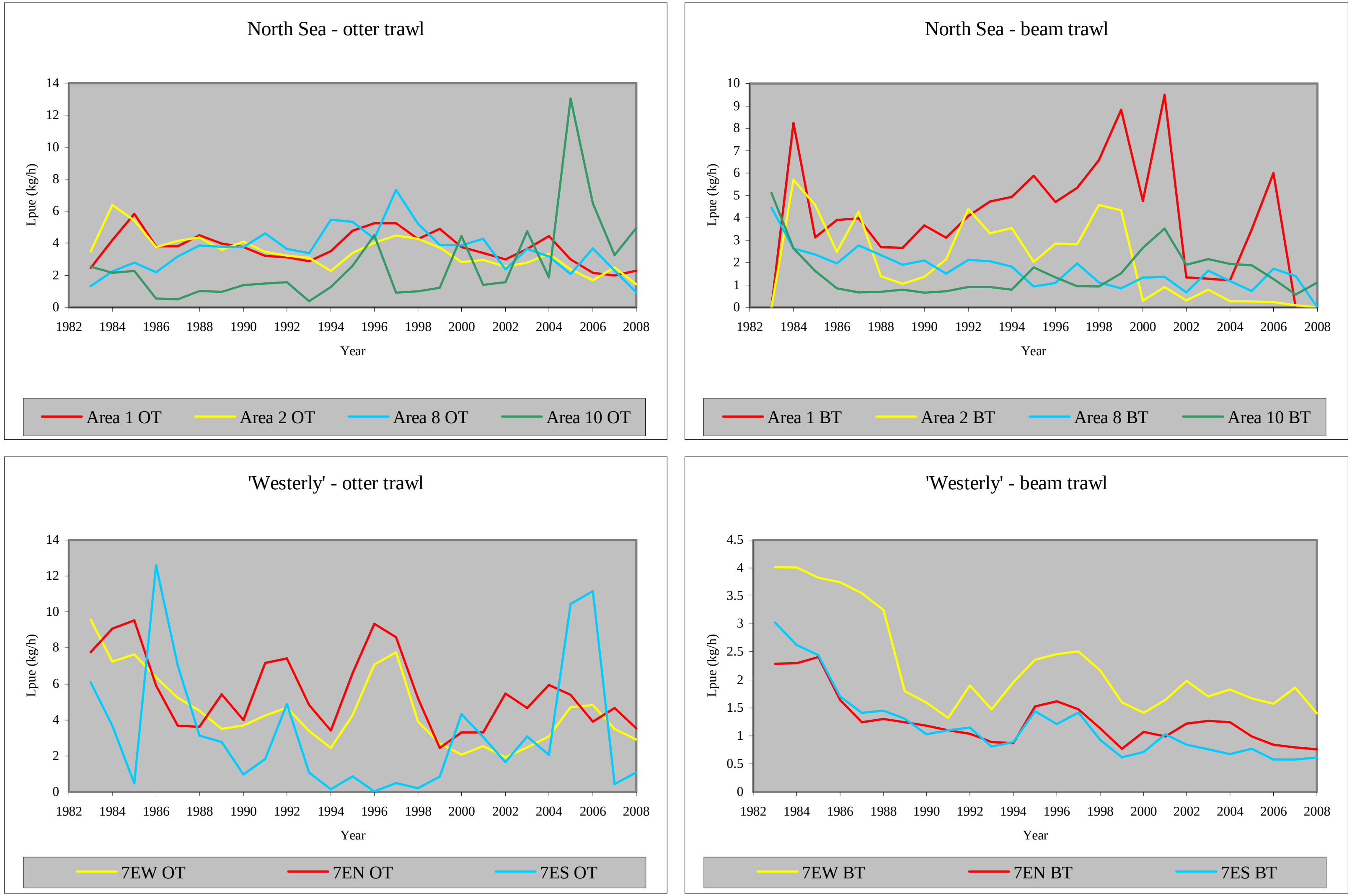


Figure 3.2.7 - LPUE of (top panels) North Sea lemon sole in roundfish areas 1, 2, 8 & 10 and (bottom panels) 'westerly' lemon sole in areas 7EW, 7EN and 7ES, for otter trawlers (left panels) and beam trawlers (right panels) of < 24 m length.

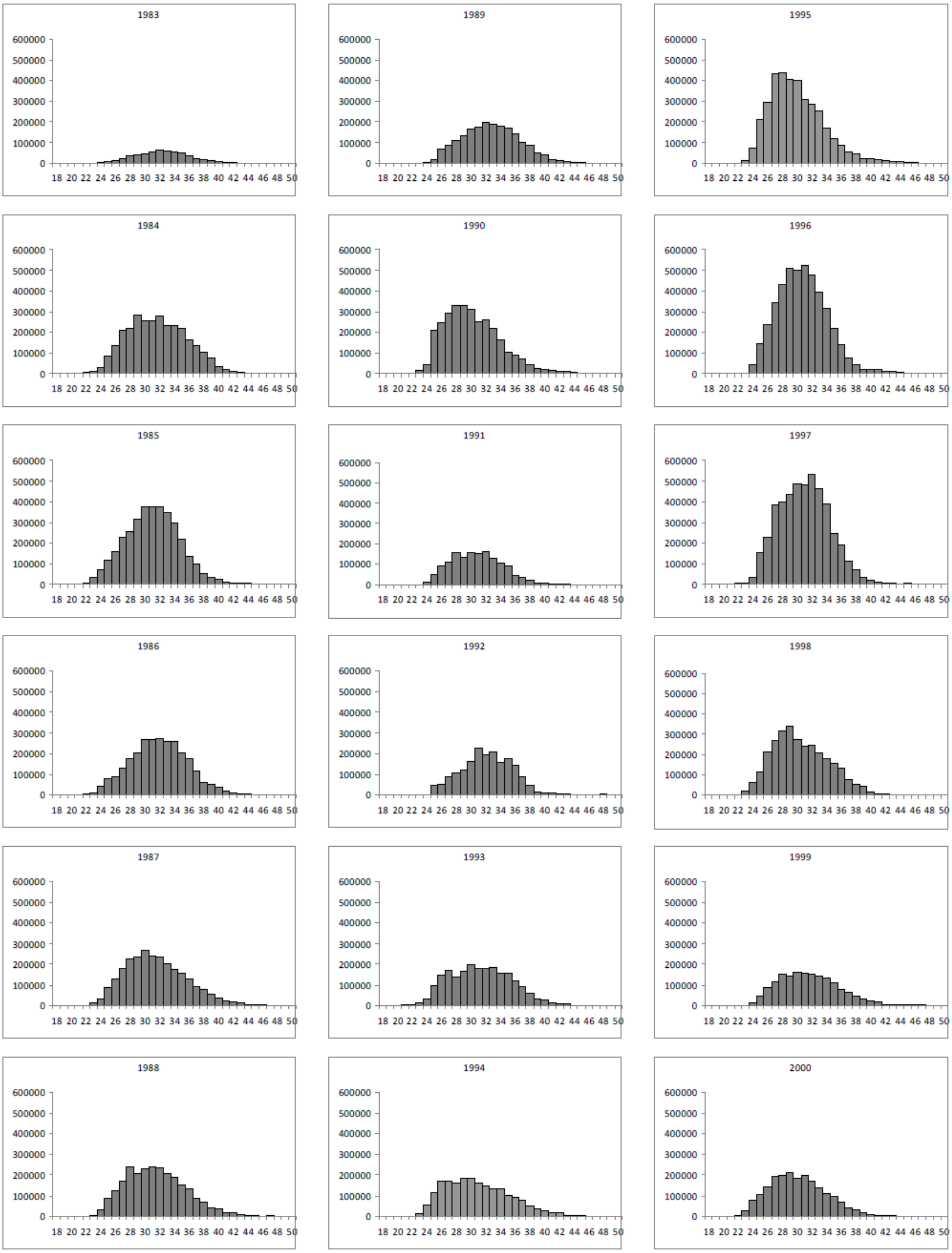


Figure 3.2.8 - Catch numbers at length for lemon sole landed into ICES Divisions VIIe-k by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 1982 and 2008.

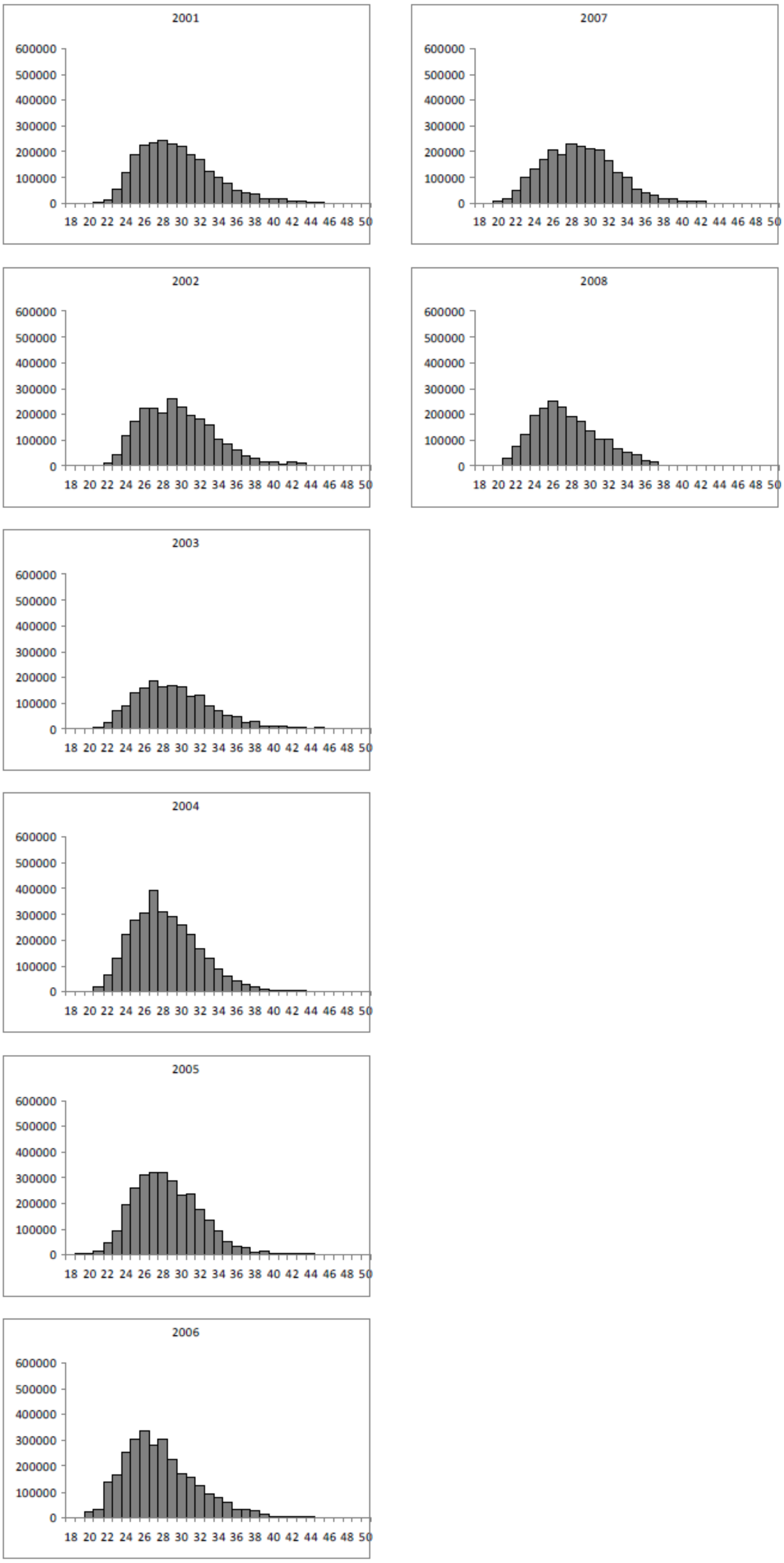


Figure 3.2.8 – Continued.

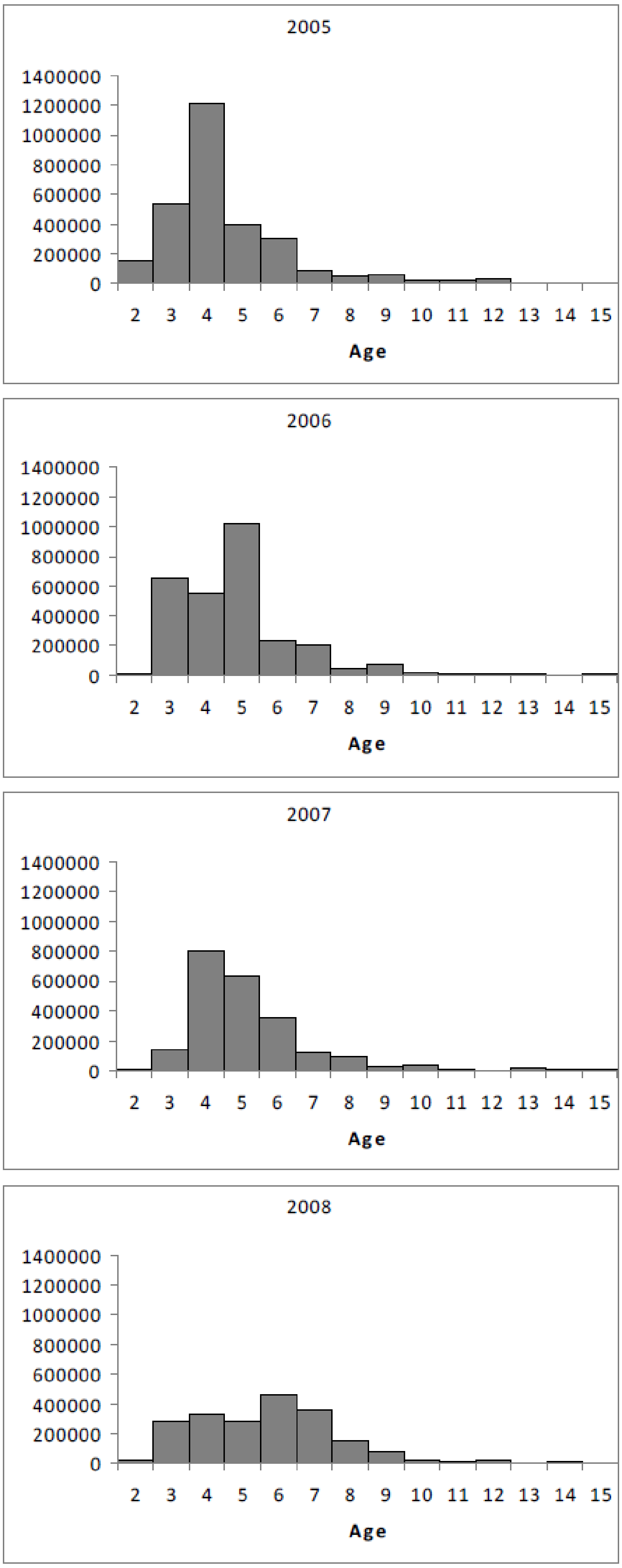


Figure 3.2.9 - Catch numbers at age for lemon sole landed in Divisions VIIe-k, by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 2005 and 2008.

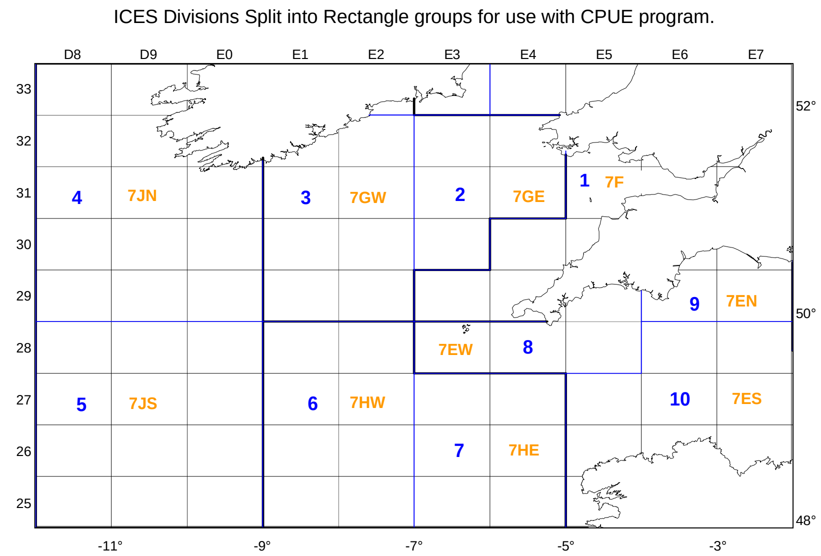


Figure 3.2.10 - Westerly rectangle groups, used for processing lemon sole LPUE.

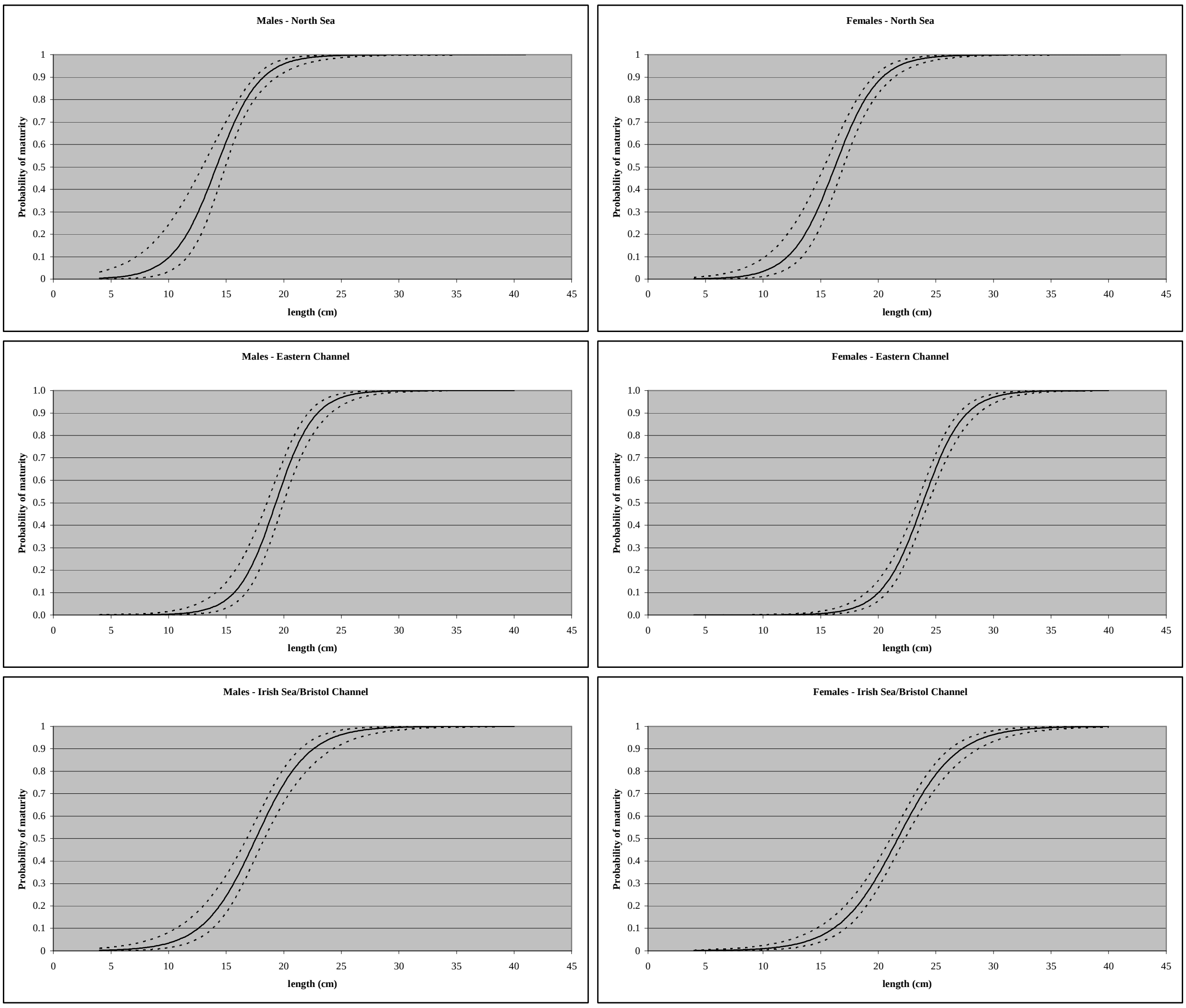


Figure 3.2.11 - Fitted maturity ogives for male and female lemon sole sampled in the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E) (male n = 460, female n = 696), eastern Channel Beam Trawl Survey (BTS7d) (male n = 288, female n = 487) and the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl Survey (NWGFS) (male n = 260, female n = 452), between 2005 and 2009.

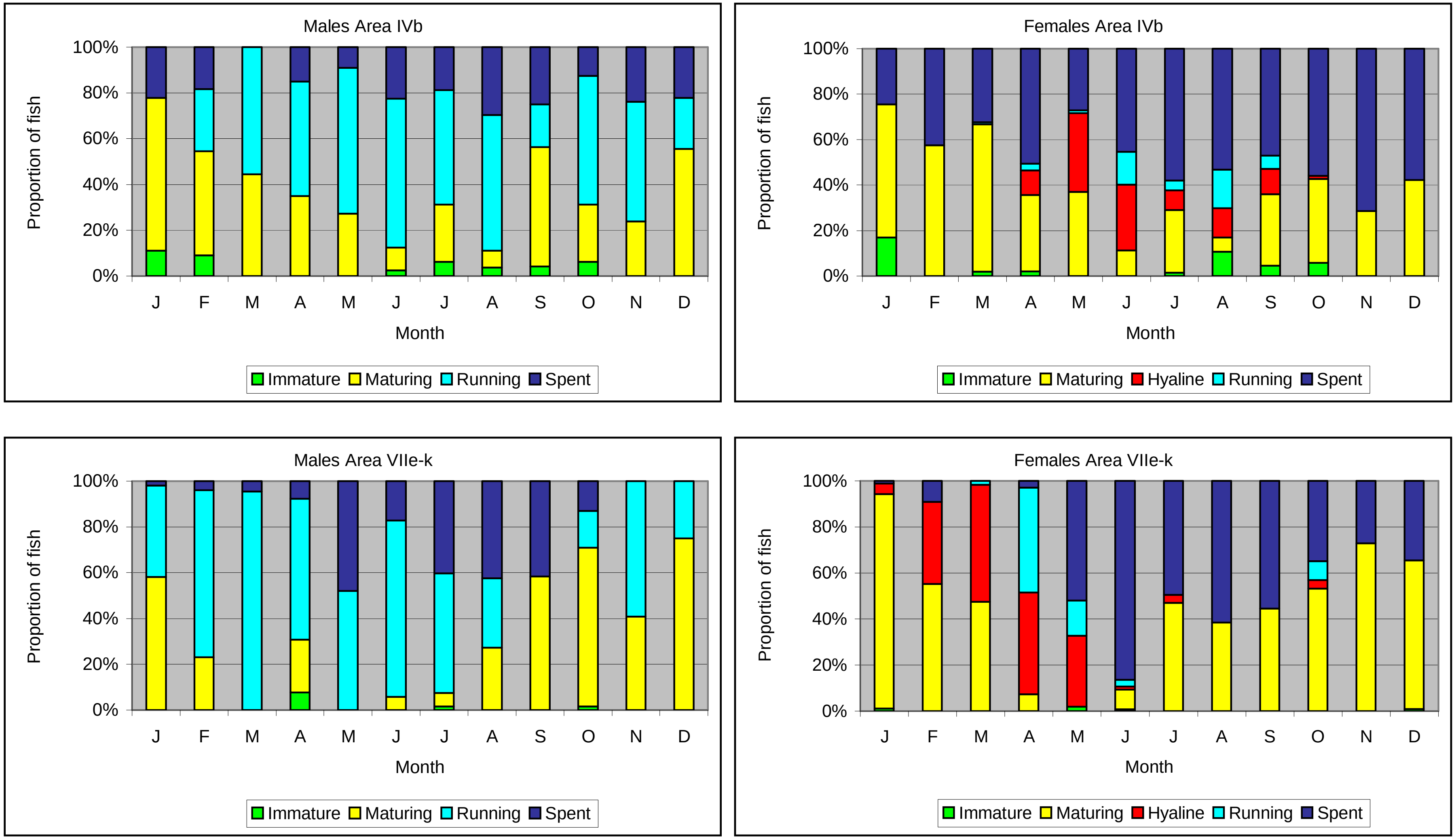


Figure 3.2.12 – Proportion of fish by maturity stage for fish sampled by the Cefas Biological Sampling Programme between 2004 and 2008 for ICES Division IVb (males n = 246; females n = 1082) and ICES Divisions VIIe,f,& g (males n = 444; females n = 984).

3.3 AZTI: Analysis of the fishery on red mullet and bass in Basque Country[11]

Red mullet and sea bass can be considered as by-catches of trawl and artisanal Basque fisheries targeting a variety of demersal species. However, they have a significant importance for the Basque fleet due to the high value in the market.

3.3.1 Material and methods

Landings of striped red mullet and sea bass in Basque Country ports by Spanish vessels from 1996 to 2009 have been analysed. Landings data are obtained directly from the auction sheets or from the computer systems of the Artisanal Fishermen Associations (Cofradías de Pescadores). As no bass and mullet discards are supposed to occur, landings might be considered as catch figures.

Effort information was obtained from the log books filled out by the skippers.

The otter bottom trawl fleet ("baka") working in Div. VIIIabd and landing in the Basque port of Ondarroa has been selected to provide information on effort and landings per unit effort (LPUEs) as an abundance index. This fleet was chosen because they land the majority of the catches of sea bass and red mullet, and because logbook data are available for the whole study period.

The objective of the value and price analysis, presented in section 3.3.2.5 and 3.3.3.5 is on the one hand to measure the value of striped red mullet and sea bass given that they represent one of the most common species of which the landings contribute significantly to the global revenues of the studied fleets. On the other hand to analyse the prices using both the standard descriptive statistics (useful to know mean, variance, variance coefficient, maximum, and minimum price values), and the so-called cumulative distribution function of the prices (CDF). CDF aims at making a graphical representation to users that "There is a probability "x" that first-hand price will be lower (higher) than a determined amount of money (expressed in Euro)."

The data used in the value and price analysis are from two sources depending on the selected fleets. This study has in particular studied the following fleets: gillnets and "Baka" otter trawl mixed fishery (OTB). Data are available in the first-hand sales from the AZTI Fisheries Data Base (based on "first sale notes") which includes volume and price for each landing lot of mullet and bass landed by local artisanal vessels. The data period covers January 2001 to December 2009. Data are also available from "first sale notes" including volume and price for each landing lot and each buyer of mullet and bass landed by Baka trawlers, for the period 2006 to 2008.

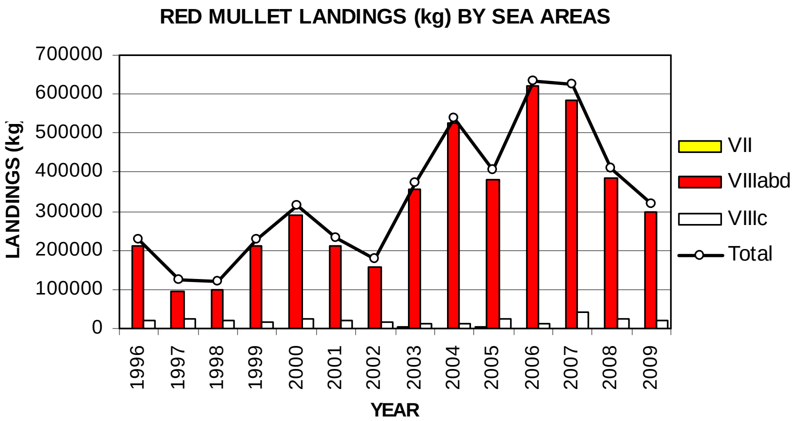


Figure 3.3.1 - Red mullet landings by area for the period 1996-2009.

[11] Authors: Lucia Zarauz, Arantza Murillas & Jon Ruiz

3.3.2 Striped red mullet

3.3.2.1 Total annual catches

Red mullet landings remained constant from 1996 to 2002, and then increased reaching their maximum during 2006 and 2007 (Figure 3.3.1). However, a decrease in the landings of this species has been observed during the last two years. In 2009 the annual Basque mullet landings amounted to 318 t, which supposes a decrease of 91 t compared to 2008 but is similar to the average landings during the years considered (338 t).

3.3.2.2 Annual catches by gear

A summary of the total catch of red mullet by area and gear from 1994 till 2009 is presented in Table 3.3.1. Fishing gears are summarized in four groups: bottom trawl, set nets, purse seiner and others.

The mean contribution of these gears to total landings has remained constant during the period of our study with an average of 91% corresponding to bottom trawl, a 8% corresponding to set nets, and the remaining 1% to purse seine and others fishing gears (Figure 3.3.2).

Between the different metiers of bottom trawl, “baka” otter trawl obtained almost the entire mullet catches (98%) in 2009, and VHVO Pair bottom trawl contributed only with a 2%. This proportion has been constant for all the years of our study, although it s important to note that there used to be two more fishing gears: "Bou" otter trawl and twin nets trawl, which disappeared in 2000 and used to represent an average around 2% of total trawl catches, with the exception of year 1999, when they landed the 18% (Figure 3.3.3).

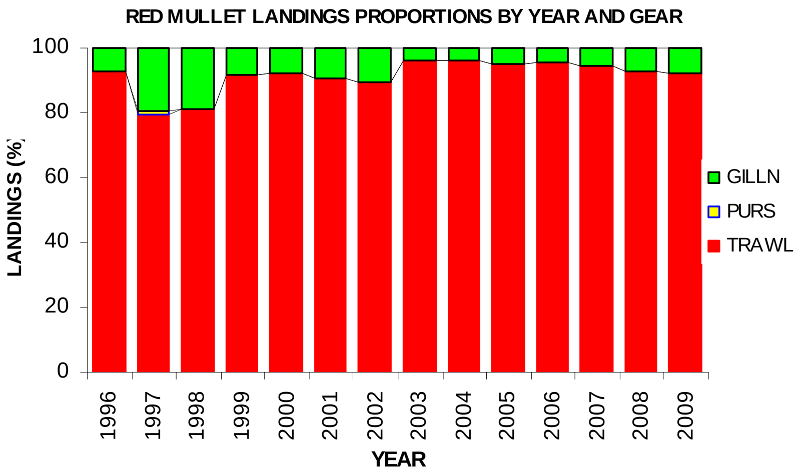


Figure 3.3.2 – Red mullet landings proportions by year and gear.

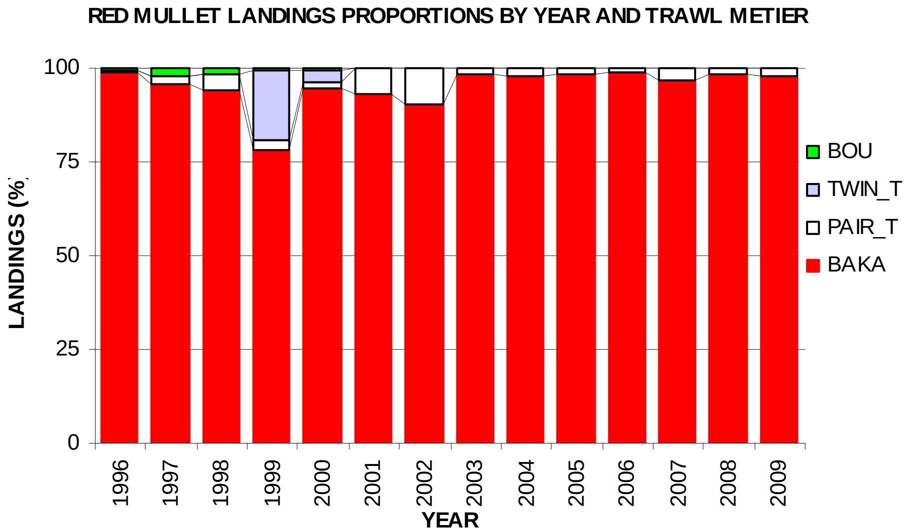


Figure 3.3.3 - Red mullet landings by gear.

3.3.2.3 <u>Seasonality of the catches</u>

Divisions VIIIa,b,d

Div VIIIabd has always been the area where most of the catches were done, in 2009 more than 94% of the annual landings in the Basque ports came from this area. An increase of the catches from the first quarter of the year can be observed since year 2000, with a maximum of catches in 2006 and 2007 (Figure 3.3.4 and 3.3.5). Catches are distributed from October to May, with higher values during the first and the fourth quarter of the year. Very few catches occur during the third quarter.

Division VIIIc

During the period of time of our study, this small sea area, in the more eastern part of Div. VIIIc, produces an average of 8% of the total Basque reported landings. More than 90% of the landings is by gillnetters.

In 2009 landings have decreased 66% compared to 2008 (5 t observed in 2009 and 15 t in 2008) (Table 3.3.1).

Some seasonality can be observed in the catches, with higher values from May to October (Figure 3.3.4 & 3.3.5). This coincides with the months when the activity of trawlers in the VIIIabd is lower.

Gear	Area	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average
All Trawl	VII	43	1716	544	650	537	511	393	2323	281	2181	1207	1108	394	0	849
	VIIIabd	210130	94424	95406	208072	288626	209936	157939	356459	512097	381903	604006	582656	380918	293416	312571
	VIIIc	1109	1459	783	770	1530	136	370	660	2570	2974	1764	7168	438	339	1576
	Total	211282	97599	96732	209492	290693	210583	158703	359442	514949	387058	606977	590932	381749	293755	314996
All Set nets	VII	0	0	0	307	63			59							71
	VIIIabd	0	275	3171	2357	2714	895	1191	745	12708	22	17708	806	4483	5298	3741
	VIIIc	16995	23725	19631	16282	21720	21509	17626	13441	8912	19795	9786	35076	24115	19441	19147
	Total	16995	24000	22802	18945	24497	22404	18817	14245	21620	19817	27494	35883	28598	24740	22918
All Purseine	VII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VIIIabd	0	0	0	0	0	7	2	49	47	44	41	29	0	0	16
	VIIIc	44	945	9	517	245	20	147	71	130	62	106	0	0	0	164
	Total	44	945	9	517	245	27	150	120	177	105	147	29	0	0	180
Others	Total	792	686	397	141	0	0	0	0	0	0	0	0	0	0	144
Grand Total		229113	123230	119940	229095	315435	233014	177669	373807	536746	406980	634619	626844	410347	318495	338238

Table 3.3.1 - Basque striped red mullet landings by gear and area for the period 1996-2009

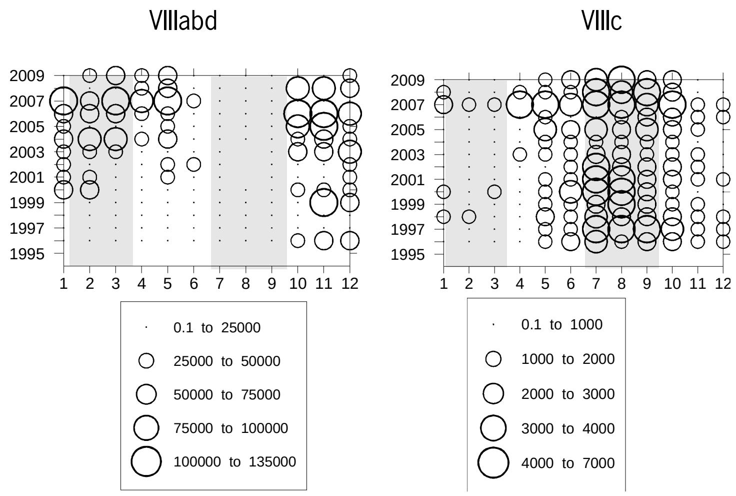


Figure 3.3.4 - Striped red mullet landings seasonality in Divisions VIIIabd and VIIIc

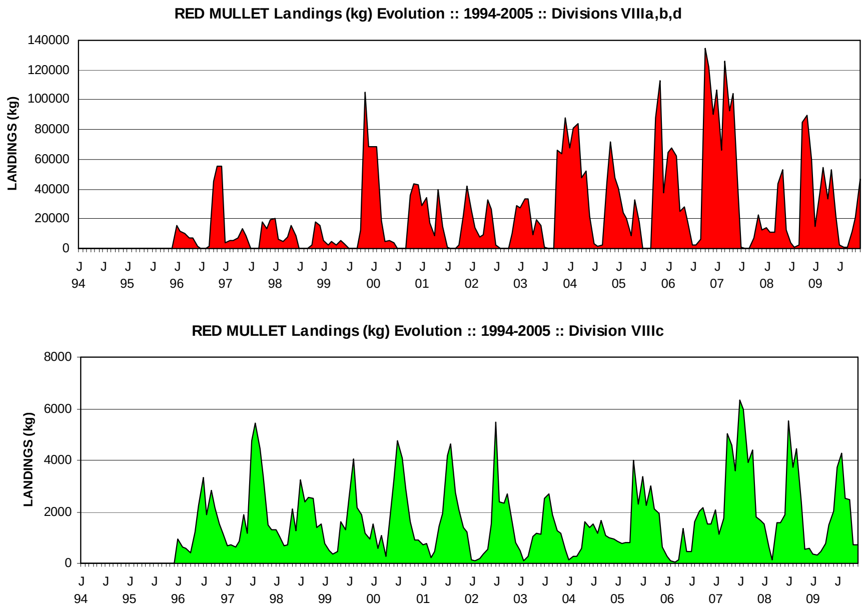


Figure 3.3.5 - Monthly striped red mullet landings (kg) in Basque ports, by ICES Sub-area, in the period 1994-2009.

3.3.2.4 Striped red mullet CPUE

The "baka" bottom trawl's fishing effort (fishing days) has progressively decreased from 1994 to 1999 by almost 50% (Table 3.3.2), mainly because of the severe decrease of the number of boats of this Basque fleet. After that time effort has been constant, although a slight decrease can be observed in the last three years (Figure 3.3.6).

The sea bass annual LPUEs, that remained relatively stable during 1994-1998 (around 5 kg/day) and increased progressively from 1999 to 2005, reaching 136 kg/day. In 2006 and 2007 a strong increase was observed (758 and 835 kg/day respectively), due to the high landings. During the last two years, however, LPUEs have decreased again (Figure 6). Mullet LPUEs evolution by quarter presents a similar pattern with higher values in the first and the fourth quarter, smaller values in the second quarter and practically nill in the third one (Figure 3.3.8).

Mullet LPUE distribution by ICES Rectangle is shown in Figure 3.3.9 for the period 2001-2009.

It is important to note here that, although this species has not been traditionally considered a target species for the bottom otter trawl fleet, this situation has changed with the entry into force of the new DCF (2008/949/EC). According to appendix IV of the DCF, the Basque otter bottom fleet is split in three different metiers, one of them targeting cephalopods and demersal species, with striped red mullet as one of the most important species (Iriondo, *et al.* 2008).

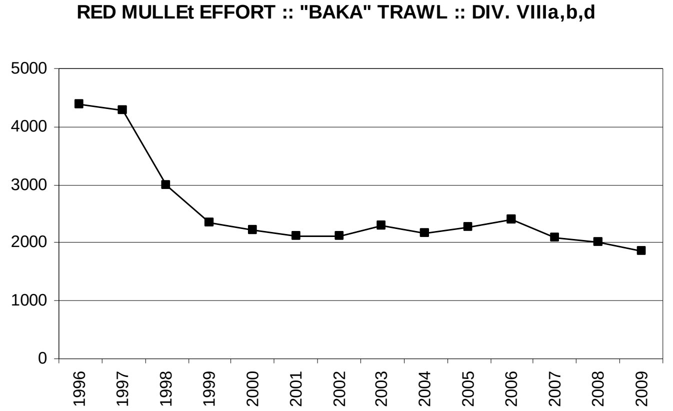


Figure 3.3.6 - “Baka” otter trawl effort (days) evolution during the period 1996-2009.

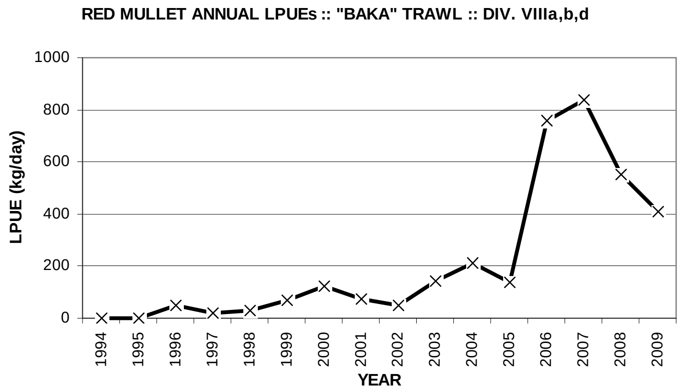


Figure 3.3.7 - Striped red mullet landings per unit effort (LPUEs in kg/day), by year of “baka” otter bottom trawl fishing in Divisions VIIIa,b,d, and landing in Ondarroa (Basque Country. Spain), in the period 1994-2005.

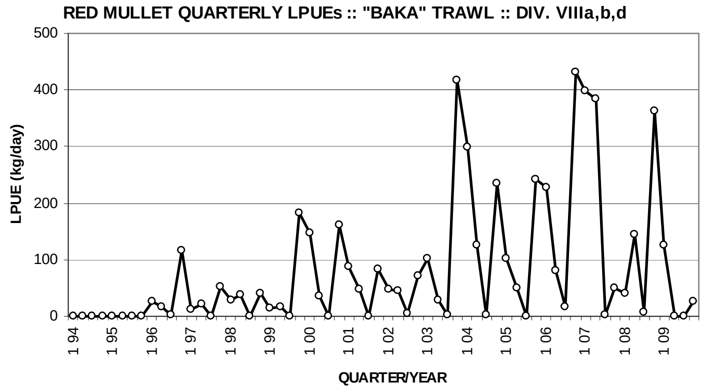


Figure 3.3.8 - Striped red mullet landings per unit effort (LPUEs in kg/day), by quarter, of “baka” otter bottom trawl fishing in Divisions VIIIa,b,d, and landing in Ondarroa (Basque Country. Spain), in the period 1994-2005.

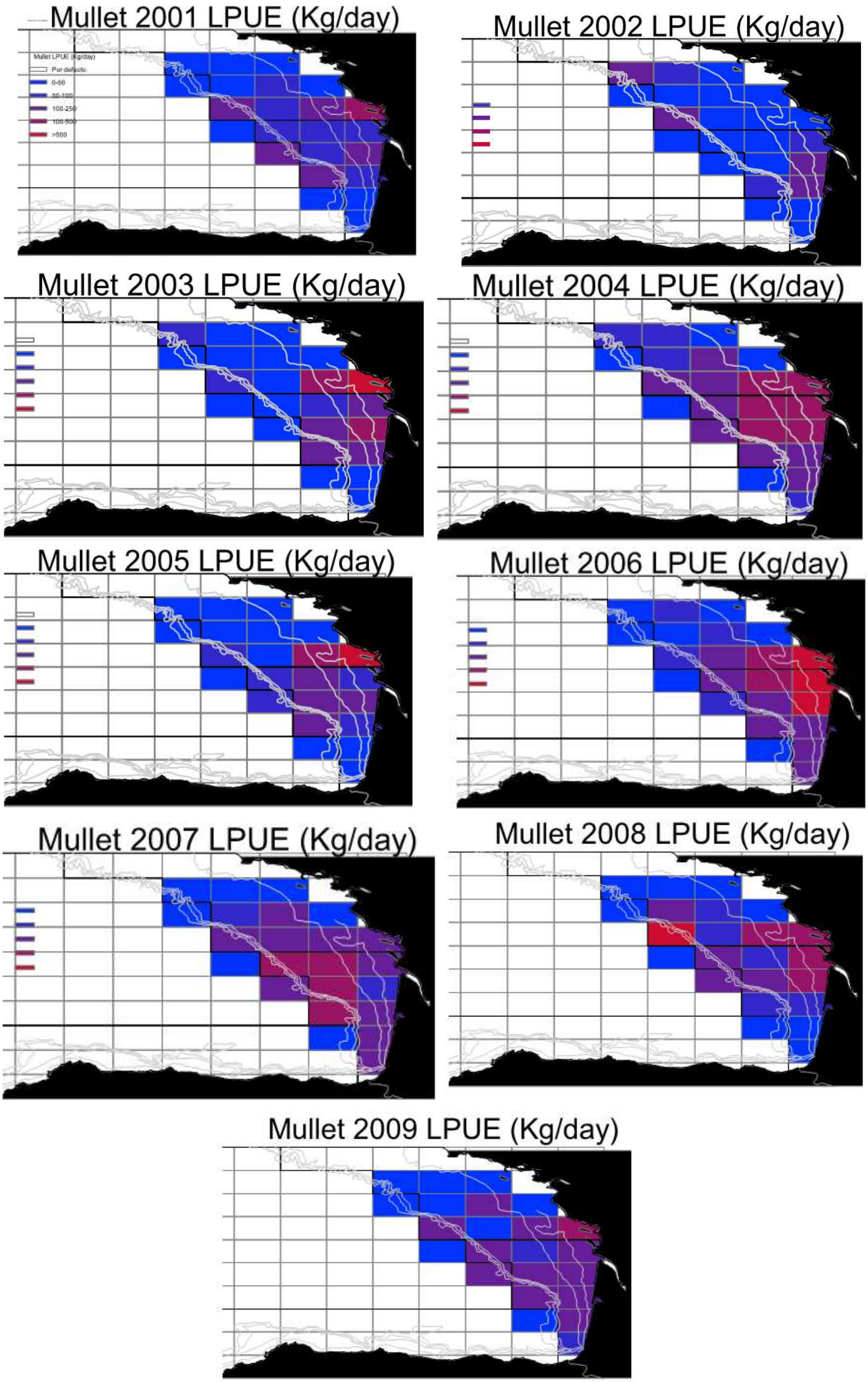


Figure 3.3.9 - Striped red mullet LPUE (Kg/day) by ICES Rectangle.

VIIIa,b,d	**LANDINGS** (kg)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	Quarter 1	36733	14513	29961	12357	142596	75618	40008	92164	228730	74906	191063	292904	30111	93452
	Quarter 2	14983	25781	24696	6600	10432	15303	23466	20305	71152	21982	47987	198107	68839	73993
	Quarter 3	1416	235	265	58	258	15	1121	244	518	62	3268	406	1134	127
	Quarter 4	154829	49784	34649	143158	119534	65688	38763	216587	155692	211664	337568	36115	229308	78131
BAKA-ON	TOTAL	**207960**	**90313**	**89569**	**162173**	**272819**	**156623**	**103357**	**329300**	**456091**	**308614**	**579886**	**527531**	**329391**	**245702**
VIIIa,b,d	**EFFORT** (days)	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	Quarter 1	1459	1345	1097	855	969	856	847	906	766	739	838	736	760	704
	Quarter 2	883	1223	655	384	295	323	510	695	565	442	588	515	480	497
	Quarter 3	699	770	384	316	219	151	202	176	167	210	188	115	145	26
	Quarter 4	1337	949	865	782	745	788	548	519	661	872	783	731	634	628
BAKA-ON	TOTAL	**4378**	**4286**	**3002**	**2337**	**2227**	**2118**	**2107**	**2296**	**2159**	**2263**	**2398**	**2098**	**2017**	**1854**
														2040	**47%**
VIIIa,b,d	**LPUE** (kg/day)	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	Quarter 1	25.2	10.8	27.3	14.5	147.2	88.3	47.2	101.8	298.6	101.3	227.9	397.7	39.6	132.8
	Quarter 2	17.0	21.1	37.7	17.2	35.3	47.4	46.0	29.2	126.0	49.8	81.6	384.5	143.5	149.0
	Quarter 3	2.0	0.3	0.7	0.2	1.2	0.1	5.5	1.4	3.1	0.3	17.3	3.5	7.8	4.9
	Quarter 4	115.8	52.5	40.0	183.0	160.5	83.4	70.7	417.6	235.4	242.6	431.2	49.4	361.9	124.4
BAKA-ON	TOTAL	**47.5**	**21.1**	**29.8**	**69.4**	**122.5**	**74.0**	**49.0**	**143.4**	**211.3**	**136**	**758**	**835**	**553**	**411**

Table 3.3.2 - Striped red mullet landings (in kg), effective effort indices (trips*(days/trip)) and landings per unit effort (LPUEs in kg/day), by quarter and year, of "baka" otter bottom trawl fishing in Divisions VIIIa,b,d, and landing in the Basque port of Ondarroa, in the period 1994-2009.

3.3.2.5 Value and price analysis

The contribution of striped red mullet catches, in terms of revenues to the total revenues of the gillnet fleet, has not undergone any important change in the last 9 years. It can be observed in Figure 3.3.10 that the contribution of the mullet catches has remained unchanged at around 20% of the total revenues for this fleet, being the first or second (depending on the year) species that contributes to the total revenues of this feet. There has been a gradual growth in volume (kg) landed of this specie, but the key factor with a significant positive impact on the revenue is the unit price. Striped red mullet is a species with a high unit price in relation to the rest of the species landed by gillnetters.

The calculated contribution of mullet catches in the context of the trawlers analysis shows little differences between 2006 and 2008. In that time period the mullet revenues represent about 6% of the total revenues of the trawler fleet. This means that striped red mullet ranks between the 6th and 8th most important species landed by this fleet.

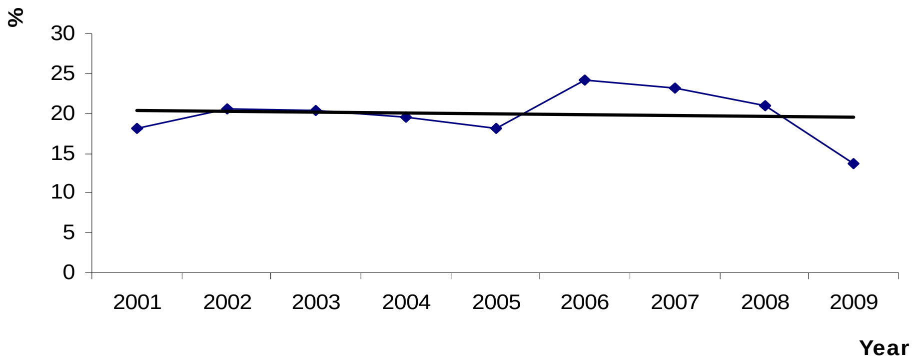


Figure 3.3.10 - Mullet revenues with respect to the total revenues of the gillnet fleet (%)

The mullet price is an important factor determining the high contribution of this species in terms of revenues; and therefore an analysis of the prices is presented.

Price descriptive statistics
Standard descriptive statistics for the gillnet fleet are presented in Table 3.3.3. The mean price of mullet over the period 2001 to 2009 was 12 Euro/kg. considered as representative enough given that the variation coefficient is lower than 0.5.

Table 3.3.3 - Statistics for mullet prices (Euro/Kg.) for the gillnet fleet

Year	Mean	Minimum	Maximum	Variance	Variation coefficient
2001	9.94	0.37	20.97	13.45	0.36
2002	11.97	0.35	24.32	17.77	0.35
2003	12.41	0.14	25.93	23.92	0.39
2004	11.57	0.22	29.86	24.53	0.42
2005	12.45	0.18	26.97	22.73	0.38
2006	13.03	0.12	31.92	28.69	0.41
2007	11.63	0.12	31.12	25.08	0.43
2008	12.42	0.12	37.82	20.41	0.36
2009	14.01	0.31	32.91	24.95	0.35
Global	**12.14**	**0.12**	**37.82**	**23.59**	**0.34**

The standard statistics for the trawler fleet are presented in Table 3.3.4. It can be observed that the mean price for striped red mullet over the period 2006 to 2008 is 3.5 Euro/kg, considered as representative enough given the variation coefficient is lower than 0.5.

Table 3.3.4 - Statistics for mullet prices (Euro/kg) related to trawlers

Year	Mean	Minimum	Maximum	Variance	Variation coefficient
2006	3.619	0.090	10.700	3.290	0.50
2007	3.500	0.150	10.140	2.227	0.42
2008	3.399	0.100	8.410	2.356	0.45
Global	3.509	0.090	10.700	2.603	0.45

The Cumulative Distribution Function (CDF)

This section presents the CDF for the price of mullet landed by gillnets fleet shown in Figure 3.3.11. Notice that the chance of having unit price below 7 Euro/kg. is around a 10%. Similarly, the chance of having unit price higher than 18.5 Euro/kg. is also around a 10%. Finally, notice that the probability of having unit price below mean price value, that is, 12.14 Euro/kg. is about a 53%.

Alternatively, the histogram of prices is also presented in Figure 3.3.12, which represents the number of mullet lots for each specified price bound by considering a total of 16,257 observations.

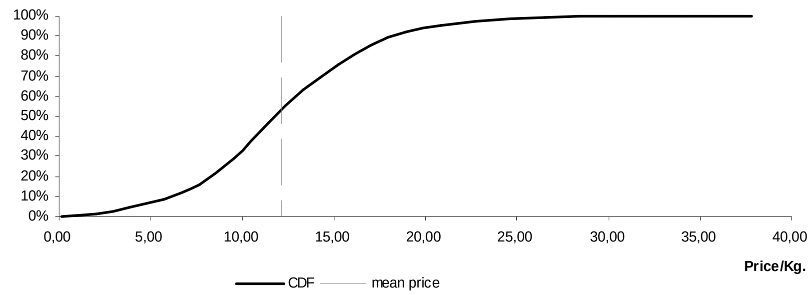


Figure 3.3.11 - Price CDF for striped red mullet landed by gillnets

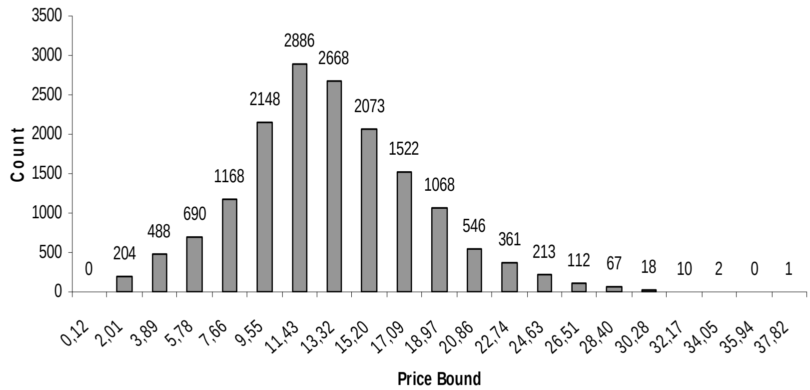


Figure 3.3.12 - Price Histogram for mullet landed by gillnets fleet

Results from the CDF and histogram for Baka trawlers are illustrated in Figure 3.3.13 and 3.3.14. The first one shows that there is a probability of 10% that the first-hand mullet price will be lower than 1.5 Euro/kg. In addition, the possibility of unit prices higher than 6 Euro/kg. has an associated probability of 10%. Finally, it appears from the Figure that probability is 52% for mullet price under its mean value.

Finally, Figure 3.3.14 presents the number of lots by price bounds covering a total of 6,232 observations.

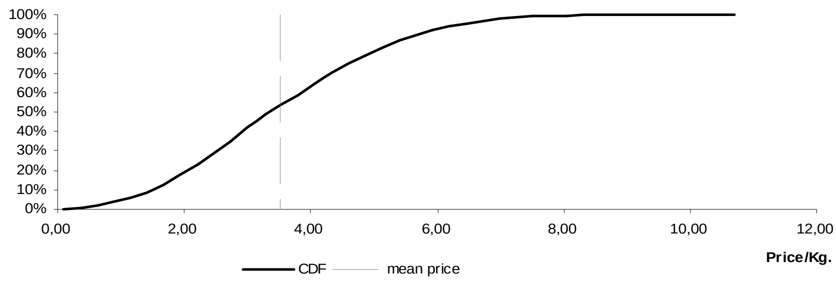


Figure 3.3.13 - Price CDF for mullet landed by Baka trawlers

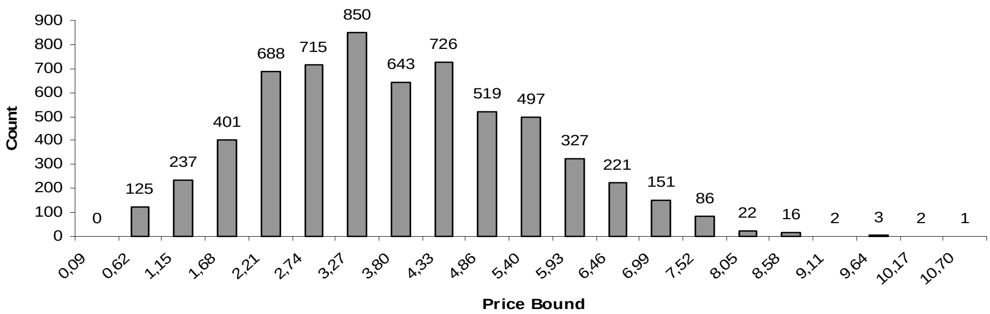


Figure 3.3.14 - Price Histogram for mullet landed by Baka trawlers

3.3.3 Sea bass

3.3.3.1 Total annual catches

An increase can be observed in the landings of sea bass from 1994 to 2009. In 2009 the sea bass Basque annual landings amounted to 131 t, which supposes an increase of 35 t compared to 2008 and is above the 1996-2009 average (Table 3.3.5). This difference is mainly due to a decrease in the caches during the first quarter of the year.

Table 3.3.5 - Sea bass landings (kg) in the Basque Country ports by ICES Sub-area, in the period 1994-2009. Average value for 1996-2009 is also presented. * Landings for the years 1994-1995 must be taken with caution, especially for Div. VIIIc as they can be underestimated.

Year	VI	VII	VIII	TOTAL	VIIIabd	VIIIc
1994	0	26	60477	60503	60473	4
1995	0	0	28770	28770	28770	0
1996	0	0	72440	72440	50945	21495
1997	0	42	50437	50479	41663	8774
1998	735	29	57898	58662	50205	7693
1999	0	1054	60007	61061	56819	3188
2000	64	100	62850	63014	57964	4886
2001	0	36	49469	49505	41553	7916
2002	0	2	64128	64130	49843	14285
2003	0	28	46008	46036	38424	7584
2004	0	296	73842	74137	66598	7243
2005	0	120	52700	52820	43569	9129
2006	0	294	94634	94928	86277	8356
2007	0	40	59997	60038	47517	12480
2008	0	3	96240	96243	81721	14520
2009	0	0	131357	131357	126438	4919
Av. [1996-2009]	57	146	69429	69632	49758	9219

During 2009 96% of the catches in the Bay of Biscay were from Divisions VIIIabd and 4% from Division VIIIc (eastern Cantabrian Sea, i.e. south-eastern Bay of Biscay) (Figure 3.3.15).

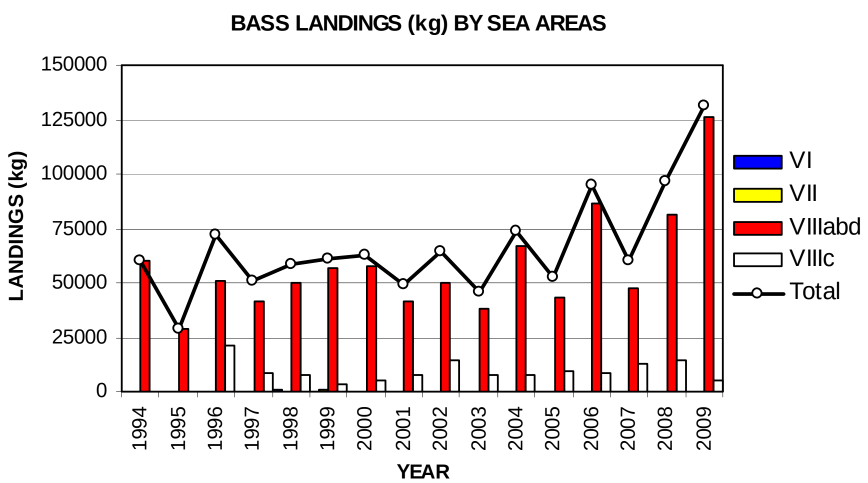


Figure 3.3.15 - Bass landings (kg) in the Basque Country ports by sea area, in the period 1994-2009.

3.3.3.2 Annual catches by gear

A summary of the total catch of sea bass by area and gear from 1994 till 2009 is presented in Table 3.3.6. In the table, fishing gears are summarized in four groups: bottom trawl, longline, set net and purse seine.

In 2009, the general pattern of the annual catches by gear remains similar in comparison with previous years. Main catches were achieved by bottom trawl (around 92%) and the rest by longline (around 4%) and set nets (2%). The importance of the longline during the period 1994 to 2009 has decreased in relation to the rest of the gears. On the other hand, the relevance of the trawler fleet has increased (Figure 3.3.16).

Between the different metiers of bottom trawl, the "baka" obtained almost the entire bass catches in 2009 (97%), followed by VHVO Pair bottom trawl (3%). Few landigs by "Bou" otter trawl and twin nets trawl were registered during the first four years of the study, with an average contribution of 1% to the total catch. These two fleets disappeared in 2000 (Figure 3.3.17).

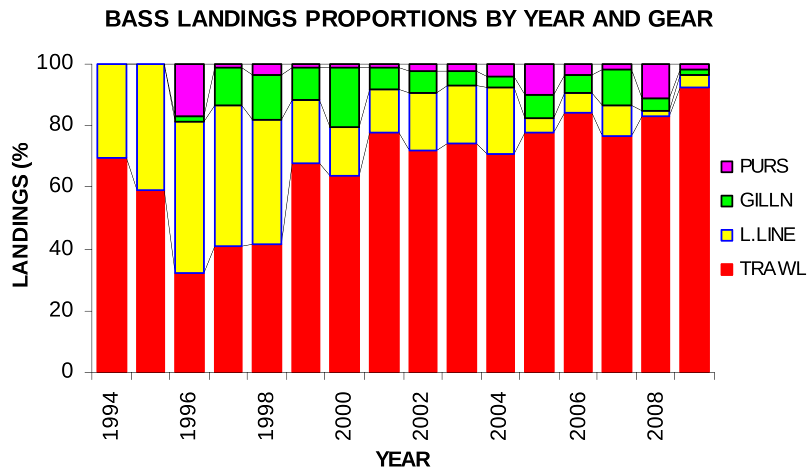


Figure 3.3.16 - Bass landings in Basque Country: proportions (%) by gear, in the period 1994-2009. TRAWL: All bottom trawl metiers; L.LINE: Surface and Bottom Longline; GILLN: Trammel and Gillnetter; PURS: Purseiner.

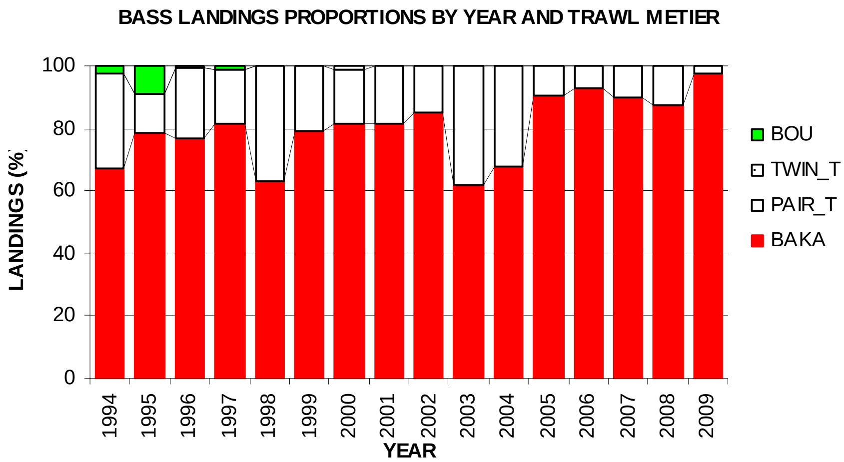


Figure 3.3.17 - Bass landings in Basque Country: proportions (%) by trawl metier, in the period 1994-2009. BAKA: "Baka" otter trawl; PAIR_T: VHVO Pair bottom trawl; [BOU ("Bou" otter trawl) and TWIN (Trawl with twin nets) disappeared in 2000].

Gear	Area	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Av. [1996-2009]
All Trawl	VI	0	0	0	0	735	0	64	0	0	0	0	0	0	0	0	0	57
	VII	26	0	0	42	29	16	98	15	2	13	0	61	0	0	0	0	20
	VIIIabd	42386	17602	23198	20525	23498	41120	39900	38442	46219	34344	52437	40876	79911	44577	79599	121408	49004
	VIIIc	4	0	10	318	40	50	32	17	0	7	8	0	3	1380	199	0	147
	Total	42416	17602	23208	20885	24302	41186	40094	38474	46221	34363	52445	40937	79915	45957	79798	121408	49228
All Longline	VI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	1038	2	21	0	15	296	59	294	40	3	0	126
	VIIIabd	18087	11169	27606	16867	18839	9768	6284	295	1002	2885	11960	1413	2745	831	717	2603	7415
	VIIIc			8035	6127	4995	2078	3720	6493	10916	5598	3693	1085	2900	5250	1094	2604	4613
	Total	18087	11169	35641	22994	23834	12884	10006	6809	11918	8498	15948	2556	5939	6121	1814	5208	12155
All Set nets	VI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VIIIabd	0	0	0	4215	7855	5573	11452	2543	2559	603	1915	328	2864	1798	1355	790	3132
	VIIIc			1077	1919	659	608	713	969	1999	1588	712	3677	2722	5084	2762	1561	1861
	Total	0	0	1077	6134	8514	6181	12165	3512	4557	2191	2627	4005	5586	6882	4117	2351	4993
All Purseine	VI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VIIIabd	0	0	141	26	13	358	328	174	59	593	287	953	758	311	49	1637	406
	VIIIc			12197	410	1999	452	396	437	1289	391	2830	4367	2730	767	10465	754	2820
	Total	0	0	12338	436	2012	810	724	611	1348	984	3117	5320	3488	1078	10514	2391	3226
Others	Total	0	0	176	30	0	0	25	99	86	0	0	0	1	0	0	0	30
Grand Total		60503	28770	72440	50479	58662	61061	63014	49505	64130	46036	74137	52818	94928	60038	96243	131357	66508

Table 3.3.6 - Sea bass Basque landings by gear and area for the period 1996-2009

3.3.3.3 Seasonality of the catches

Divisions VIIIa,b,d

In 2009, as in the previous years, the majority (96%) of annual landings in the Basque ports came from this area. The highest catches of bass were achieved during the first and the fourth quarter showing a very marked seasonality which is maintained along the whole period 1994-2005 (Figures 3.3.18 & 3.3.19).

Division VIIIc

During the years covered by our study, this small area in the eastern part of Div. VIIIc, produced in 2009 4% of the total Basque reported landings with 5 t. This constitutes a 66% decrease compared to 2008 (15 t in 2008) (Table 3.3.5). All landings were performed by the artisanal fleet, 53% was from longliners, 32% from set nets and 25% from purse seine. These proportions have been relatively constant during the studied period (Table 3.3.6)

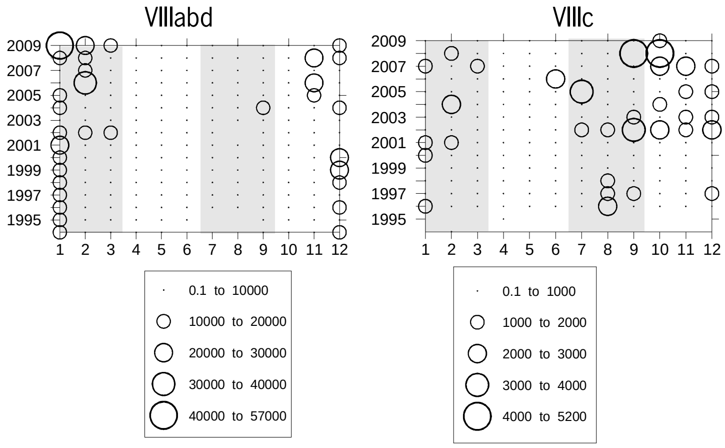


Figure 3.3.18 - Seasonality of sea bass landings (kg) in the Basque ports, by ICES Sub-area.

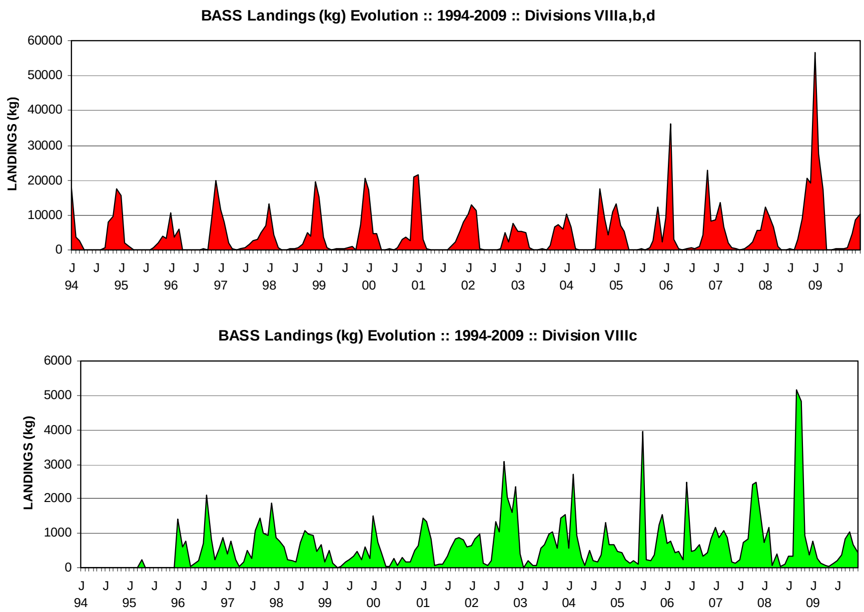


Figure 3.3.19 - Monthly sea bass landings (kg) in the Basque ports, by ICES Sub-area, in the period 1994-2009. Although a kind of seasonality can be observed in the catches, with higher cacthes taking place from July to January, it is not as clear as in the rest of the Bay of Biscay (Div. VIIIa,b,d). (Figure 3.3.18 and 3.3.19).

In addition, a traditional sport fishery (by rods or by lines) takes place close to the coast and in the rivers mouths. No information on the amount of these catches or other characteristics are available. Main catches are obtained in autumn (September to November) (L. Arregi, pers. com.), although major effort is applied in the summer months (holiday season).

3.3.3.4 Sea bass CPUE

It has to be noted that bass is not a target for this metier (presently focused on mixed fisheries), but only an economically interesting by-catch restricted to a period of the year.

As it has been noted for the striped red mullet, the "baka" bottom trawl's fishing effort (fishing days) has progressively decreased from 1994 to 1999 (Table 3.3.7), mainly due to the strong decrease in the number of vessels of this fleet. After that time effort has been constant, although a slight decrease can be observed in the last three years.

The sea bass annual LPUEs remained relatively stable during 1994-1998 (around 5 kg/day), and increased slightly from 1999 to 2005 (16 kg/day). After this time, an increase of the LPUE has been observed, reaching a value of 153 kg/day in 2009. The sea bass LPUEs evolution by quarter presents a similar pattern with high values in the first and the fourth quarter, and very small ones in the second and third quarter.

Sea bass first and fourth quarter LPUE distributions by ICES Rectangle are shown in Figure 3.3.22 for the period 2001-2009.

Although the observed increase of the annual sea bass LPUE in the last years could be considered as an indicator of the increasing abundance of sea bass in this sea area, it must be considered with caution. In fact it coincides with the drastic decline of Northern hake LPUE in the same area for the same fleet. In the past, in the 1980s and until the middle of the 1990s, hake was one of the main targets for the "baka" trawl (about 20% of total landings), but in the last years hake landings represent only around 5%. It would seem that, with the crisis of the Northern hake fishery in the last years of the 1990s and later with the enforcement on the minimum legal landings size in the hake landings, this fleet changed their objectives and became more a "very" mixed fishery, allocating more directed effort on other species not under the TAC and quota system. This could be the case with the sea bass fishery.

VIIIa,b,d	LANDINGS (kg)	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	Quarter 1	12832	6781	12452	11588	10500	10204	21290	21172	30582	14636	5472	22328	43717	26662	27507	88176
	Quarter 2	13	62	100	25	4	198	0		32	790	29	15	182	41	81	27
	Quarter 3	459	293	177	182	100	33	5	39		9	7589	465	168	88	807	0
	Quarter 4	15214	6691	5100	4917	3952	22065	11441	8045	7265	5717	22534	12373	17485	8556	36741	17051
BAKA-ON	TOTAL	**28518**	**13827**	**17829**	**16712**	**14556**	**32500**	**32736**	**29255**	**37879**	**21152**	**35624**	**35181**	**61551**	**35346**	**65135**	**105254**

VIIIa,b,d	EFFORT (days)	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	Quarter 1	1596	1229	1459	1345	1097	855	969	856	847	906	766	739	838	736	760	704
	Quarter 2	1283	1006	883	1223	655	384	295	323	510	695	565	442	588	515	480	497
	Quarter 3	1230	825	699	770	384	316	219	151	202	176	167	210	188	115	145	26
	Quarter 4	1509	1414	1337	949	865	782	745	788	548	519	661	872	783	731	634	628
BAKA-ON	TOTAL	**5619**	**4474**	**4378**	**4286**	**3002**	**2337**	**2227**	**2118**	**2107**	**2296**	**2159**	**2263**	**2398**	**2098**	**2017**	**1854**

VIIIa,b,d	LPUE (kg/day)	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	Quarter 1	8.0	5.5	8.5	8.6	9.6	11.9	22.0	24.7	36.1	16.2	7.1	30.2	52.1	36.2	36.2	125.3
	Quarter 2	0.0	0.1	0.1	0.0	0.0	0.5	0.0	0.0	0.1	1.1	0.1	0.0	0.3	0.1	0.2	0.1
	Quarter 3	0.4	0.4	0.3	0.2	0.3	0.1	0.0	0.3	0.0	0.1	45.4	2.2	0.9	0.8	5.6	0.0
	Quarter 4	10.1	4.7	3.8	5.2	4.6	28.2	15.4	10.2	13.3	11.0	34.1	14.2	22.3	11.7	58.0	27.2
BAKA-ON	TOTAL	**5.1**	**3.1**	**4.1**	**3.9**	**4.8**	**13.9**	**14.7**	**13.8**	**18.0**	**9.2**	**16.5**	**16**	**76**	**49**	**100**	**153**

Table 3.3.7 - Sea bass landings (in kg), effective effort indices (trips*(days/trip)) and landings per unit effort (LPUE in kg/day), by quarter and year, of "baka" otter bottom trawl fishing in Divisions VIIIa,b,d, and landing in the Basque port of Ondarroa, in the period 1994-2009.

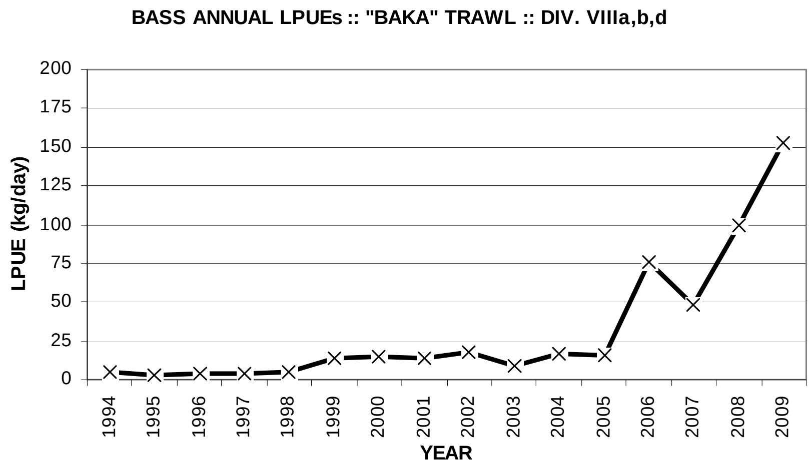


Figure 3.3.20 - Sea bass landings per unit effort (LPUE in kg/day), by year of "baka" otter bottom trawl fishing in Divisions VIIIa,b,d, and landing in Ondarroa (Basque Country. Spain), in the period 1994-2009.

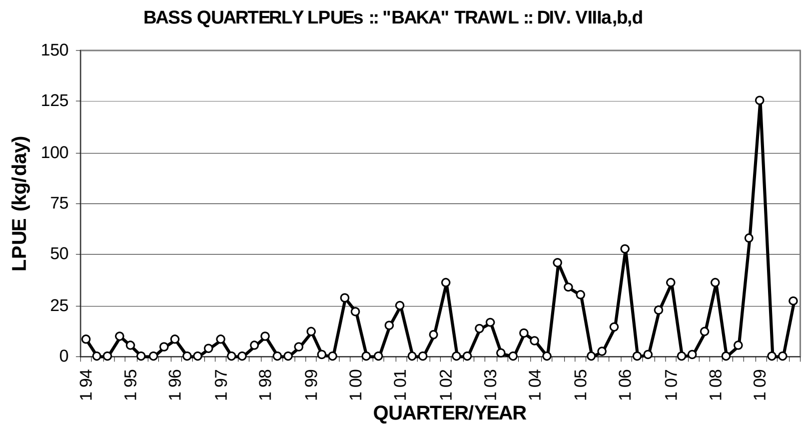


Figure 3.3.21 - Sea bass landings per unit effort (LPUEs in kg/day), by quarter, of "baka" otter bottom trawl fishing in Divisions VIIIabd, and landing in Ondarroa (Basque Country. Spain), in the period 1994-2009.

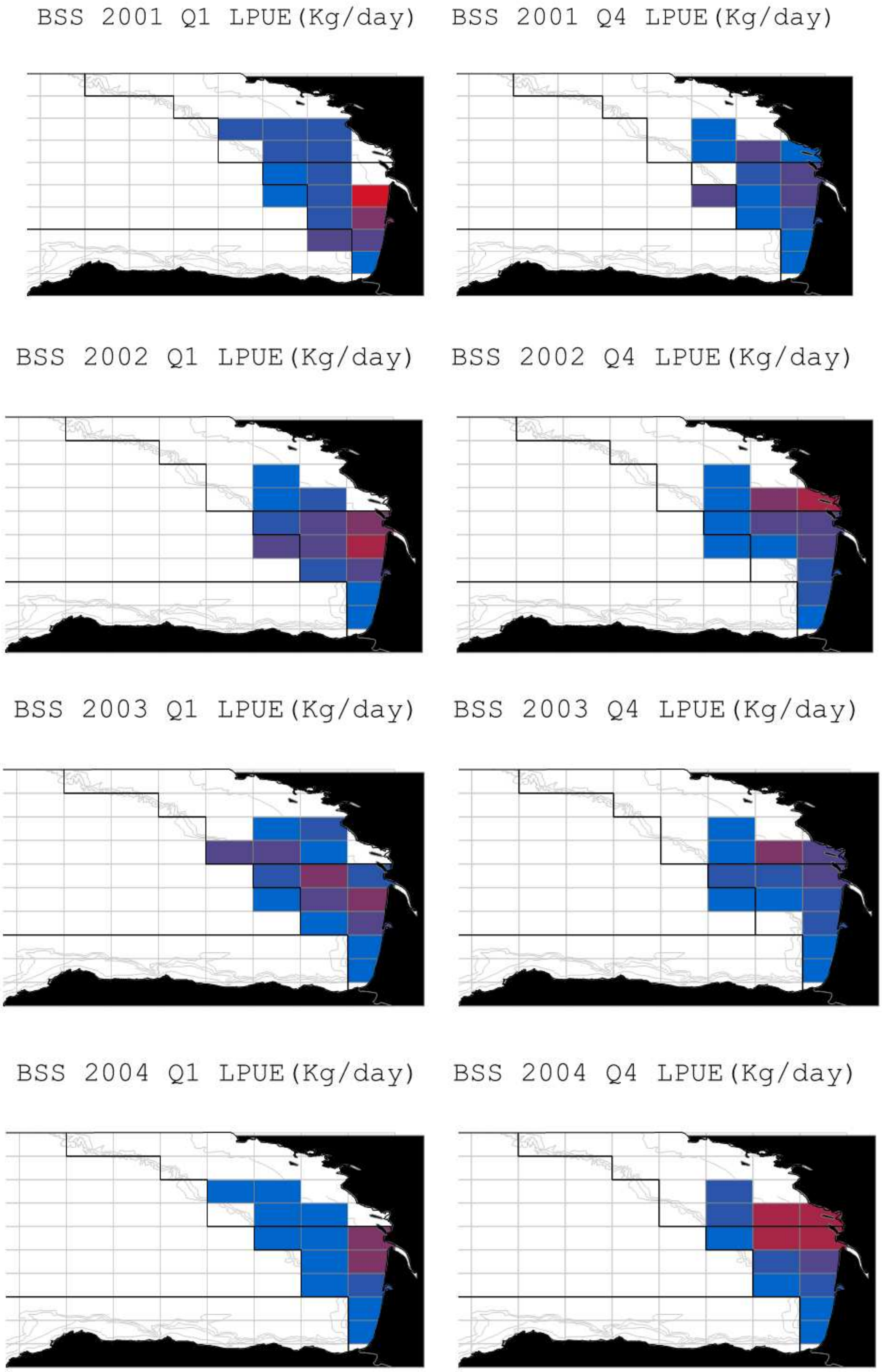


Figure 3.3.22 - Sea bass LPUE (kg/day) by ICES rectangle.

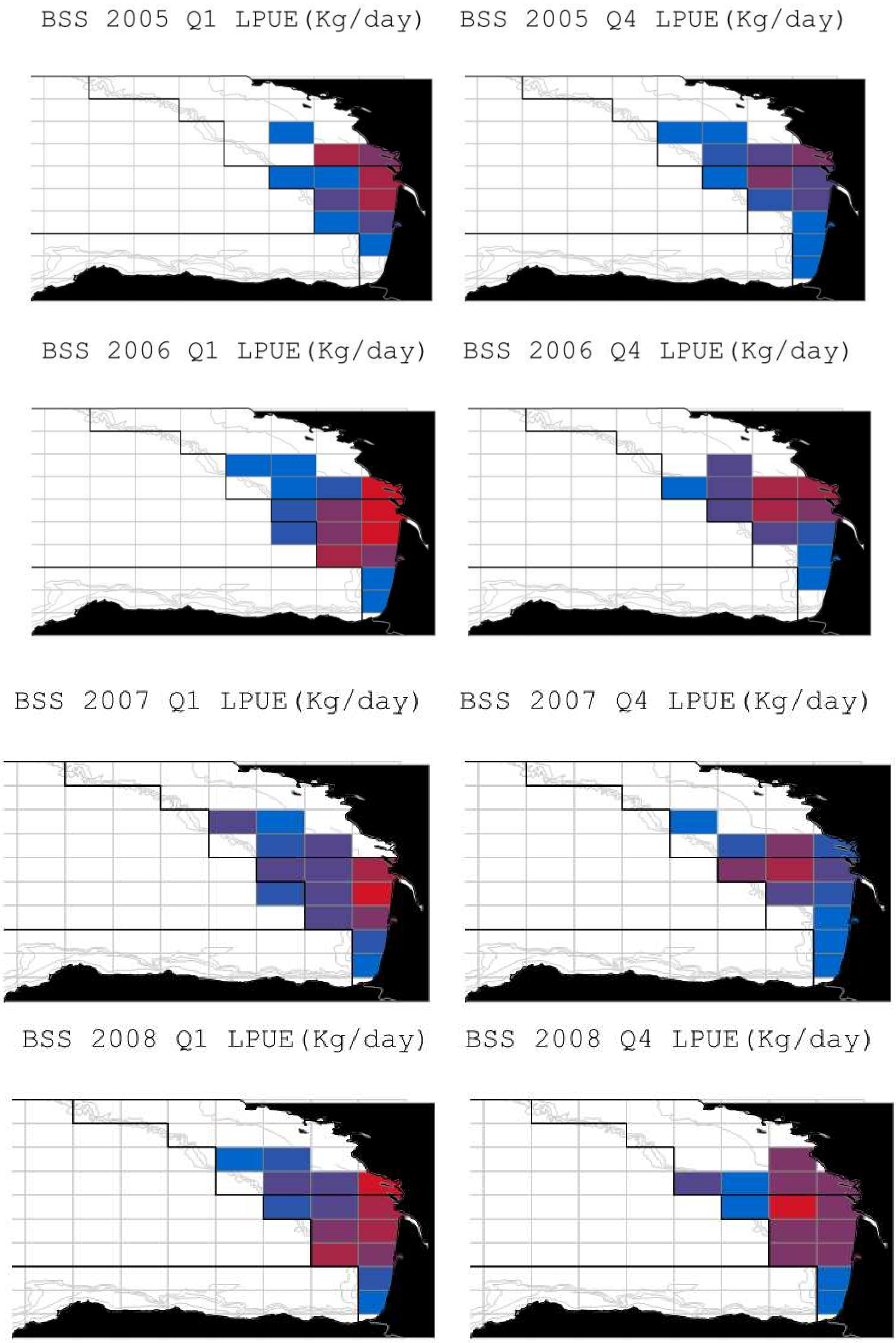


Figure 3.3.22 - Continued

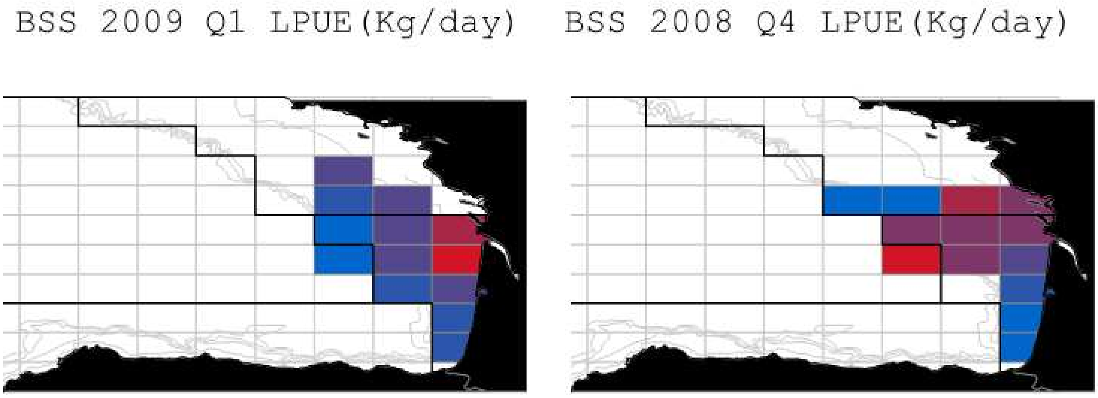


Figure 3.3.22 - Continued

3.3.3.5 Value and price analysis

Over the past nine years (2001 to 2009) the relative contribution of the revenue coming from seabass landings, in the total revenues associated to the surface longline fleet, has experimented a decreasing pattern. This pattern, observed at Figure 3.3.23, is due to the decreasing pattern of the seabass landings in that period rather than to price variations (reductions). However, the seabass is allocated at the first or second position of the ranking when comparing revenues from all of the species landed by longlines in relation to the total revenues of this fleet. The only exceptions are found in 2001 and 2009 years, in which landings (and therefore revenues) have been significantly low (see Figure 3.3.24).

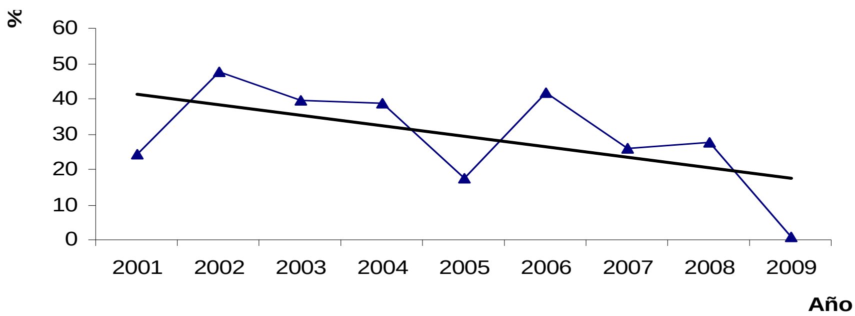


Figure 3.3.23 - Seabass revenues with respect to the total revenues of the longlines (%)

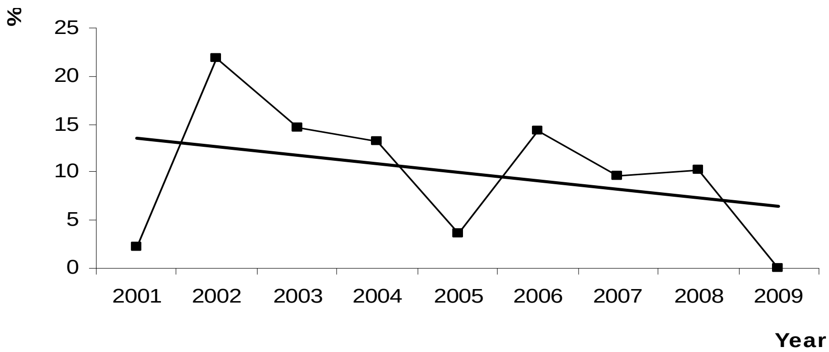


Figure 3.3.24 - Seabass landings with respect to the total landings of the longlines (%)

The seabass price is one of the highest for species landed by longlines and trawlers, and therefore, it is an important factor determining the high contribution of this species to the total revenues. Thus, a detailed price analysis is presented below.

Price descriptive statistics
Standard descriptive statistics for the longline fleet are presented in Table 3.3.8. The mean price for sea bass over the period 2001 to 2009 is 15 Euro/kg. considered as representative given the variation coefficient is lower than 0.5.

Table 3.3.8 - Statistics for seabass prices (Euro/kg.) for the longline fleet

Year	Mean	Minimum	Maximum	Variance	Variation coefficient
2001	13.368	3.263	24.912	11.580	0.255
2002	14.885	0.670	30.400	15.336	0.263
2003	15.701	5.410	25.150	13.839	0.237
2004	15.876	6.490	24.850	11.474	0.213
2005	16.052	2.430	26.320	18.812	0.270
2006	16.653	1.900	36.300	26.460	0.309
2007	15.187	2.280	29.080	16.812	0.270
2008	14.522	0.120	26.050	29.477	0.374
2009	12.569	1.160	21.930	24.799	0.396
Global	**15.037**	**0.120**	**36.300**	**18.246**	**0.284**

The standard statistics associated with the trawler fleet are presented in Table 3.3.9. It can be seen that the mean price for sea bass over the period 2006 to 2008 is 8.8 Euro/kg. considered as representative given the variation coefficient is lower than 0.5.

Table 3.3.9 - Statistics for seabass prices (Euro/kg.) related to trawlers

Year	Mean	Minimum	Maximum	Variance	Variation coefficient
2006	8.599	0.800	21.000	10.089	0.369
2007	8.965	0.010	21.510	9.243	0.339
2008	9.006	2.800	20.200	7.733	0.309
Global	**8.867**	**0.010**	**21.510**	**9.001**	**0.338**

The Cumulative Distribution Function (CDF)
The CDF for the price of sea bass landed by the longline fleet is shown in Figure 3.3.25. It can be observed that the chances of having a unit price below 10 Euro/kg. are around 10%. Similarly, the chances of having unit price higher than 20 Euro/kg. are also around 10%. Finally, notice that the probability of having a unit price below the mean price value, that is 15 Euro/kg, are about 50%.

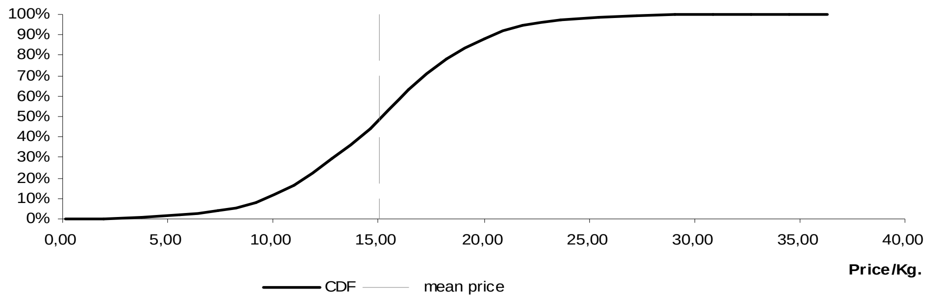


Figure 3.3.25 - Price CDF for seabass landed by longline fleet

In addition to the calculated CDF for the sea bass prices, the histogram of prices is also presented in Figure 3.3.24, which represents the number of sea bass lots for which the allocated price is under each of the specified price bounds. The study covers a total of 2,765 observations.

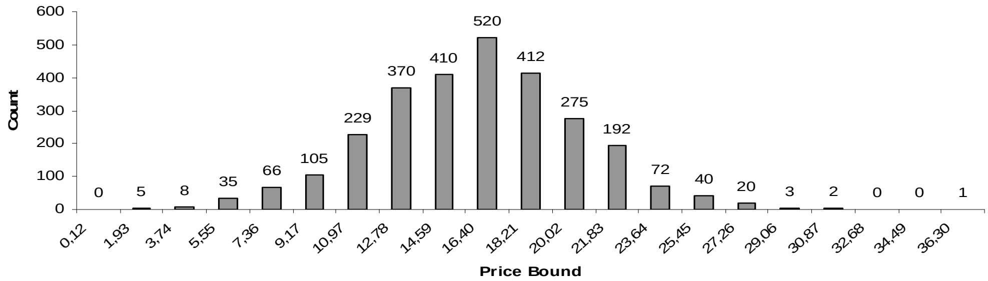


Figure 3.3.26 - Price Histogram for bass landed by the longline fleet

Results from the CDF and histogram for Baka trawlers are illustrated in Figure 3.3.27 and 3.3.28. The first one shows that there is a probability of 10% that first-hand sea bass price will be lower than 5.3 Euro/kg. In addition, the existence of unit prices higher than 13 Euro/kg. has an associated probability of 10%. Finally, it appears from the figure that probability is 55% for a sea bass price under its mean value.

Finally, Figure 3.3.28 presents the number of lots by price bounds covering a total of 2,612 observations.

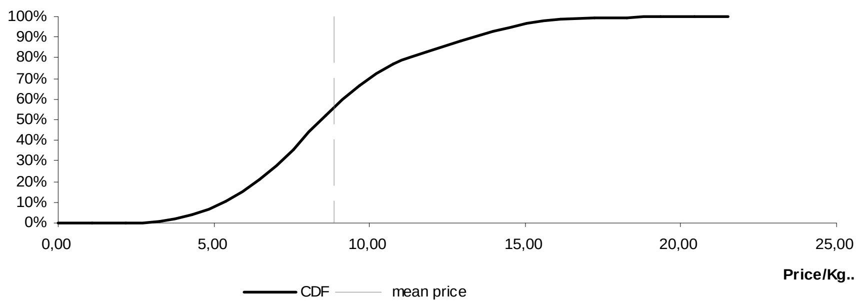


Figure 3.3.27 - Price CDF for seabass landed by Baka trawlers

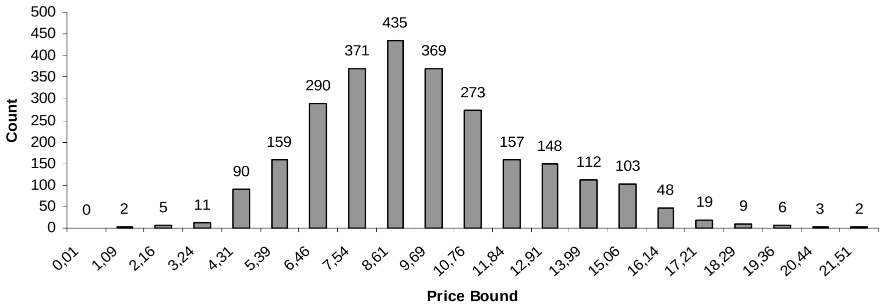


Figure 3.3.28 - Price histogram for sea bass landed by otter trawlers

REFERENCE

Iriondo, A., R. Prellezo, M. Santurtún, D. García, I. Quincoces, 2008 .Basque trawl metier definition for 2003-2007 period. Revista de Investigación Marina, 3: 263-264

3.4 IFREMER: Data on striped red mullet, gurnards and John dory[12]

For striped red mullet, red gurnard, tub gurnard and John dory, the landings (in t) are presented by important ICES region. These data come from the European database "Eurostat" : http://ec.europa.eu/eurostat . In the tables, the symbol ":" means "not available". The symbol "0" means "<500kg".

These data were checked until 2005 with ICES Fisheries Statistics (http://www.ices.dk/fish/statlant.asp).

In addition, some countries provided their data (indicated in the tables in blue):

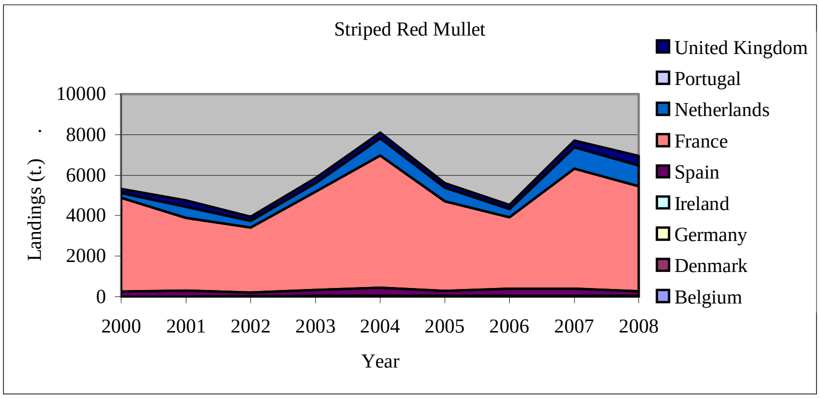
- Belgium, John Dory and gurnards (1997-2008), striped red mullet (2003-2008)
- France, from 1985 to 2008 except 1999
- Denmark, from 1992 to 2008
- Germany, from 1998 to 2008
- UK, the years with landings
- Netherlands, from 2000 to 2008

N.B. Many data are not available in the Eurostat database for these species. For the gurnards (red, tub, and grey gurnard) and "red mullet", most countries do not distinguish the species in the landings.

Striped red mullet (Figure 3.4.1, Table 3.4.1 and 3.4.2)
For striped red mullet, France contributes to 80% on average to the international landings. Among the fishing areas, the eastern Channel is most significant with 37% on average, followed by the Bay of Biscay with 21% and the western Channel with 15%. The differences between years in the total international landings are primarily explained by the eastern Channel which contributes from 23% to 51% to the landings.

Since 2004, biological data have been collected from the French landings of striped red mullet in the southern the North Sea (IVc) and the Eastern Channel (VIId): length, weight and age. The composition of the French landings is shown by age group in Table 3.4.2.

12 Authors: Kélig Mahé, Jean Claude Mahé, Robert Bellail & Frank Coppin



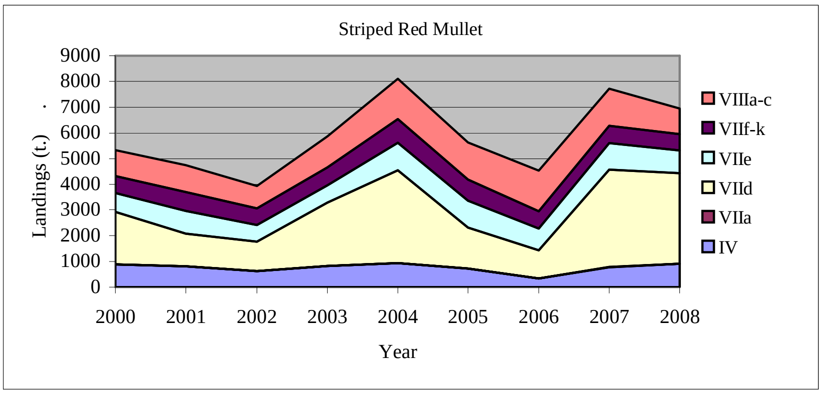


Figure 3.4.1 – Total international landings of striped red mullet in the years 2000 to 2008 by country (upper panel) and by area (lower panel).

Table 3.4.2 – French landings of striped red mullet by age by weight and by number for the years 2004-2008.

Landings (kg)

Age group	Year				
	2004	2005	2006	2007	2008
1	3212809	2120792	315856	2806648	95079
2	334743	515188	241796	248475	1096190
3	209376	95905	223410	164885	211365
4	26947	26370	22809	29827	76531
5+	60318	101923	15072	15616	67967

Landings (number)

Age group	Year				
	2004	2005	2006	2007	2008
1	35428082	20152558	2153665	26117316	985379
2	1501860	2979339	1283604	793125	7830983
3	773003	319353	924622	390184	934687
4	61954	68707	60032	66854	234098
5+	91269	242819	43007	23050	165644

Red Gurnard (Figure 3.4.2 and Table 3.4.3)
For red gurnard, the international landings (without Spain, Germany and Ireland) are more than 5000 t per year. Since 2005, the landings decreased. France contributes to 90% on average in the international landings. Among the fishing areas, the western Channel is most significant with 53% on average (2687 t.) followed by the eastern Channel with 23% (1161 t.).

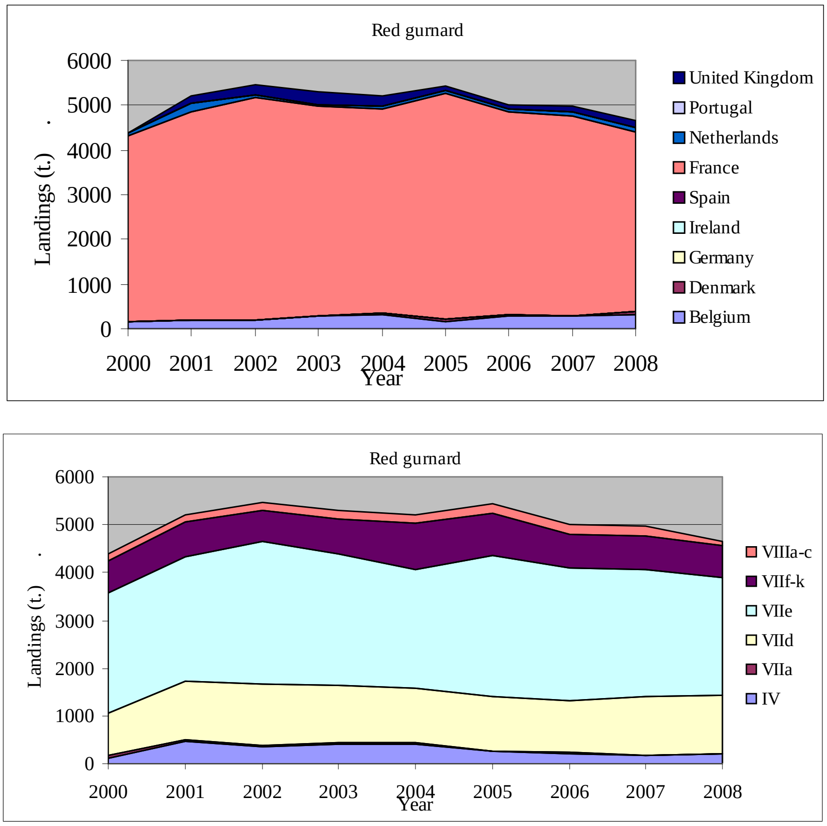


Figure 3.4.2 – Total international landings of red gurnard in the years 2000 to 2008 by country (upper panel) and by area (lower panel).

Tub gurnard (Figure 3.4.3 and Table 3.4.4)
For tub gurnard, the international landings (without Spain, Germany and Ireland) are relatively constant, nearly 3000 t except for 2007 when 4120 t was landed. Three countries contribute strongly to the international landings :

- The Netherlands : 47% ; 1542 t. on average
- France : 36% ; 1159 t. on average
- Belgium : 16% ; 513 t. on average

As far as fishing areas are concerned, the North Sea is most important with 52% on average (1575 t.), followed by the eastern Channel with 37% (1113 t.).

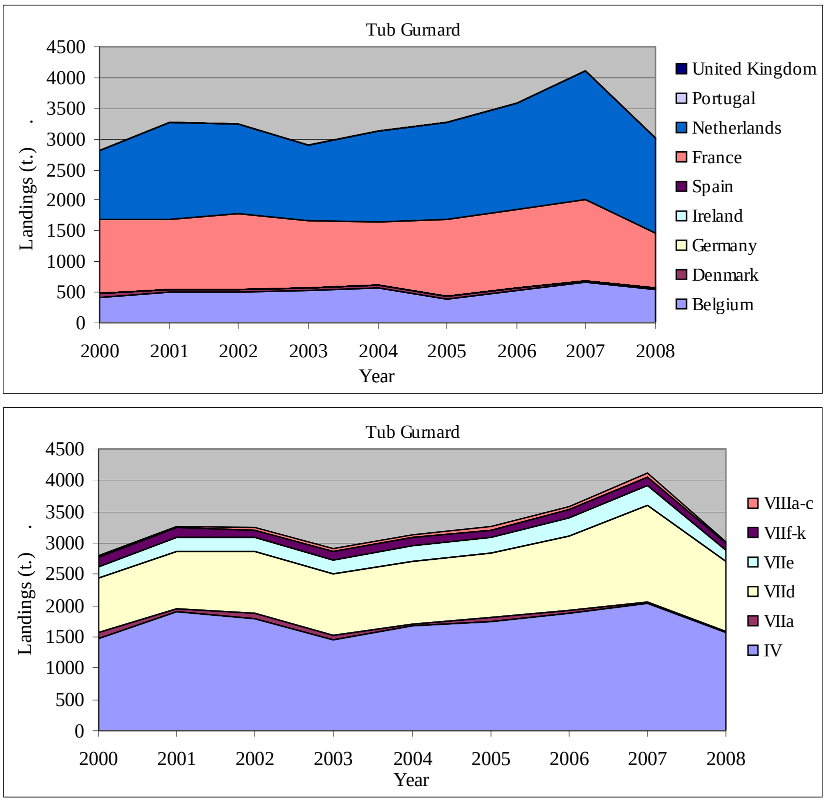


Figure 3.4.3 – Total international landings of tub gurnard in the years 2000 to 2008 by country (upper panel) and by area (lower panel).

John dory (Figure 3.4.4 and Table 3.4.5)

For John dory, the international landings (without Germany and Ireland) are 2000 t per year except for the years 2003 and 2004 with 3300 t. These two years are particular with the Spanish landings which were multiplied by a factor of 4. Since 2004, the international landings decreased.

Among the fishing areas, the Celtic Sea is most significant with 60% on average (1431 t.) followed by the eastern Channel (20% ; 479 t.) and the Bay of Biscay (17% ; 406 t.).

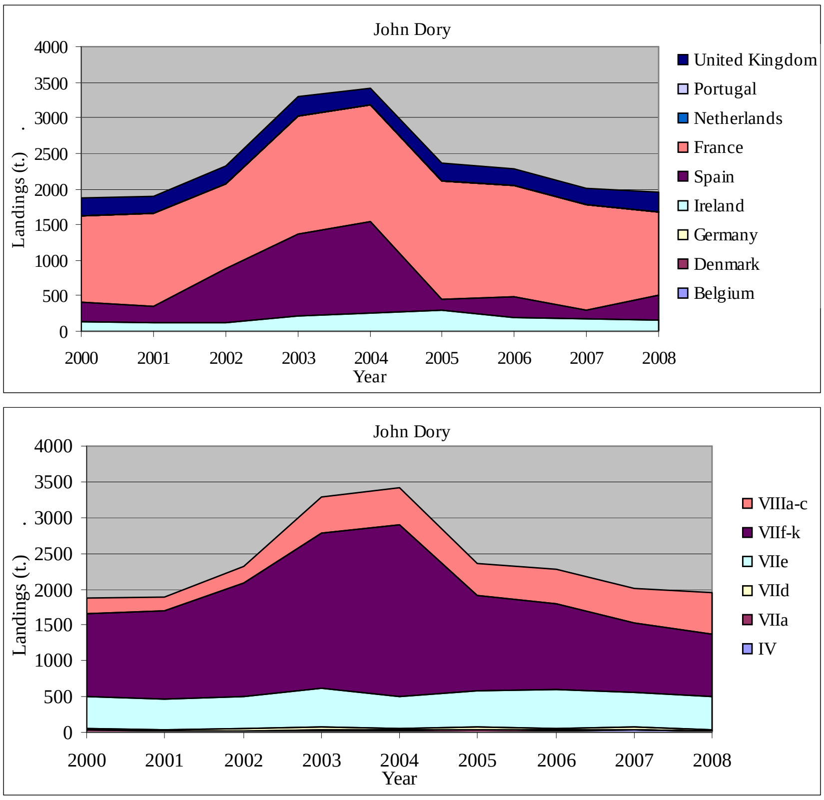


Figure 3.4.4 – Total international landings of John dory in the years 2000 to 2008 by country (upper panel) and by area (lower panel).

Table 3.4.1 – Landings of striped red mullet by area.

North Sea (ICES IV)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	10	9	9	2	2	4
Denmark	1	1	2	1	0	0	0	0	0	0	0	1	1	1	3	2	5	12	13	24	16	20	6	4
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	7	4	5	4	3	33	23	27	60	54	521	254	125	368	:	611	372	312	506	519	324	116	507	474
Netherlands	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	229	382	235	230	344	314	173	241	397
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	2	1	1	2	2	0	3	3	3	4	6	8	13	20	33	40	41	59	62	37	55	28	22	40

Irish Sea (ICES VIIa)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	0	0	0	0	0	0	2	0	0	0	0	0	0	0	:	0	0	0	0	0	1	0	0	0
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	0	0	0	0	0	0	2	2	1	1	1	0	0	0	0	3	5	1	0	0	0	0	1	0

Eastern Channel (ICES VIId)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	6	13	5	6	9	10
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	128	80	35	31	34	491	185	404	456	254	1495	1531	606	2230	:	1979	1045	1034	2244	3099	1272	914	2968	2776
Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	127	86	162	451	288	121	674	464
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	2	2	3	2	3	13	8	11	15	10	57	28	35	77	37	53	101	23	53	53	26	41	139	273

Table 3.4.1 – Landings of striped red mullet by area (Continued)

Western Channel (ICES VIIe)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	1	8	8	17	23	8
Denmark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	123	92	177	164	111	258	261	253	327	211	274	578	525	560	:	630	711	528	546	860	795	586	699	555
Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	39	16	29	58	102	113	147	173
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
United Kingdom	53	46	26	49	46	86	88	51	60	51	75	92	92	60	63	106	137	105	94	144	134	142	165	141

Celtic Sea (ICES VIIf-k)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	29	0	31	21	21	18	11	13	9	9	13	14	18	23	:	:	:	5	1	3	4	2	2	4
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	8	12	19	3	0	0	0	0	8	0	0	0	0	0	0	0	0	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	406	506	454	488	413	363	420	390	364	413	451	476	482	549	:	651	719	640	685	916	840	670	670	633
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	1	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
United Kingdom	:	:	:	:	0	1	0	0	0	0	0	0	1	0	0	0	20	7	15	2	0	:	0	1

Bay of Biscay (ICES VIII)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	1	3	4	2	2	4
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	135	171	175	141	165	170	180	0	0	0	0	100	108	125	123	262	298	191	307	391	248	349	344	247
France	708	655	775	739	686	691	696	837	529	612	564	515	528	421	:	753	734	688	879	1128	1172	1231	1091	737
Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0
Portugal	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
United Kingdom	0	2	1	0	0	0	15	29	83	33	14	10	10	8	2	0	0	0	22	46	6	0	0	0

Table 3.4.3 – Landings of red gurnard by area.

North Sea (ICES IV)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	35	0	74	61	107	59	19	11	19	19	15	17	10	11	10	16	26	31	41	83	29	13	7	13
Denmark	:	:	:	:	:	:	:	0	0	21	2	2	2	3	15	10	8	0	27	40	68	48	0	60
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	50	40	77	68	111	136	65	58	81	75	71	75	48	70	:	54	111	43	39	27	26	13	19	15
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	45	166	53	43	52	51	63	44	36
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	7	24	25	30	28	32	42	23	6	0	0	4	150	217	253	221	95	76	107	84

Irish Sea (ICES region : 7a)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	32	0	20	13	9	12	5	12	15	16	15	26	21	21	38	33	26	23	24	8	5	10	7	5
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	0	0	0	8	0	0	0	0	10	0	0	0	0	0	0	0	0	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	49	36	30	15	13	14	50	23	10	8	4	5	5	2	:	6	15	12	2	0	2	0	0	0
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	1	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	2	2	4	3	2	2	3	2	2	0	0	0	3	5	12	11	0	0	:	:

Eastern Channel (ICES VIId)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	56	0	61	75	88	70	71	93	64	68	65	80	67	85	95	94	106	104	161	131	68	155	187	218
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	1384	1226	977	1171	1214	1574	1292	1376	1143	1132	1239	1424	1178	1000	:	800	1119	1183	1043	1005	1039	898	971	894
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	11	2	6	14	16	17	37	64
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	32	55

Table 3.4.3 – Landings of red gurnard by area (continued)

Western Channel (ICES VIIe)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	27	0	14	27	22	8	3	11	4	5	7	5	7	10	0	1	5	7	23	46	24	73	62	60
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	1122	2290	2237	1990	1642	1199	2112	2106	2194	2189	2199	2269	2614	2303	:	2499	2575	2968	2728	2436	2951	2714	2603	2382
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	14	0	0	0	0	0	0	2	2
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	3	0

Celtic Sea (ICES VIIf-k)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	29	0	31	21	21	18	11	13	9	9	13	14	17	19	11	9	12	15	26	47	16	26	33	36
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	8	12	19	3	0	0	0	0	8	0	0	0	0	0	0	0	0	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	406	506	454	488	413	363	420	390	364	413	451	476	482	549	:	651	719	640	685	916	840	670	670	633
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	0	1	0	0	0	0	0	0	1	0	0	0	20	7	15	2	0	:	0	1

Bay of Biscay (ICES VIII)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	0	0	2	0	2	0	0	1	2	1	2	3	1	2	1	1	1	1	1	1	2	1	1	1
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	211	241	332	274	236	206	189	190	153	224	165	174	176	191	:	143	141	152	166	169	202	218	202	92
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	2	0	0	0	0	0	0	0
Portugal	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	:	0
UK	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	3	:	:	:

Table 3.4.4 – Landings of tub gurnard by area.

North Sea (ICES IV)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	47	33	32	112	176	115	96	106	61	67	63	85
Denmark	0	0	0	0	0	0	0	48	125	63	23	29	62	29	62	63	60	46	60	59	52	45	16	24
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	39	0	37	24	96	122	73	120	123	205	160	95	55	101	:	206	134	203	99	83	110	94	89	76
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	1093	1533	1437	1202	1422	1519	1666	1875	1390
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

Irish Sea (ICES VIIa)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	80	41	24	73	42	80	56	22	64	51	22	15
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	0	0	0	0	0	0	2	0	0	0	0	0	0	1	:	3	6	10	4	2	3	1	1	0
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	17	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

Eastern Channel (ICES VIId)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	81	83	143	186	247	265	328	368	221	357	514	353
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	375	74	226	276	618	1343	916	1095	1421	1248	1145	780	427	544	:	667	637	692	633	612	766	762	826	603
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	14	35	19	32	46	58	59	204	157
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

Table 3.4.4 – Landings of tub gurnard by area (continued)

Western Channel (ICES VIIe)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	0	3	0	0	5	6	8	19	12	23	28	32
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	76	12	150	114	87	94	207	180	173	120	126	185	179	185	:	188	212	216	216	190	212	251	242	152
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	5	4	4	7	17	6	26	29	6
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

Celtic Sea (ICES VIIf-k)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	20	24	27	34	24	27	25	42	19	32	38	47
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	17	23	25	35	23	18	35	41	33	34	28	52	62	68	:	105	125	84	96	92	104	97	109	56
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

Bay of Biscay (ICES VIII)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	3	7	7	7	4	6	5	7	7	6	6	6
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	138	2	4	5	5	3	3	6	2	5	3	5	7	7	:	36	24	28	45	51	50	56	58	21
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	2	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

Table 3.4.5 – Landings of John dory by area.

North Sea (ICES IV)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	0	0	1	1	1	0	0	0	0	1	0	0	0	4	:	0	1	1	1	0	0	1	1	0
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	0	0	0	1	1	0	0	1	1	3	2	0	9	4	4	8	5	3	10	12	8	21	28	18

Irish Sea (ICES VIIa)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	6	9	11	3	6	5	14	15	11	9	11	8	12	17	12	6	14	8	7	7	3	3
Spain	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
France	3	5	4	5	3	3	3	4	4	3	2	1	0	2	:	8	3	5	3	4	8	4	2	2
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	0	0	1	2	2	1	1	3	4	4	4	1	1	1	1	2	2	1	4	5	25	5	1	2

Eastern Channel (ICES VIId)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	:	:
France	25	26	23	33	34	26	20	20	21	31	24	16	12	19	:	18	21	29	41	25	28	27	31	9
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	1
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	0	1	3	2	3	3	1	3	3	3	2	1	1	1	1	2	2	4	3	1	2	1	2	4

Table 3.4.5 – Landings of John dory by area (continued)

Western Channel (ICES VIIe)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	:
Spain	:	:	:	:	:	:	:	:	:	:	:	2	2	2	0	0	0	0	0	0	0	0	:	:
France	108	132	123	151	199	186	236	218	204	233	255	207	189	207	:	322	318	334	428	378	414	422	411	361
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	26	35	70	90	114	106	55	84	101	163	140	86	48	68	73	120	106	119	124	66	90	106	88	108

Celtic Sea (ICES VIIf-k)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	9	14	19	33	34	51	65	58	118	99	88	79	108	113	104	117	194	241	277	190	168	152
Spain	:	:	:	:	:	:	:	:	:	:	:	143	179	119	15	199	154	694	951	1057	100	150	:	:
France	221	275	261	379	341	338	356	365	357	356	356	393	371	408	:	735	841	642	890	943	841	760	691	574
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0
Portugal	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
UK	9	16	24	25	19	33	12	31	27	87	137	123	95	52	77	122	125	130	120	150	116	101	108	133

Bay of Biscay (ICES VIII)

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0
Ireland	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Spain	:	:	:	:	:	:	:	:	:	:	:	15	76	97	65	76	81	62	208	235	59	145	112	360
France	52	60	81	99	69	88	62	46	48	67	71	52	82	115	:	123	124	178	295	284	382	334	365	222
Netherlands	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0
Portugal	0	0	0	2	4	4	6	2	4	4	2	3	4	8	3	3	1	0	3	1	0	1	1	1
UK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0

3.5 vTI-SF: Fisheries for dab[13]

3.5.1 Time series for dab

Landings by ICES division

As documented by ICES catch statistics until 2008, in continental waters the main landings for dab have been taken in the eastern Channel and eastern North Sea (ICES divisions IVb+c and VIId), Skagerrak (IIIa) and western Baltic (IIIb23, IIIc22) (Table 3.5.1). From the eastern Baltic division IIId, only from IIId24 dab landings are reported. Total annual landings from this area have been markedly above 10,000 t since 1998, when full reporting of dab catches commenced.

In non-continental waters, dab landings in ICES division Va have been high before 2003 with on average 4-5000 t per year. Since 2003, landings have decreased markedly.

For all other ICES divisions, dab landings were on average less than 100 t per year.

At the scale of ICES statistical rectangles, major dab landings were obtained from off the Dutch coast, the German Bight, Skagerrak and the Western Baltic, with highest landings from ICES division IVc (Figure 3.5.1). The distribution of catches allows to delineate two fairly contiguous fishing grounds: (1) the North Sea fishing ground from the Belgium coast (eastern part of VIId) to Jutland/Skagerrak (western part of IIIa), and (2) the Baltic Sea fishing ground in ICES division IIIc22.

Landings by country

Before 1998, catches are likely underestimates mainly due to missing reports from The Netherlands (no reports until 1997) and Germany (year 1995 not reported). Further underreporting must be expected from Norway, Spain and the Russian Federation (Table 3.5.2).

Recent years show, that The Netherlands is the major country for dab landings, followed by Denmark. The Netherlands land about 5000 t per year since 2001, and Denmark about 2000 t.

Germany, the UK (S+W+E+N) and France land about 1000 t annually, whereas Belgium reports some 500 t per year. Generally, landings by all countries peaked in the mid-1990s but have since declined.

Description of the fleets

In the North Sea, dab is caught as by-catch in the mixed flatfish fisheries for plaice and sole with beam trawl with 80-99 mm mesh size as the main fleet segment. This fleet segment mainly targets certain flatfish (sole and plaice), but is also known to catch roundfish (cod, whiting) and dab. In the German Bight, the fleet operates over nursery grounds for round- and flatfish. This causes high by-catch and discard rates of undersized target and non-target species.

Further North Sea landings are obtained in the fleet segments otter trawl with 80-99 and with > 100 mm mesh size. The main target species for the fleet segment with 80-99 mesh size is Nephrops. The fleet segment also includes vessels targeting plaice and/or roundfish and striped red mullet in the southern part of the North Sea. The segment with mesh sizes > 100 mm mainly targets roundfish and flatfish (see SEC, 2007).

In the Baltic, landings mainly originate from the cod fisheries with otter trawls with 110-119 mm mesh size.

Two groups of countries can be distinguished: (1) countries with a by-catch of dab from predominantly flatfish fisheries with beam trawls in the North Sea (Netherlands, Germany North Sea, Belgium); (2) countries with a by-catch from mixed fisheries (UK, Denmark, Germany Baltic).

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13 Authors: Heino Fock and Maren Odefey

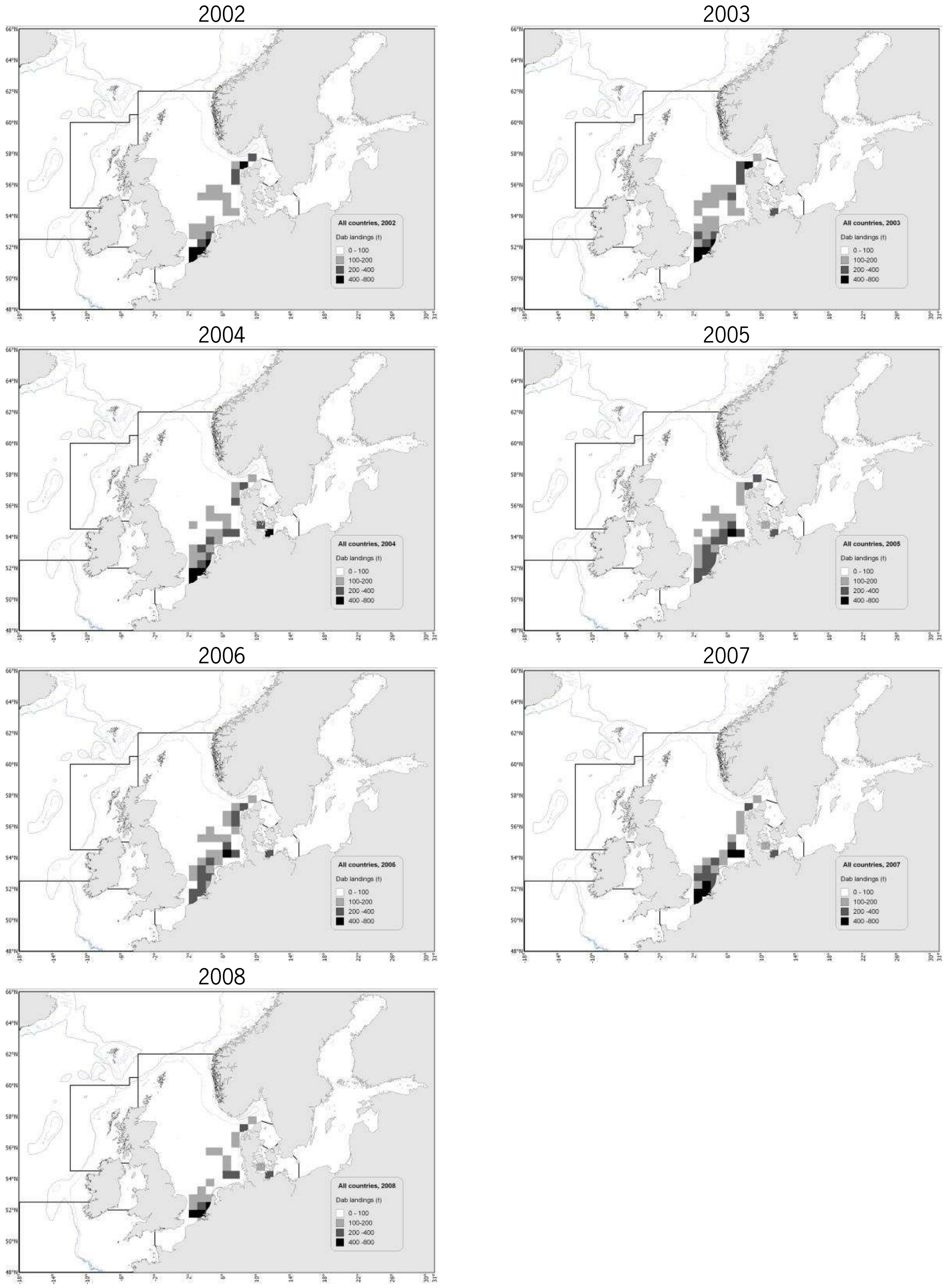


Figure 3.5.1 - Distribution of landings from ICES statistical rectangles for 2002 to 2008 from Germany, The Netherlands, Denmark, Belgium and UK. Catch level shading (in t per year): 0-100 (white), 100-200 (light grey), 200-400 (dark grey), 400-800 (black).

Table 3.5.1 - Dab landings (t) by ICES division. Source : ICES catch statistics
(- : missing data, . = fishing ceased)

Year	I	IIIa	IIIb+c	IIId	IVa	IVb	IVc	Va	Vb 1	VIa	VIb	VIIa	VIIb	VIId	VIIe	VIIf	VIIg-k	VIIj	VIIIa	VIIIc
1990	-	1571	2092	74	272	1947	462	1897	6	196	<0.5	118	18	1302	148	39	65	113	33	.
1991	-	1604	2156	111	286	2545	606	2632	3	171	-	127	7	1272	141	48	30	30	32	.
1992	-	1444	1891	83	272	1799	572	3045	5	149	-	130	19	1407	113	27	66	110	23	.
1993	66	1716	1687	101	191	2470	645	4222	3	98	3	91	16	1453	88	32	35	20	11	.
1994	-	1954	2998	151	144	3246	466	5159	6	96	3	85	17	1242	110	26	25	46	11	.
1995	-	1527	1687	8	93	3361	406	5557	24	56	-	104	22	811	100	22	22	43	8	.
1996	-	1409	2086	152	118	4071	642	7954	36	63	-	116	13	1051	112	24	20	34	12	.
1997	-	1015	1228	30	77	4660	517	7891	39	73	6	149	25	1450	181	40	28	33	10	<0.5
1998	-	963	1006	3	44	7639	5073	5061	39	61	89	99	24	1535	142	49	23	72	6	123
1999	-	675	1085	8	18	8671	4580	3981	27	26	42	99	4	131	67	31	28	60	.	75
2000	-	659	889	8	28	5788	4768	3015	.	12	4	76	9	1045	90	40	34	10	14	8
2001	35	759	828	76	37	5027	4727	4373	41	10	6	104	9	915	80	39	23	4	7	2
2002	19	976	715	17	28	4517	4132	4358	15	6	7	62	8	1123	79	34	19	11	8	3
2003	2	855	1240	9	28	5259	3717	4213	7	12	15	63	12	1153	84	34	25	27	27	58
2004	9	781	1917	12	12	4944	3648	2953	10	5	8	52	22	1078	91	50	30	13	10	34
2005	88	841	1467	0	12	6041	3346	2116	32	6	1	51	4	1056	92	37	20	5	18	-
2006	133	707	1251	0	8	6157	3007	1081	32	1	<0.5	45	3	1078	88	23	34	2	11	-
2007	104	691	1579	0	5	5154	4268	810	22	0	.	24	.	1034	49	30	20	0	30	.
2008	47	520	1419	0	6	3673	4343	798	19	0	.	23	.	960	62	20	27	0	30	-

Table 3.5.2 - Dab landings (t) by country. Source : ICES catch statistics.
UK-E = England, -W=Wales, -N=Northern Ireland (- : missing data, . = fishing ceased)

Year	UK-Scotland	UK/E+W+N	Sweden	Spain	Russian Federation	Norway	Netherlands	Ireland	Iceland	Germany	France	Faeroe Islands	Denmark	Belgium
1990	760	443	36	-	-	-	-	231	1897	405	1494	6	4554	527
1991	1057	657	47	-	-	-	-	101	2632	672	1439	3	4596	597
1992	877	576	32	-	-	-	-	230	3045	626	1499	5	3677	588
1993	671	670	32	-	-	-	-	79	4222	1103	1569	69	3878	655
1994	799	894	35	-	-	-	-	90	5159	1943	1248	6	5057	554
1995	809	1403	45	-	-	-	-	95	5557	-	883	24	4483	552
1996	780	1417	18	-	-	-	-	76	7954	1880	1115	36	3951	686
1997	1078	1495	22	<0.5	-	-	-	112	7891	1384	1437	39	3211	783
1998	1108	1316	19	123	-	-	7975	109	5061	1127	1573	39	2646	955
1999	1213	995	12	75	-	-	8651	64	3981	1102	1194	27	2512	952
2000	799	891	6	8	-	48	6532	39	3015	1113	1071	0	2113	845
2001	695	818	7	2	3	44	5889	34	4373	1073	946	73	2298	830
2002	677	671	6	3	-	51	4955	32	4358	762	1190	34	2648	742
2003	601	764	4	58	-	77	5137	40	4213	1146	1108	9	3003	665
2004	598	700	3	34	-	53	5161	51	2953	1527	1045	19	2945	578
2005	480	821	3	-	68	130	5477	9	2116	1630	1077	52	2813	543
2006	669	861	4	-	68	94	5184	6	1081	1687	1061	97	2248	578
2007	578	712	9	-	46	116	6470	1	810	1105	1080	80	2189	611
2008	375	574	7	-	3	57	5635	0	798	927	925	63	2024	538

Germany

The fleet structure with regard to dab landings is different between fisheries in the North Sea and in the Baltic in terms of vessel power and gear type.

In the North Sea, dab is mainly landed in the métier beam trawl with 80-99 mm mesh size as the main fleet segment (Fig. 3.5.2). In 2008, 96 t out of 112 t total landings from this métier were obtained from the vessel category > 221kW (300 Hp). In turn, 15 t were landed from the vessel category <=221kW.

In the Baltic, landings are mainly derived from the cod fisheries with otter trawls with 110-119 mm mesh size as the main fleet segment. In 2008, 399 t were landed from vessel category <=221kW, whereas only 1 t was landed from vessel category >221kW.

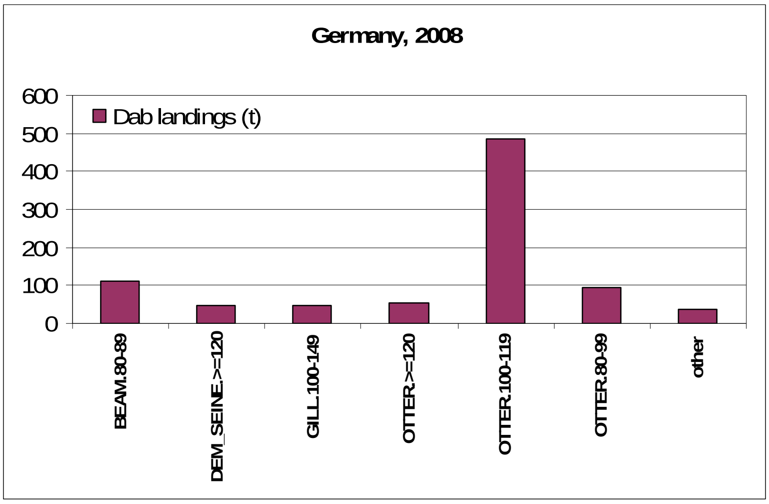


Figure 3.5.2 – Dab landings by métier for Germany, 2008.

The Netherlands

For the Dutch seafood industry, flatfish product exports are an essential and integral part of its economic development. Flatfish products are supplied to retail sales, catering and bulk accounts from the main species plaice, sole and dab.

Landings are only reported from the North Sea. Dab is part of the by-catch in the beam trawl fishery for plaice and sole. The main métier is beam trawling with 80-99 mm mesh size (Fig. 3.5.3).

Discard data have been collected during recent years (see Section 3.1.1). Only the bigger specimens of dab are landed, and most of the catch will usually be discarded. The portion retained depends on the availability of the main target species and on the prices in the market.

Belgium

Flatfish fisheries with beam trawls is the major métier for dab landings (Figure 3.5.4). About equal amounts are yielded in the vessel categories >221kW and <=221kW.

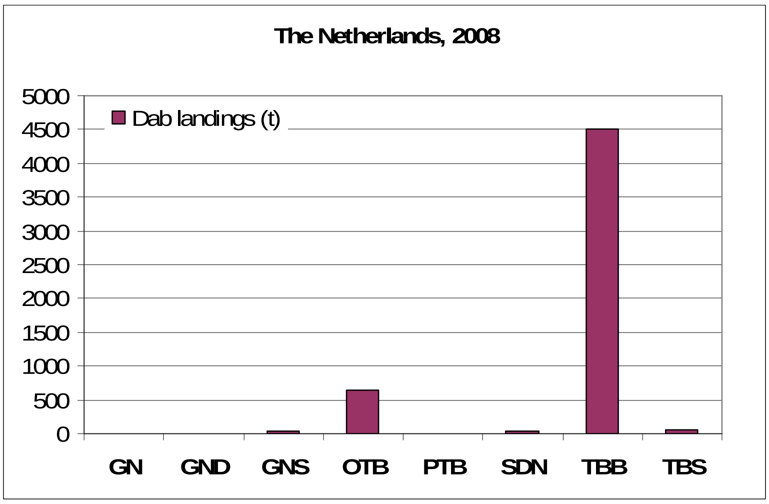


Figure 3.5.3 - Dab landings by métier for The Netherlands, 2008. GN, GND, GNS- gill nets; OTB, PTB – otter boards, single and paired; SDN – Danish seines; TBB – beam trawl; TBS – shrimp trawl (*Crangon crangon* fisheries).

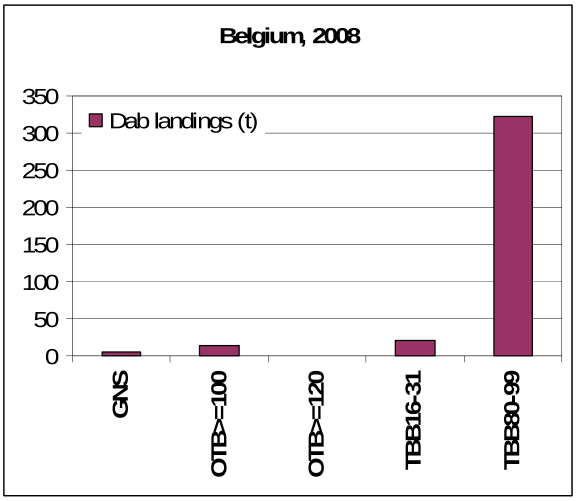


Figure 3.5.4 - Dab landings by métier for Belgium, 2008. TBB16-31 is equivalent to TBS, i.e. shrimp fisheries (*C. crangon* fisheries).

<u>United Kingdom</u>
Dab is a by-catch in beam trawl fisheries for flatfish, both for sole and plaice (80-99 mm mesh size) and for plaice only (> 99 mm mesh size), and in mixed fisheries/Nephrops fisheries with otter trawls (Fig. 3.5.5).

About 95 % of dab landings are in the vessel power category > 221 kW.

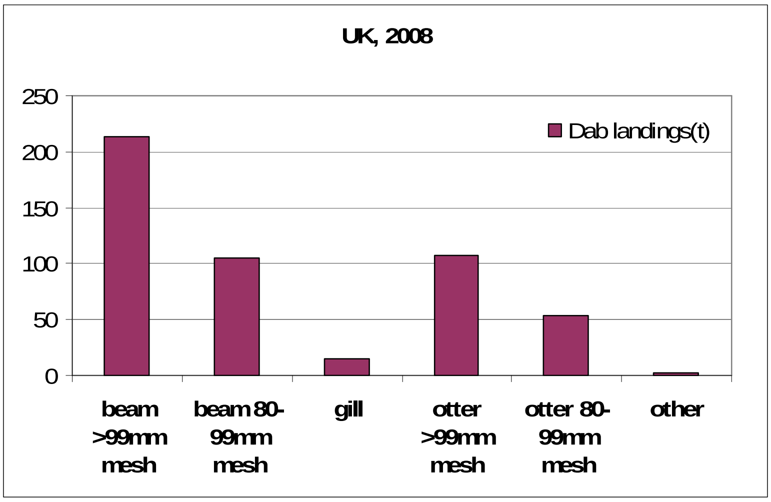


Figure 3.5.5 - Dab landings by métier for the UK (England, Wales, Scotland and Northern Ireland merged), in 2008.

<u>Denmark</u>

Historically, a directed dab fishery was carried out in the Danish Wadden Sea which ceased in the early 1950's, and the dab fishermen's association dissolved in 1957 (Holm, 2005). Dab maintained further important catches in the Kattegat and Belt Sea area in the 1930s, yielding about 4000 t annually (Poulsen, 1933).

Recent landings are yielded as by-catch from mixed fisheries with otter trawls and seiners (Fig. 3.5.6).

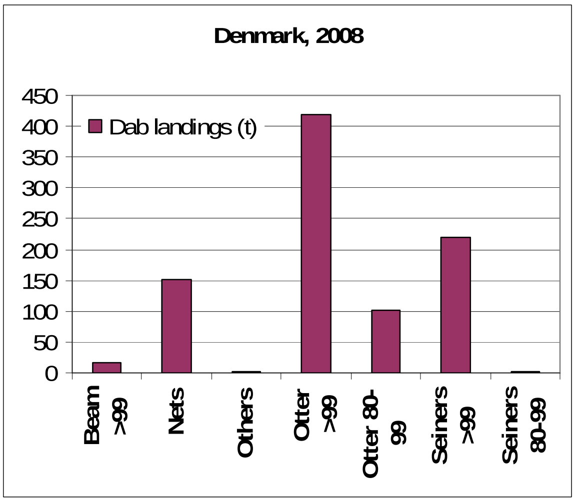


Figure 3.5.6 - Dab landings by métier for Demark, 2008.

Assigning national landings to ICES rectangles

As in Figure 3.5.1, catches split up by country are concentrated in the eastern North Sea, Skagerrak and Kattegat, and the Western Baltic (Fig. 3.5.7).

The western boundary is the Dogger Bank, where the UK landings are mainly taken. In the German Bight and the southern North Sea, Dutch, German and Belgium landings are concentrated. Danish landings were taken off Jutland's coast. As mentioned before, Wadden Sea fisheries are not undertaken any more. In the Baltic, major landings are only reported for Germany in ICES divisions III c22 and d24.

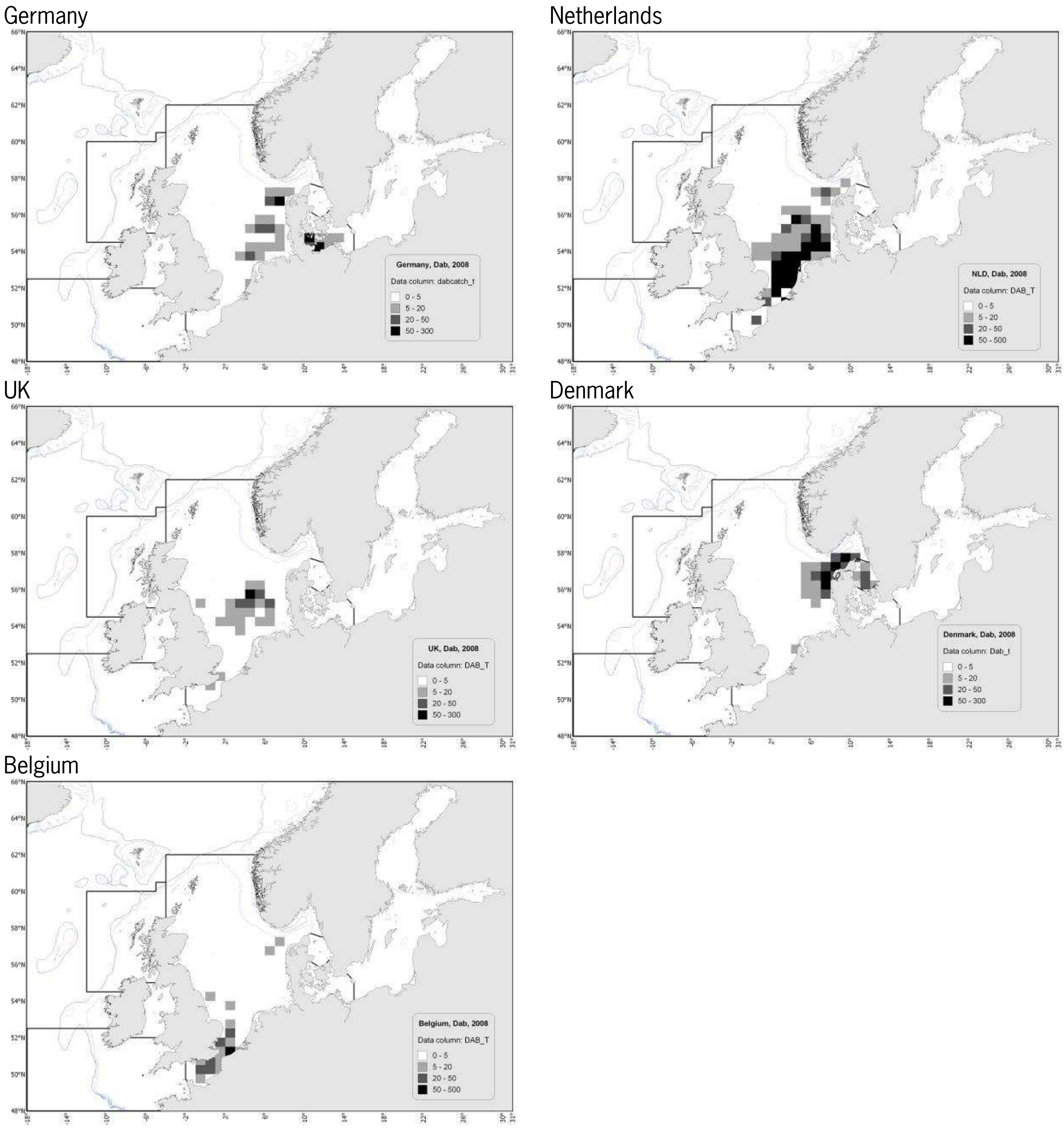


Figure 3.5.7 - Assignment of landings to ICES rectangles by country, 2008. Catch level shading (t per year): 0-5 (white), 5-20 (light grey), 20-50 (dark grey), 50-500 (black).

3.5.2 Discard data

Dab and plaice are the most discarded species in the ICES area.

In the 1990's, the Northeast Atlantic flatfish beam-trawl fishery was assessed among the 20 most discarding fisheries world-wide (Alverson et al., 1994). Recent estimates still indicate heavy dab discards from the beam-trawl fishery, amounting to 60 to 70 % of the total catch (Borges et al., 2005).

3.5.2.1 Dab discard rates by métier

The objective of this analysis is to obtain and spatially resolve discard rates in selected métiers, and to include an estimate on discards in shrimp (i.e. *Crangon crangon*) fisheries.

Distribution of dab discard rates is shown for 7 different métiers, for which sufficient discard sampling data were available:

North Sea

- Flatfish fisheries, small vessels BEAM.80-89.<=221kW
- Flatfish fisheries, large vessels BEAM.80-89.>221kW
- Mixed fisheries, small vessels OTTER.80-89.<=221kW
- Mixed fisheries, large vessels OTTER.80-89.>221kW
- Mixed fisheries, small vessels OTTER.100-119.<=221kW
- Mixed fisheries, large vessels OTTER,100-119.>221kW

Baltic Sea

- Mixed fisheries, small vessels OTTER.100-119.<=221kW

For shrimp fisheries, only few discard sampling data were available, which were not spatially resolved. In shrimp fisheries, dab discards were linked to shrimp landings, in flatfish and mixed fisheries, discards were linked to dab landings.

3.5.2.2 Discard sampling data

Shrimp fisheries, métier BEAM.16-31.<=221 kW

Discard data from shrimp fisheries by month and ICES rectangle are only available for 3 years. Before 2000, landings were spatially unassigned and effort was not reported.

In shrimp fisheries, by-catch of dab is linked to shrimp landings. Mainly juvenile, undersized dab are caught.

Landings based by-catch data are available only for the German shrimper fleet for the years 2006 to 2009 through the EU data collection program (Ulleweit *et al.*, 2010). 44 samples were analysed from vessels operating veil nets.

Length frequencies of discarded dab are different between years (Fig. 3.5.8). In 2006 (not shown) and 2007 mainly dab in the size range < 7.5 cm were discarded. In 2008 and 2009, also larger specimens were discarded. In 2008, the modal size was about 10.5 cm length. Age-length curves indicate, that within the size range < 7.5 cm mainly 0-group dab are discarded, whereas in the size group 10-15 mainly age group 1 is affected. In 2009, also older dab were discarded.

Table 3.5.3 - Temporal coverage of discard sampling by country and métier for the North Sea, GER – Germany , NLD – the Netherlands.

power	metier	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
<=221kW	BEAM100-119				GER	GER			GER							
	BEAM16-31												GER	GER	GER	GER
	BEAM80-89	GER	GER	GER	GER	GER	GER NLD	GER NLD	GER	GER NLD	GER	GER	GER			
	GILL>=120										GER	GER				
	GILL100-119										GER	GER				
	GILL80-89									GER						
	GILL90-99										GER	GER			GER	
	OTTER>=120									GER	GER				GER	
	OTTER100-119							GER	GER	NLD	GER			GER		
	OTTER80-89						GER		GER	GER	GER	GER	GER		GER	GER
	OTTER90-99									GER		GER				
>221kW	BEAM80-89					GER NLD	NLD	GER NLD	NLD	GER NLD	GER	GER	GER	GER	GER	GER
	DEM_SEINE100 -119													GER		GER
	OTTER>=120								GER	GER		GER	GER	GER	GER	
	OTTER100-119									NLD			GER			
	OTTER80-89							GER	NLD				GER			

Table 3.5.4 - Available discard sampling by métier for the Baltic Sea, IIIc22+d24, country: Germany. Numbers of months sampled by métier.

power	metier	2005	2006	2007	2008	Total
<=221kW	GILL>=120				1	1
	GILL100-119				2	2
	OTTER>=120	5		2		7
	OTTER>120		3			3
	OTTER100-119	1	4	8	16	29
	OTTER55-69		2	4		6
	TRAMMEL>=120			1	1	2
>221kW	OTTER55-69				2	2
	OTTER100-119		5	1		6

To derive tentative estimates on dab discards in shrimp fisheries, the method applied for estimating 0-group discards of plaice was adopted (Beare *et al.*, 2010). The rationale is to base the assessment on shrimp landings. It is assumed that dab mainly as 0-group by-catch and discard in the métier BEAM16-31.<=221 kW (shrimp fisheries) is dependent on the shrimp landings C in year *y*, the average annual discard rate r in terms of shrimp landings, an efficiency factor f indicating progress in fishing technology and capabilities, and a factor R representing the year-class strength of dab hatched in year *y*:

$$Discards_{lm} = C_y * r_m * R_y * f$$

This approach underestimates the proportion of larger dab as observed in 2009.

Monthly by-catch rates were obtained as weighted averages with shrimp catch as weighting factor. Except for the month September (0.04 % by-catch rate), by-catch rates of dab in shrimp landings ranged from 4.9 to 10.1 %. Based on different seasonal patterns in landings, different annual discard rates were calculated for German and Dutch shrimp vessels. Based on catch statistics from ICES WGCRAN (ICES, 2009), German parameters were also applied to Danish and Belgian landings. On average, for German and Dutch shrimpers, 5.4 and 5.6% of annual landings by weight were calculated as dab discard rate. This is consistent with the respective rates for plaice of

4.3 % and 4.2 % (Beare *et al.*, 2010), given that on catch trip basis the ratio of dab to plaice discards is 41.3 to 34.9 kg in shrimp fisheries (Ulleweit *et al.*, 2010).

The year class index as relative estimate of 0-group strength standardized to the period 2006-2008 was derived from the German Demersal Young Fish Survey (DYFS) as abundance of dab < 9 cm TL. DYFS is an autumn survey in the German Wadden Sea. Data were available until 2008. In recent years, year class strength has declined as compared to the early 1990s (Fig 3.5.9), similar to findings for plaice (Beare *et al.*, 2010). The average weight of dab caught is 2.3 g per specimen in 2006 and 2007, indicating a by-catch mainly consisting of 0-group specimens. In 2008, the average weight was 5 g.

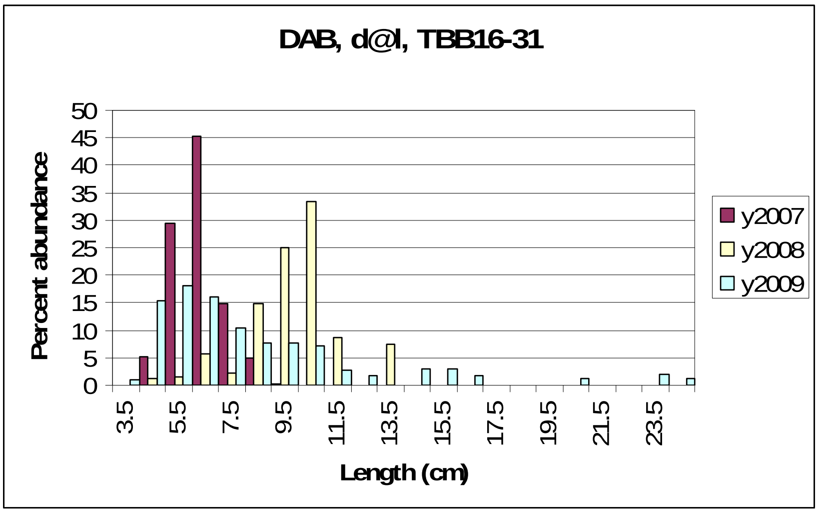


Figure 3.5.8 - Length frequencies of dab discards in shrimp fisheries for the years 2007 to 2009.

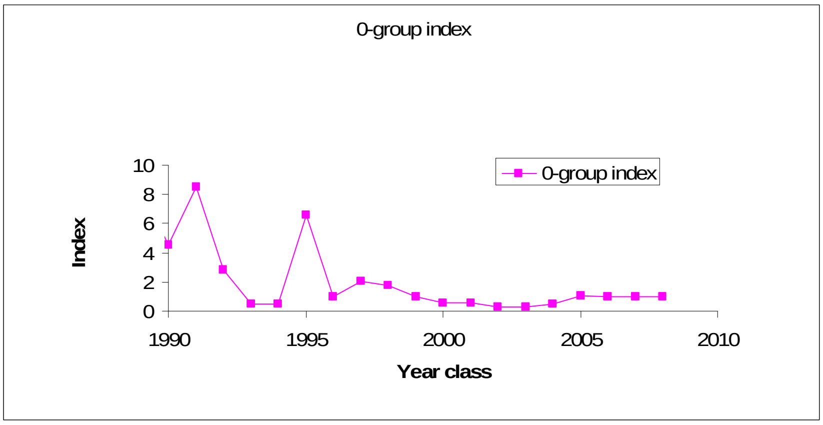


Figure 3.5.9 - 0-group index for dab from the German DYFS, standardized to 2006-08=1.

Table 3.5.5 - Dab 0-group discard estimates in the North Sea shrimp fisheries, TBB16-31, <=221kW.

Year	DYFS dab 0-group Index, standardised	Shrimp landings (t)	Dab 0_group by-catch by GER+B+DK (t)	Dab 0_group by-catch by NLD (t)	Total 0-group by-catch (t)
1990	4.5	9876	1258	1078	2337
1991	8.5	16298	4216	2947	7163
1992	2.8	15479	1462	1019	2481
1993	0.5	18110	286	227	513
1994	0.5	20869	341	226	566
1995	6.6	23760	3567	4870	8437
1996	1.0	24273	671	626	1298
1997	2.1	28331	1804	1397	3201
1998	1.8	23306	1193	1088	2281
1999	1.0	27492	777	693	1470
2000	0.6	24920	481	368	849
2001	0.6	24021	372	476	848
2002	0.3	23730	247	190	437
2003	0.3	27713	271	269	540
2004	0.5	28407	492	418	909
2005	1.0	33062	1195	946	2141
2006	1.0	30270	1028	869	1896
2007	1.0	28486	884	902	1786
2008	1.0	27768	899	815	1713

Berghahn *et al.* (1992) provide discard mortality data for a number of by-catch species taken by shrimp vessels in the North Sea. Survival of flatfish is noted to depend strongly on the species and the size of specimens, as well as conditions of catch processing. A series of experiments on dab survival resulted in discard mortalities ranging from 0% to 67%, with an average mortality of 32.6% for fish collected after “sieving” and 11.9% for dab collected from the catch before “sieving” the shrimp catch (Appendix 3.5 Table App3.5.1).

Flatfish/mixed fisheries

No discard data were available for the Danish fleet with regard to métiers relevant for dab discards in the area considered for the investigation. 74 samples were available from the national discard sampling program. However, time series were of limited length for most of the métiers which hinders full spatial and temporal analysis (Table 3.5.3 and 3.5.4).

Aggregation of data in which many gaps occur was required to either provide spatial or temporal trend estimates. For the métiers considered in this analysis and aggregated by month, métier and ICES-rectangle, dab discards were considered in conjunction with dab landings.

Discard rates were aggregated to ICES rectangles to account for spatial variability. Temporal trends of discards from GLM are discussed in terms of mean effects, due to limited coverage in time series (see Tables 3.5.3 and 3.5.4).

Catch is the sum of discards and landings. These can be transferred into percent of dab discard by métier *m*, expressed in terms of weight of catch c, i.e.

$$r_{cm} = discards_m / (discards + landings)_m$$

The discard rate r_c in relation to catch ranges from 0 to 1.

After arcsine transformation, a mean effect for r_{cm} is calculated for each year *y* and for each sampled area *a* (ICES rectangle) by means of a GLM model and back-transformed. To recalculate discards in relation to the landings, the equation

$$Discards_{mya} = landings_{mya} / (1 - r_{cmya}) - landings_{mya}$$

needs to be applied.

Data on discard rates are presented in Tables App3.5.2 (North Sea) and App3.5.3 (Baltic Sea).

NORTH SEA

Spatial patterns for dab discard rates show little regularity in terms of gradients with e.g. lower rates further offshore as observed for other flatfish fisheries (Beare *et al.*, 2010). In turn, in the entire North Sea high discard rates are observed (Fig. 3.5.10). High discard rates are observed in métiers with mesh sizes up to 120 mm (Table App3.5.2). This can be attributed to the fact that dab is only a by-catch and not targeted directly.

Only for the fleet segment OTTER.>=120 both for small (<=221kW) and large vessels (>221kW) lower rates are indicated (Table App3.5.2).

In the fleet segment BEAM.80-89.<=221kW and BEAM.80-89.>221kW a high dab by-catch is obtained in the plaice and sole fisheries throughout the entire area with accordingly high dab discard rates. The same holds for otter trawls > 221kW with mesh sizes 80-89 and 100-119. Only in the fleet segments otter trawls 80-89/100-119 mm with smaller vessels (<=221kW) apparently lower discard rates are indicated in the North Sea.

Discarding trends are linked to year-class strength, which was postulated already for dab discards in shrimp fisheries. This is shown by empirically aligning the 0-group index to the time series of dab discard rates for beam trawlers 80-89 mm (Figure 3.5.11). By this, the trend of decreasing and low discard rates in 2005 and 2006 can be linked to relatively low year-class strength in 2002 and 2003. In turn, relatively high discard rates in 2008 and 2000/01 can be linked to corresponding high values in year-class strength in 1997/98 and 2005.

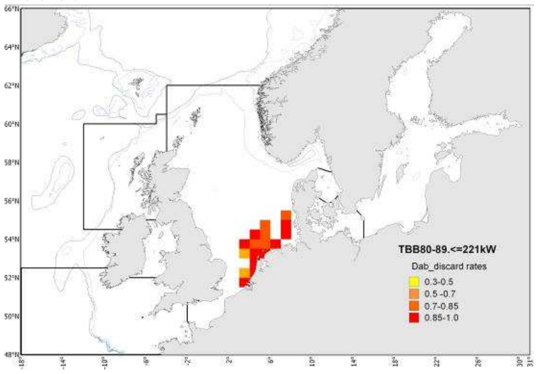
This can be interpreted in a way, that main discarding for dab takes place at age 3+. Similar findings were obtained for plaice (Beare *et al.*, 2010).

BALTIC SEA

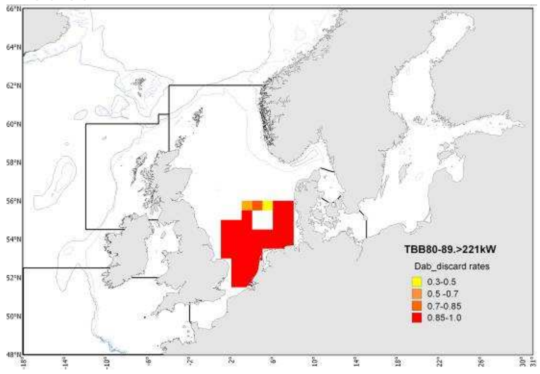
In the Baltic, discard rates are generally lower (Table App3.5.3). Differences appear in particular in direct comparisons by métier for mesh sizes <120 mm (Table 3.5.6). In turn, for mesh sizes > 120 no clear differences are indicated, i.e. at mesh sizes for which discarding in the North Sea was also low.

For the period 1960 to 1981, discards in IIIc22 were estimated for Danish and German fisheries (Temming, 1983). German findings are in accordance to the low discard rates as documented in Table App3.5.2. However, for the Danish fleet segment OTTER.55-69mm discard rates from that time were 50 to 65 % of the total catch, which is higher than for the German fleet, but still considerably lower than for fleets operating in the North Sea. But, since dab was not the primary target in the cod fisheries, discards of dab as secondary target depended on the availability of cod, and with relatively low cod abundances in recent years, dab discards could have declined as well.

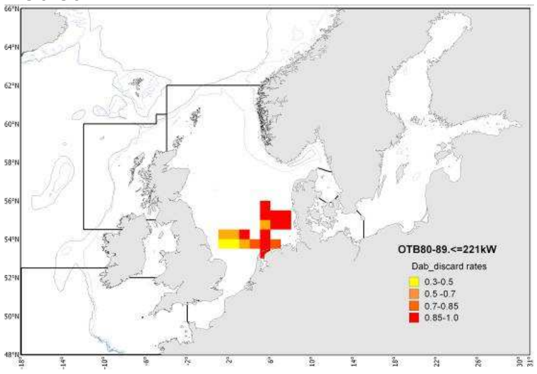
TBB80-89.<=221kW



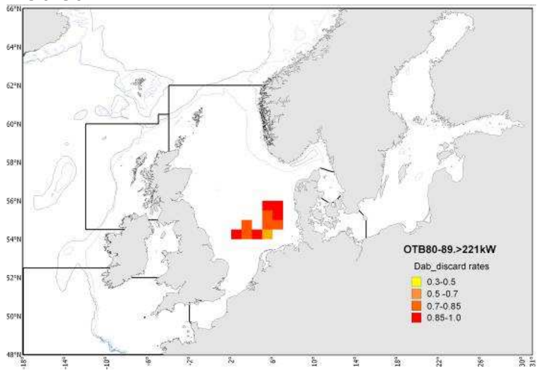
TBB.80-89.>221kW



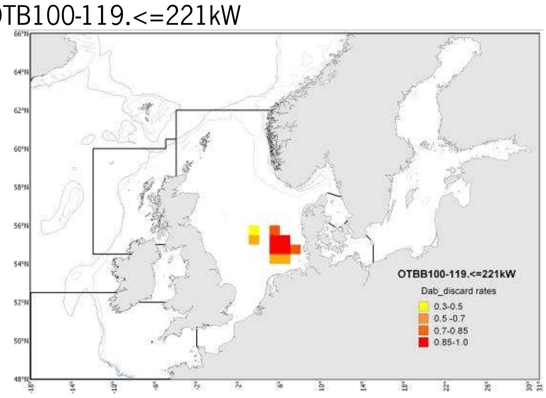
OTB80-89.<=221kW



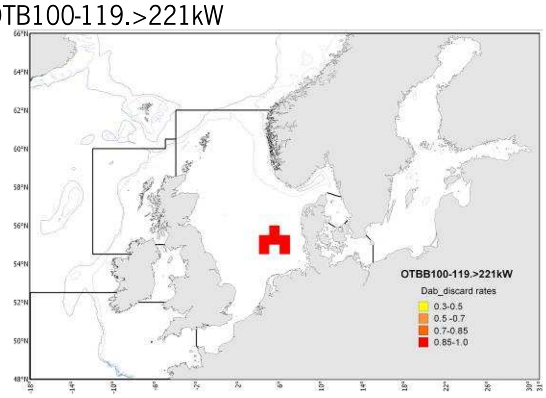
OTB80-89.>221kW



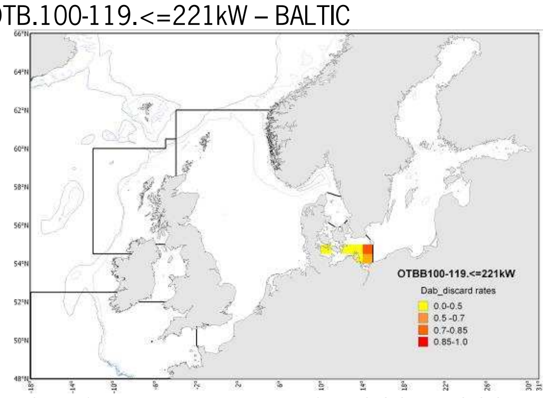
OTB100-119.<=221kW



OTB100-119.>221kW



OTB.100-119.<=221kW – BALTIC



Scale for lowest class changed from 0.3-0.5 to 0.0-0.5.

Figure 3.5.10 – Distribution of dab discards in the North Sea and the Baltic by métier.

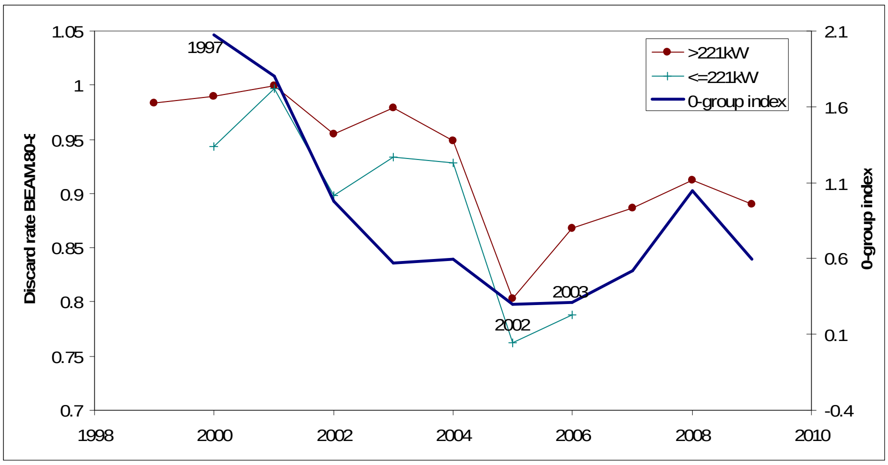


Figure 3.5.11 - Trend for discard rates for beam trawlers in the North Sea compared to 0-group index shifted for three years. Corresponding year classes 1997, 2002 and 2003 indicated.

Table 3.5.6: Comparison of discard rates between the North Sea and the Baltic. Original data from App3.5.1 and App3.5.2.

Metier	Vessel power	Year	Discard rate North Sea	Discard rate Baltic (IIIc22,d24)
OTTER100-119	<=221kW	2002	0.78	
OTTER100-119	<=221kW	2003	0.99	
OTTER100-119	<=221kW	2004	0.62	
OTTER100-119	<=221kW	2005		0.2
OTTER100-119	<=221kW	2006		0.12
OTTER100-119	<=221kW	2007	0.77	0.09
OTTER100-119	<=221kW	2008		0.14
OTTER100-119	>221kW	2003	0.92	
OTTER100-119	>221kW	2006	0.90	0.33
OTTER100-119	>221kW	2007		0.17
OTTER>=120	<=221kW	2003	0.84	
OTTER>=120	<=221kW	2004	0.31	
OTTER>=120	<=221kW	2005		0.13
OTTER>=120	<=221kW	2007		0.33
OTTER>=120	<=221kW	2008	0.08	

3.5.3 Length distributions in catch and discards

Major differences appear between the North Sea and the Baltic (here: IIIc22 and d24) (Table 3.5.7). North Sea catches mainly comprise small-sized dab, which is mostly discarded. Thus, mean length in discards and mean length in total catch are fairly equal.

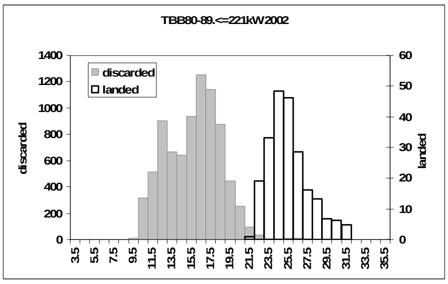
Within the North Sea, differences appear with regard to mesh size, métier and vessel power. Beam trawl catches from vessel category <=221kW were on average larger in size than catches from vessel category > 221kW. This difference can rather be attributed to larger length in discards whereas lengths in landings were slightly smaller. However, discards outnumber landings (Figure 3.5.12), so that the mean length in the total catch is driven by discard length.

It appears, that for the selected fleet segment BEAM.80-89.<=221kW little inter-annual variation in length composition is detected (Figure 3.5.12), in particular for the discarded fraction of the catch. This is in correspondence with relatively constant mean lengths in survey catches (Chapter 2.4). Year-to-year variability appears for the landed fraction, when under certain yet unknown conditions also dab < 20 cm is landed.

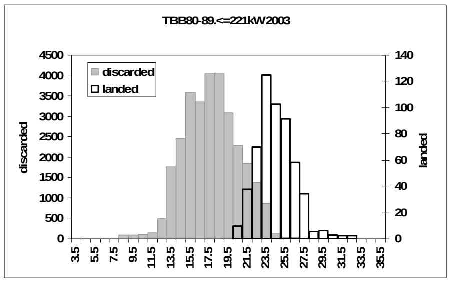
The differences in mean catch lengths between Baltic and North Sea for the same métier are further reflected by differences in the length composition (Figure 3.5.13). As shown for OTB.100-119.<=221kW, the discarded fraction comprises larger specimens in the Baltic than in the North Sea, and a larger fraction of the catch is retained onboard.

Table 3.5.7 - Mean length for dab in discards and landings and in total catch

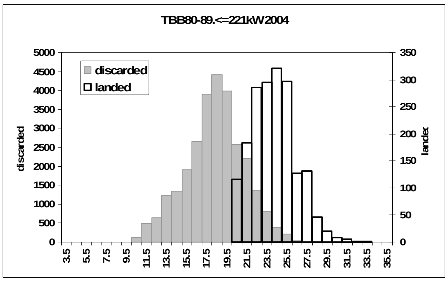
Metier/Region	Year	Mean length – discarded (TL cm)	Mean length – landed (TL cm	Mean length – catch (TL cm)
TBB.80-89.>221kW				
North Sea	2003	17.00	25.67	17.26
	2004	16.66	27.31	16.67
	2005	17.22	25.08	17.83
	2006	16.46	24.89	16.84
	2007	16.92	24.26	17.24
	2008	17.31	25.11	17.56
	2009	18.46	26.24	18.78
TBB.80-89.<=221kW				
North Sea	2002	15.76	25.56	16.02
	2003	17.76	24.49	17.88
	2004	18.32	24.22	18.68
	2005	17.97	23.26	18.65
	2006	18.29	25.57	18.93
OTTER.100-119.<=221kW				
North Sea	2002	18.82	25.98	19.47
	2004	18.62	26.09	18.96
	2007	18.92	26.20	19.81
Baltic Sea	2005	22.78	26.19	25.33
IIIc22, d24	2006	22.26	27.03	25.76
	2007	24.18	24.50	24.38
	2008	19.56	25.60	24.07



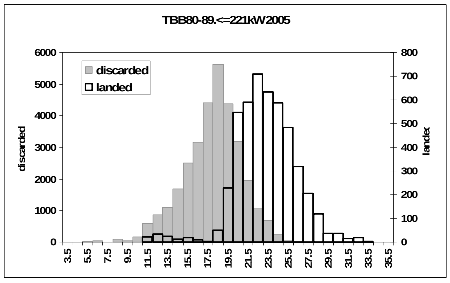
2002



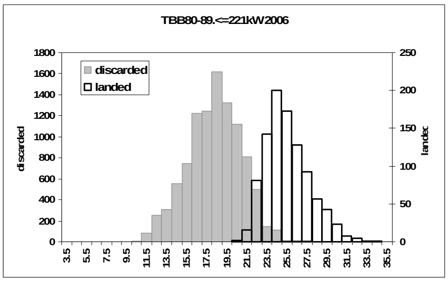
2003



2004



2005



2006

Figure 3.5.12 - Inter-annual variability of length composition in dab catches for one selected métier, BEAM.80-89.<=221kW. In 2002 and 2003, there are indications of incoming cohorts at age1 (~11.5 cm) and likely age 2 (~15.5 cm) from year class 2001, whereas no further recruitment sign from year classes 2002 to 2005 can be identified (see also Fig. 3.5.11).

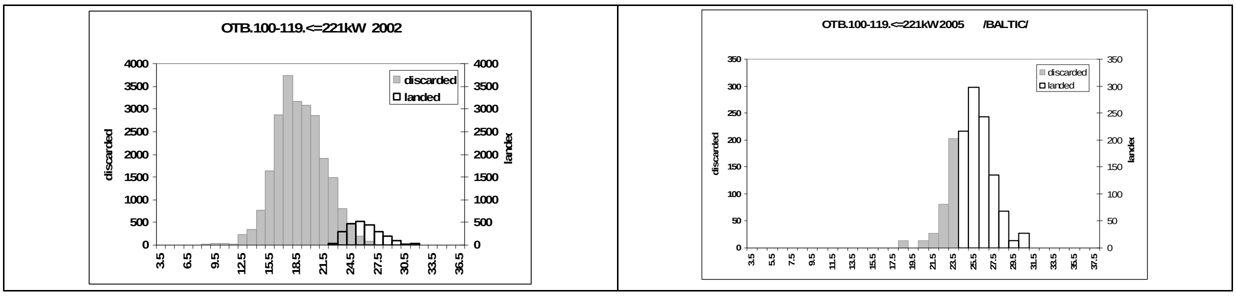


Figure 3.5.13 - Comparison of the dab catch composition in fleet segment OTB100-119.<=221kW between North Sea in 2002 (left) and Baltic in 2006 (right panel).

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3.6 ILVO: Time series for turbot and brill in several areas[14]

International landing series from the Skagerrak, the English Channel, the Celtic and Irish Seas were updated for both species (sources: EUROSTAT and several national databases) and can be consulted in Tables 3.6.1 – 3.6.8 and Figures 3.6.1 – 3.6.8. An analysis of time series of landings and data from on board sampling provided information on length-distributions, but not much on age-distributions, of landings and discards of turbot and brill. Tables 3.6.9 and 3.6.10 and Figures 3.6.9 and 3.6.10 give the length-distribution of landings and discards as recorded on observer trips in the Irish Sea, the Celtic Sea (only VIIf and VIIg) and the English Channel by ILVO during 2007-2008, for turbot and brill respectively.

Table 3.6.1 – International landings of turbot in the Skagerrak IIIa (in tonnes).

	Belgium	Denmark	Germany (+ ex-GDR)	Netherlands	Sweden	United Kingdom	Norway	TOT
1973	0	98	2	0	0	0	0	100
1974	0	116	1	0	0	0	0	117
1975	0	167	2	7	7	0	0	183
1976	7	178	2	190	6	0	0	383
1977	7	331	4	389	5	0	0	736
1978	2	327	4	186	6	0	0	525
1979	8	307	0	87	4	0	0	406
1980	7	205	0	14	6	1	0	233
1981	2	183	0	12	8	2	0	207
1982	1	164	0	9	7	1	0	182
1983	4	171	0	24	10	0	0	209
1984	0	176	0	0	12	0	0	188
1985	1	224	0	0	16	0	0	241
1986	2	180	0	0	11	0	0	193
1987	5	147	0	0	9	0	0	161
1988	2	115	0	11	10	0	0	138
1989	2	173	0	0	9	0	0	184
1990	5	363	0	0	18	0	0	386
1991	4	244	0	0	21	0	7	276
1992	4	278	0	0	19	0	8	309
1993	3	336	2	0	0	0	10	351
1994	2	313	1	0	22	0	15	353
1995	4	268	1	0	11	0	17	301
1996	0	185	1	0	11	0	13	210
1997	0	200	0	0	11	0	9	220
1998	0	148	1	0	8	0	7	164
1999	0	139	1	0	6	0	10	156
2000	0	180	1	0	6	0	6	193
2001	0	227	0	0	3	0	8	238
2002	0	205	1	0	5	0	11	222
2003	0	128	0	13	4	0	14	159
2004	0	119	0	14	7	0	7	147
2005	0	108	0	7	6	0	6	127
2006	0	95	1	8	9	0	8	121
2007	0	138	1	15	12	0	7	173
2008	0	121	1	4	11	0	6	143

[14] Author: Kelle Moreau

Table 3.6.2 – International landings of turbot in the Channel VIIde (in tonnes).

	Belgium	Denmark	Ireland	France	Netherlands	UK	TOT
1973	8	0	0	0	0	50	58
1974	12	0	0	122	1	52	187
1975	8	0	0	217	0	59	284
1976	14	0	0	288	0	86	388
1977	15	1	0	331	0	91	438
1978	16	60	0	405	0	137	618
1979	19	1	0	316	0	125	461
1980	18	1	1	269	0	103	392
1981	28	0	0	325	0	97	450
1982	31	0	0	234	2	123	390
1983	37	0	0	397	0	175	609
1984	43	0	0	381	0	151	575
1985	31	0	0	372	0	144	547
1986	35	0	0	289	0	128	452
1987	37	0	0	356	0	118	511
1988	46	0	0	421	0	131	598
1989	49	0	0	517	0	104	670
1990	65	0	0	452	0	136	653
1991	74	0	0	567	0	85	726
1992	60	0	0	445	0	114	619
1993	50	0	0	493	0	139	682
1994	55	0	0	361	0	170	586
1995	54	1	1	356	0	174	585
1996	45	0	0	269	0	176	490
1997	40	0	0	195	0	127	362
1998	22	0	0	234	0	98	354
1999	40	0	0	0	2	73	115
2000	54	1	1	274	4	112	445
2001	62	0	0	265	12	142	481
2002	72	0	0	303	1	167	543
2003	95	1	1	354	2	136	588
2004	76	2	2	363	2	163	606
2005	64	1	1	390	5	154	614
2006	100	0	0	338	3	125	566
2007	125	0	0	347	1	144	617
2008	98	0	0	255	3	164	520

Table 3.6.3 – International landings of turbot in the Celtic Sea VIIfgh (in tonnes).

	Belgium	Denmark	Ireland	Spain	France	Netherlands	UK	TOT
1973	19	0	0	0	0	0	38	57
1974	22	0	0	0	52	0	22	96
1975	21	0	0	0	27	0	27	75
1976	9	0	0	0	47	0	19	75
1977	6	0	0	0	33	0	19	58
1978	6	0	0	0	41	0	27	74
1979	8	0	0	0	38	0	41	87
1980	16	0	0	0	32	0	29	77
1981	15	0	0	0	27	0	28	70
1982	13	0	0	0	26	0	31	70
1983	23	0	0	0	16	2	27	68
1984	15	0	0	0	8	0	38	61
1985	27	0	0	0	192	0	40	259
1986	32	4	0	0	207	0	55	298
1987	22	0	5	0	177	0	144	348
1988	26	35	6	0	187	0	190	444
1989	32	7	6	0	203	0	71	319
1990	20	8	25	0	196	0	66	315
1991	38	24	18	0	145	0	65	290
1992	15	10	26	0	126	0	98	275
1993	14	16	41	0	113	0	165	349
1994	21	0	20	0	87	0	288	416
1995	22	5	19	0	116	0	237	399
1996	19	0	16	2	153	1	210	401
1997	18	0	20	3	151	0	228	420
1998	19	0	18	2	110	1	142	292
1999	55	0	44	2	0	0	112	213
2000	69	0	54	1	166	0	106	396
2001	69	0	53	0	175	0	97	394
2002	71	0	65	1	147	0	244	528
2003	106	0	89	5	125	0	121	446
2004	94	0	99	0	148	0	120	461
2005	82	0	82	5	117	0	100	386
2006	82	0	70	1	109	0	95	357
2007	72	0	50	1	106	0	89	318
2008	53	0	51	1	72	0	89	266

Table 3.6.4 – International landings of turbot in the Irish Sea VIIa (in tonnes).

	Belgium	Denmark	Ireland	France	Netherlands	UK	TOT
1973	14	0	33	0	2	76	125
1974	15	0	32	7	3	70	127
1975	13	0	27	11	6	63	120
1976	8	0	45	3	6	48	110
1977	6	0	36	27	2	43	114
1978	8	0	50	18	2	35	113
1979	5	0	57	17	4	33	116
1980	4	0	60	6	5	27	102
1981	7	0	57	7	4	21	96
1982	8	0	55	3	4	23	93
1983	30	0	58	2	2	25	117
1984	10	77	67	5	0	32	191
1985	23	0	62	8	0	47	140
1986	33	0	88	10	0	46	177
1987	37	0	136	6	0	94	273
1988	16	0	182	6	0	81	285
1989	10	0	68	3	0	75	156
1990	20	0	47	6	0	57	130
1991	12	0	25	5	0	49	91
1992	16	0	43	5	0	48	112
1993	13	0	52	3	0	95	163
1994	25	0	55	2	0	52	134
1995	24	0	58	2	0	38	122
1996	27	0	38	2	3	37	107
1997	32	0	69	1	8	39	149
1998	31	0	59	1	3	53	147
1999	30	0	22	0	2	58	112
2000	22	0	33	3	3	45	106
2001	35	0	19	0	0	52	106
2002	50	0	21	0	0	61	132
2003	43	0	31	1	0	133	208
2004	28	0	22	0	0	50	100
2005	54	0	16	3	0	32	105
2006	35	0	19	1	0	30	85
2007	31	0	17	1	0	31	80
2008	19	0	10	0	0	23	52

Table 3.6.5 – International landings of brill in the Skagerrak IIIa (in tonnes).

	Belgium	Denmark	Germany	Netherlands	Sweden	Norway	TOT
1973	0	131	3	0	0	0	134
1974	0	200	2	0	0	0	202
1975	0	167	2	1	19	0	189
1976	1	185	3	26	12	0	227
1977	1	276	1	99	12	0	389
1978	0	178	2	27	11	0	218
1979	0	156	0	17	11	0	184
1980	2	69	0	1	10	0	82
1981	0	54	0	0	5	0	59
1982	1	64	0	1	8	0	74
1983	0	73	0	3	7	0	83
1984	0	89	0	0	8	0	97
1985	0	100	0	0	9	0	109
1986	0	94	0	0	12	0	106
1987	0	93	0	0	10	0	103
1988	0	91	0	0	10	0	101
1989	0	88	0	0	9	0	97
1990	1	116	0	0	10	0	127
1991	1	81	0	0	10	7	99
1992	1	123	0	0	15	7	146
1993	2	184	0	0	16	10	212
1994	0	191	0	0	17	12	220
1995	0	124	1	0	13	13	151
1996	0	94	0	0	5	12	111
1997	0	83	1	0	11	11	106
1998	0	108	1	0	13	10	132
1999	0	126	1	0	17	13	157
2000	0	112	2	0	16	12	142
2001	0	73	0	0	12	13	98
2002	0	66	0	0	11	12	89
2003	0	99	1	1	16	12	129
2004	0	119	1	4	17	15	156
2005	0	101	0	3	13	16	133
2006	0	105	1	3	14	16	139
2007	0	119	1	3	22	15	160
2008	0	138	2	1	28	13	182

Table 3.6.6 – International landings of brill in the Channel VIIde (in tonnes).

	Belgium	Denmark	Ireland	France	Netherlands	UK	TOTAL
1973	20	0	0	130	0	70	220
1974	25	0	0	0	0	56	81
1975	24	0	0	55	0	58	137
1976	41	0	0	170	0	74	285
1977	45	0	0	197	0	81	323
1978	58	3	0	227	0	123	411
1979	55	0	0	262	0	142	459
1980	64	2	3	213	0	120	402
1981	83	0	0	271	0	136	490
1982	105	0	0	225	1	156	487
1983	107	0	0	234	1	184	526
1984	114	0	0	226	0	191	531
1985	103	0	0	213	0	213	529
1986	123	0	0	183	0	183	489
1987	131	0	0	216	0	216	563
1988	121	0	0	202	0	202	525
1989	97	0	0	213	0	213	523
1990	104	0	0	249	0	249	602
1991	84	0	0	249	0	249	582
1992	86	0	0	223	0	223	532
1993	80	0	0	256	0	256	592
1994	91	0	0	227	0	227	545
1995	95	0	1	248	0	248	592
1996	107	0	0	240	0	240	587
1997	109	0	1	185	0	185	480
1998	74	0	0	196	2	198	470
1999	97	0	0	0	3	3	103
2000	166	0	1	260	4	264	695
2001	217	0	0	256	2	258	733
2002	213	0	0	268	1	269	751
2003	231	0	1	287	1	288	808
2004	180	0	1	259	3	262	705
2005	153	0	0	267	2	269	691
2006	203	0	0	281	3	284	771
2007	242	0	0	325	1	326	894
2008	177	0	0	225	2	227	631

Table 3.6.7 – International landings of brill in the Celtic Sea VIIfgh (in tonnes).

	Belgium	Ireland	France	Netherlands	UK	TOT
1973	20	0	0	0	15	35
1974	21	0	0	0	14	35
1975	23	0	4	0	17	44
1976	32	0	46	0	14	92
1977	95	0	127	0	13	235
1978	17	0	26	0	16	59
1979	18	1	35	0	20	74
1980	43	0	87	0	25	155
1981	17	0	14	0	29	60
1982	22	0	19	0	26	67
1983	35	0	22	2	25	84
1984	20	0	10	0	28	58
1985	33	0	54	0	29	116
1986	40	0	56	0	34	130
1987	34	3	62	0	82	181
1988	33	4	68	0	66	171
1989	35	7	59	0	38	139
1990	21	13	48	0	70	152
1991	24	15	52	0	68	159
1992	15	26	61	0	53	155
1993	14	11	59	0	59	143
1994	23	7	56	0	123	209
1995	26	9	47	0	187	269
1996	30	8	57	1	149	245
1997	21	20	59	0	156	256
1998	27	17	56	0	82	182
1999	64	20	0	0	54	138
2000	55	22	78	0	56	211
2001	52	28	86	0	74	240
2002	53	24	81	0	78	236
2003	75	34	77	0	51	237
2004	78	47	85	0	48	258
2005	74	46	83	0	36	239
2006	66	38	88	0	37	229
2007	70	26	84	0	41	221
2008	59	21	54	0	31	165

Table 3.6.8 – International landings of brill in the Irish Sea VIIa (in tonnes).

	Belgium	Ireland	France	Netherlands	Poland	UK	TOT
1973	24	20	10	2	0	78	134
1974	22	21	0	4	0	53	100
1975	23	20	0	6	0	68	117
1976	11	22	1	4	0	56	94
1977	17	21	2	7	0	74	121
1978	14	25	5	6	0	63	113
1979	20	31	8	5	0	77	141
1980	15	28	4	9	0	81	137
1981	13	33	5	3	0	54	108
1982	10	35	2	1	0	49	97
1983	35	40	2	2	0	60	139
1984	20	49	3	0	0	78	150
1985	31	58	4	0	0	147	240
1986	41	55	4	0	0	148	248
1987	39	51	4	0	0	160	254
1988	18	143	3	0	0	84	248
1989	13	29	2	0	0	80	124
1990	31	24	2	0	0	84	141
1991	21	25	3	0	0	94	143
1992	27	50	3	0	0	96	176
1993	11	21	2	0	0	85	119
1994	31	26	1	0	0	75	133
1995	28	29	1	0	0	76	134
1996	34	17	1	4	4	68	128
1997	48	34	0	7	7	67	163
1998	40	32	0	2	2	79	155
1999	41	19	0	1	1	72	134
2000	30	31	1	3	3	41	109
2001	43	28	0	0	0	48	119
2002	43	15	0	0	0	49	107
2003	36	20	0	0	0	75	131
2004	31	15	0	0	0	41	87
2005	55	13	1	0	0	33	102
2006	35	12	0	0	0	32	79
2007	32	12	0	0	0	33	77
2008	26	9	0	0	0	36	71

Table 3.6.9 – Length-distribution of landings and discards of turbot as recorded on observer trips in the Irish Sea, the Celtic Sea (only VIIf and VIIg) and the Channel by ILVO during 2007-2008.

	Discards No @ length			Subtot	Landings No @ length				Subtot	Total
Length	VIIa	VIId	VIIf	disc	VIIa	VIId	VIIf	VIIg	land	catch No
210	2			2						2
220	3			3						3
230	3			3						3
240	3			3						3
250	10			10						10
260	10			10						10
270	10		1	11						11
280	17		1	18						18
290	28	1	1	30		1			1	31
300	6			6	73	12	1		86	92
310					94	21	1		116	116
320					93	37	6		136	136
330					93	51	2		146	146
340					76	96	4		176	176
350					99	109	6	1	215	215
360					70	118	5	1	194	194
370					68	110	5	3	186	186
380					58	114	4	1	177	177
390					46	114	8	3	171	171
400					36	97	7	1	141	141
410					42	77	2	1	122	122
420					25	60	2	4	91	91
430					25	42	3		70	70
440					17	31	4	1	53	53
450					16	28	8	4	56	56
460					20	27	5	2	54	54
470					22	28	1	2	53	53
480					15	16	3	4	38	38
490					12	15	3	1	31	31
500					16	16	2		34	34
510					11	14	1	2	28	28
520					21	13		1	35	35
530					10	7	2	1	20	20
540					6	10			16	16
550					8	7	2		17	17
560					5	4			9	9
570					8		2	1	11	11
580					2	1		1	4	4

590					3		1	1	5	5
600					2	1	1		4	4
610					2	1			3	3
620					1				1	1
630							1		1	1
640					2				2	2
650					1				1	1
660						1			1	1
680					1				1	1
700					1				1	1
710					1	1			2	2
720					1				1	1
Total No	92	1	3	96	1102	1280	92	36	2510	2606

Table 3.6.10 – Length-distribution of landings and discards of brill as recorded on observer trips in the Irish Sea, the Celtic Sea (only VIIf and VIIg) and the Channel by ILVO during 2007-2008.

Length	Discards No @ length			Subtot	Landings No @ length					Subtot	Total
	VIIa	VIId	VIIf	disc	VIIa	VIId	VIIe	VIIf	VIIg	land	catch No
220	1			1							1
230	4			4							4
240	12	1		13	1					1	14
250	16			16	3					3	19
260	25		1	26	2					2	28
270	26		1	27	2					2	29
280	34	2	2	38	3	3				6	44
290	32	1	2	35	18	9				27	62
300	13			13	64	51		5		120	133
310					71	79		5		155	155
320					68	116		12	1	197	197
330					57	125	1	19	1	203	203
340					54	133		15	3	205	205
350					65	130	3	23	1	222	222
360	1			1	50	136	2	16	3	207	208
370					37	133		16	1	187	187
380					48	111	2	19	2	182	182
390					47	94	1	14	2	158	158
400					52	80	2	15	5	154	154
410					57	68	2	17	4	148	148
420					39	81	1	20	4	145	145
430					28	66	1	14	5	114	114
440					32	55	2	14	5	108	108
450					29	68	3	14	4	118	118
460		1		1	33	44	3	9	1	90	91
470					27	46	4	10	4	91	91
480					21	33	3	9		66	66
490					14	31	2	6	2	55	55

500					19	21	2	6	4	52	52
510					13	15	1	6	3	38	38
520					10	9		5	2	26	26
530					9	5	1	2		17	17
540					7	13		5		25	25
550					7	3	1		1	12	12
560					1	2		3	1	7	7
570					5	2	2	1	1	11	11
580					4	1		2		7	7
590					3		1	3		7	7
600					4	3				7	7
610					1	2				3	3
620							1			1	1
630								1		1	1
640											
650											
660											
670											
680											
690							1			1	1
Total No	164	5	6	178	1005	1768	42	306	60	3181	3359

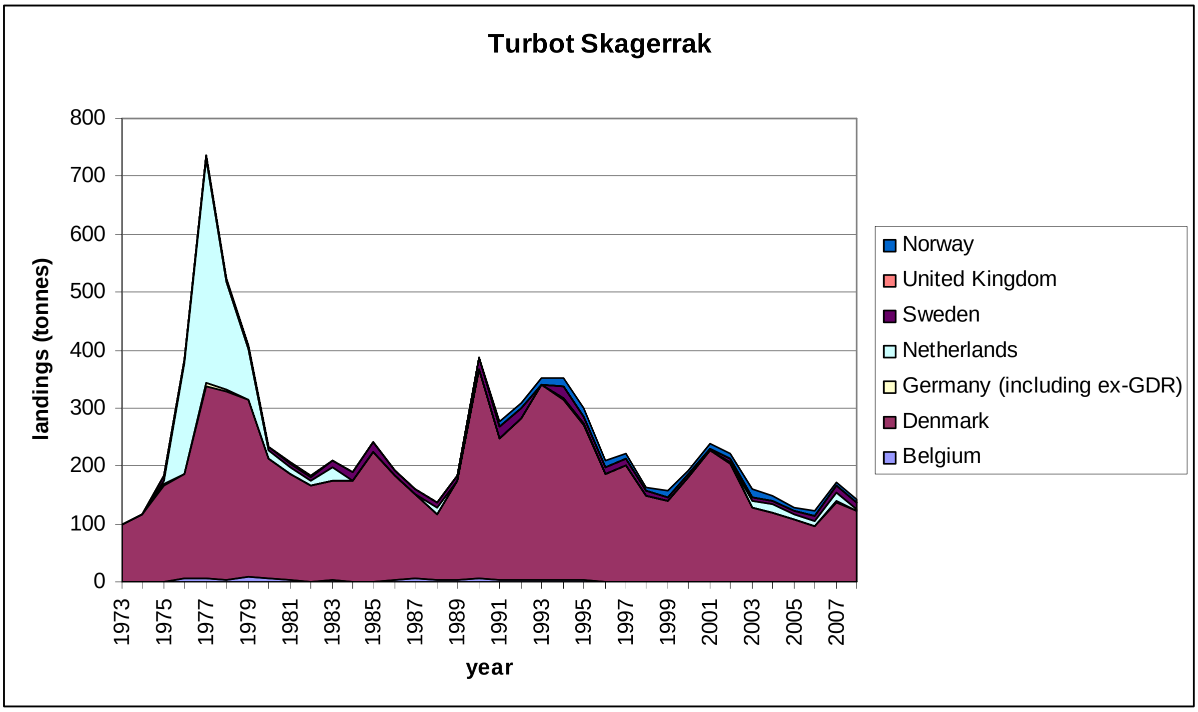


Figure 3.6.1 – International landings of turbot in the Skagerrak IIIa (in tonnes).

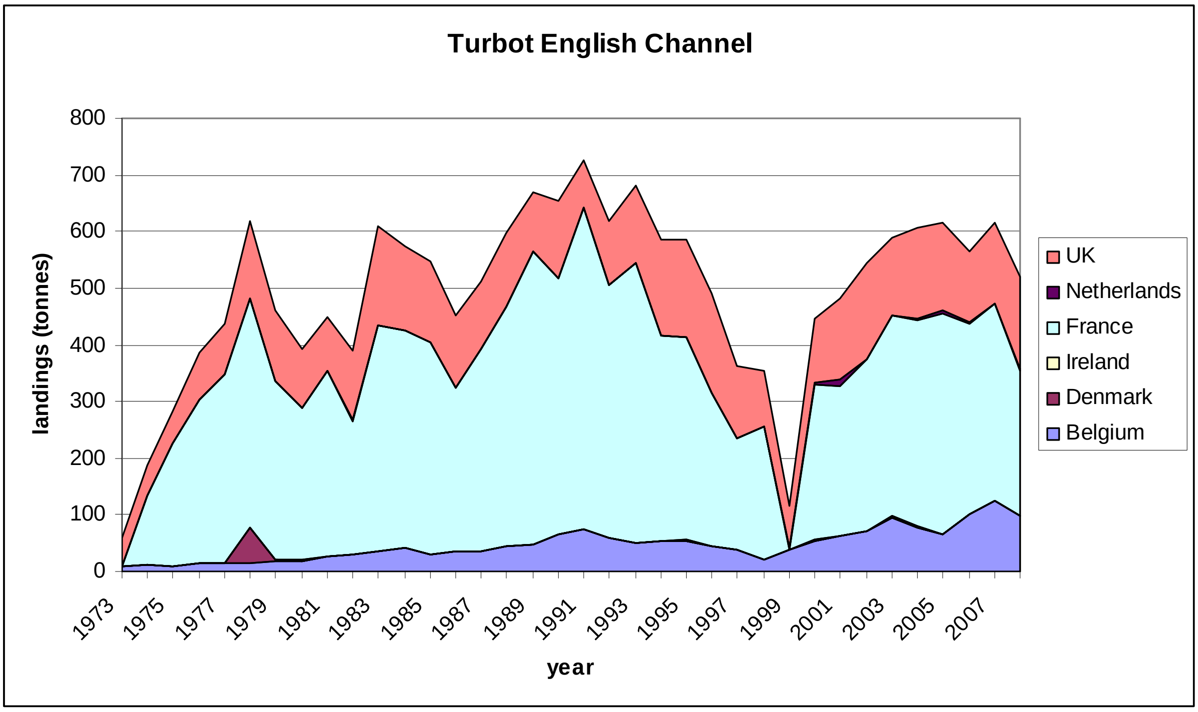


Figure 3.6.2 – International landings of turbot in the Channel VIIde (in tonnes). The steep drop in 2000 is mainly attributable to missing data.

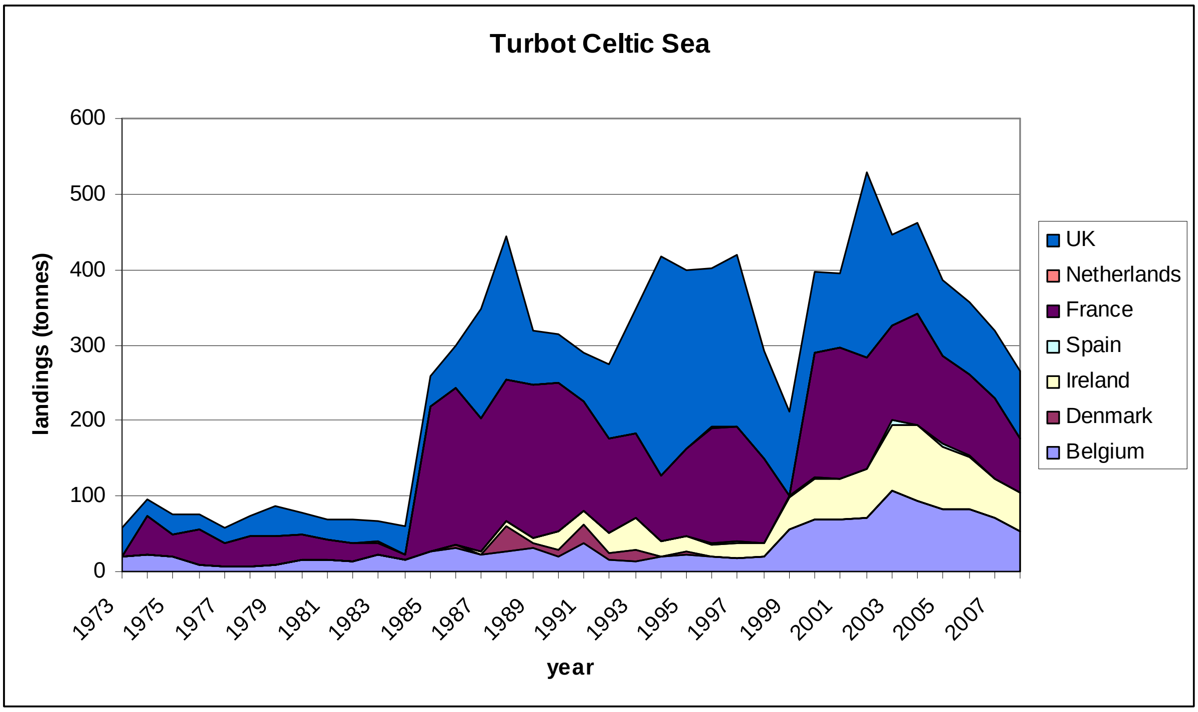


Figure 3.6.3 – International landings of turbot in the Celtic Sea VIIfgh (in tonnes).

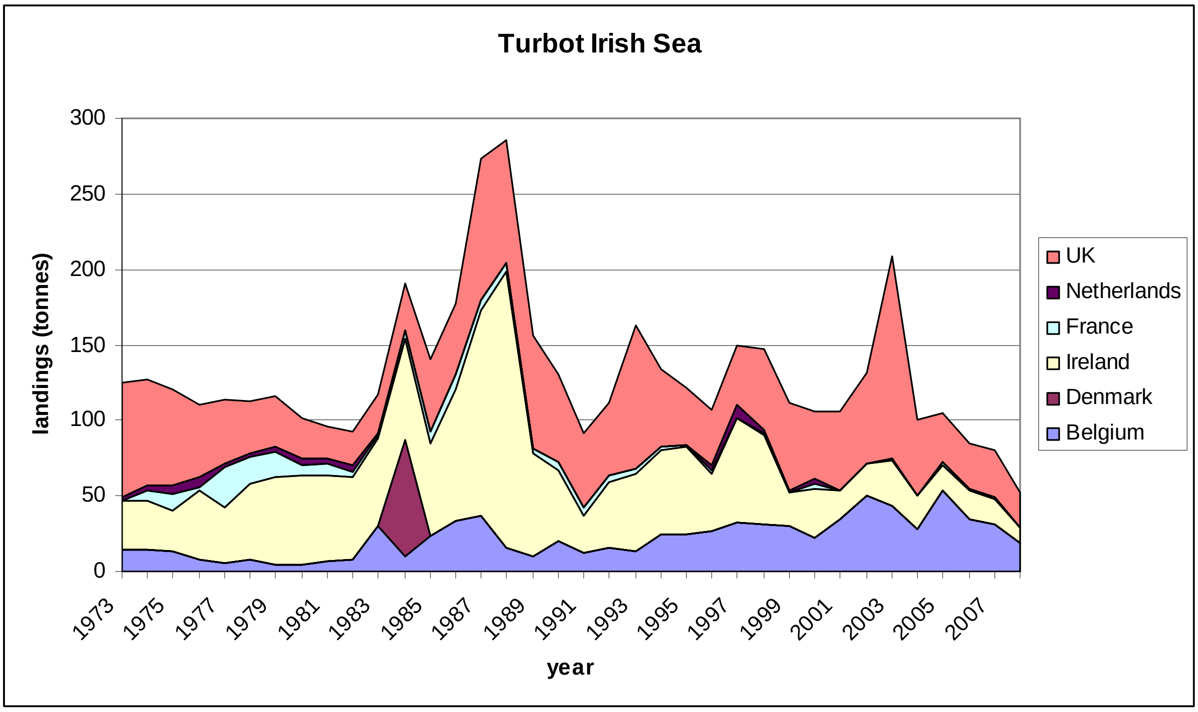


Figure 3.6.4 – International landings of turbot in the Irish Sea VIIa (in tonnes).

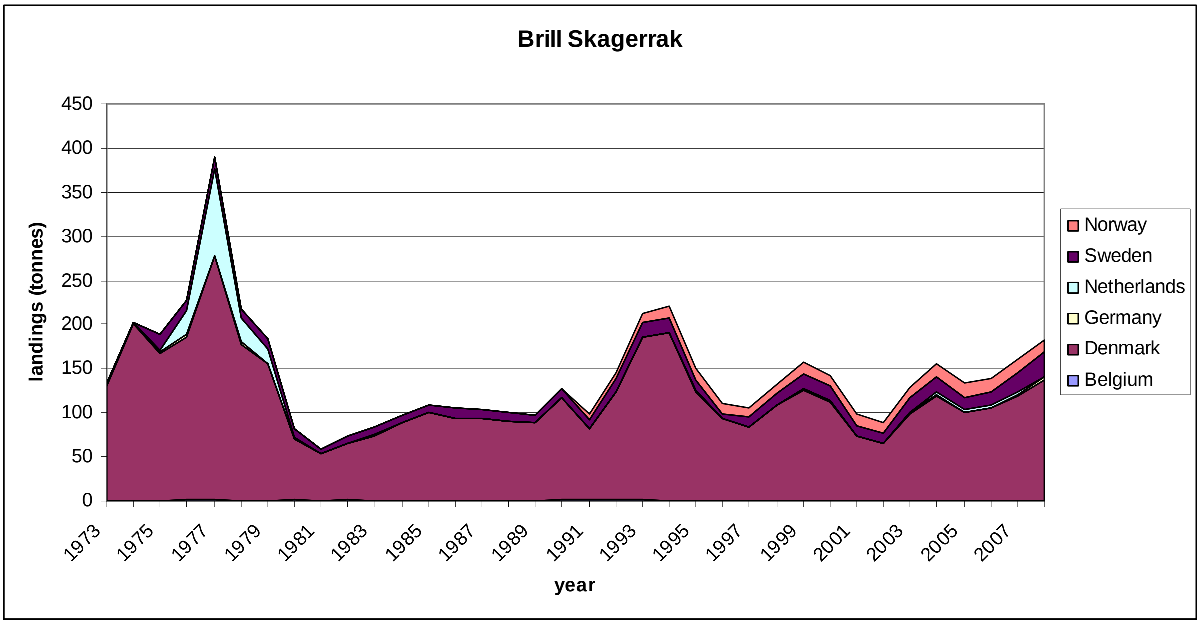


Figure 3.6.5 – International landings of brill in the Skagerrak IIIa (in tonnes).

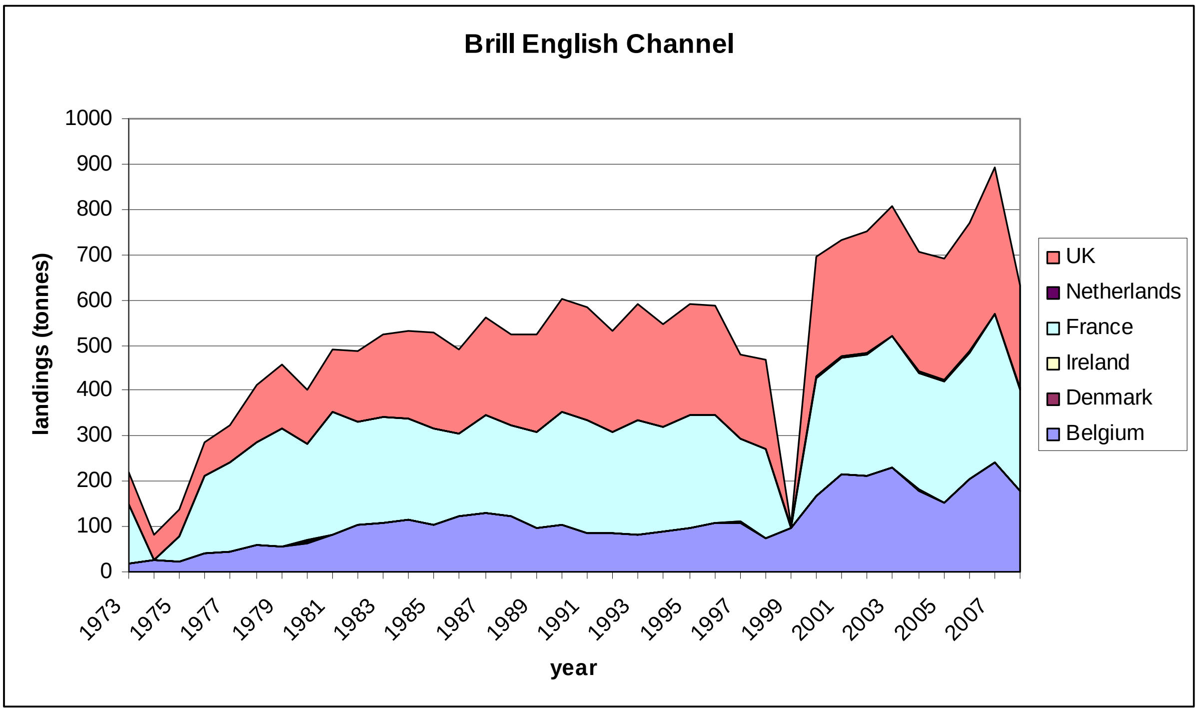


Figure 3.6.6 – International landings of brill in the Channel VIIde (in tonnes). The steep drop in 2000 is mainly attributable to missing data.

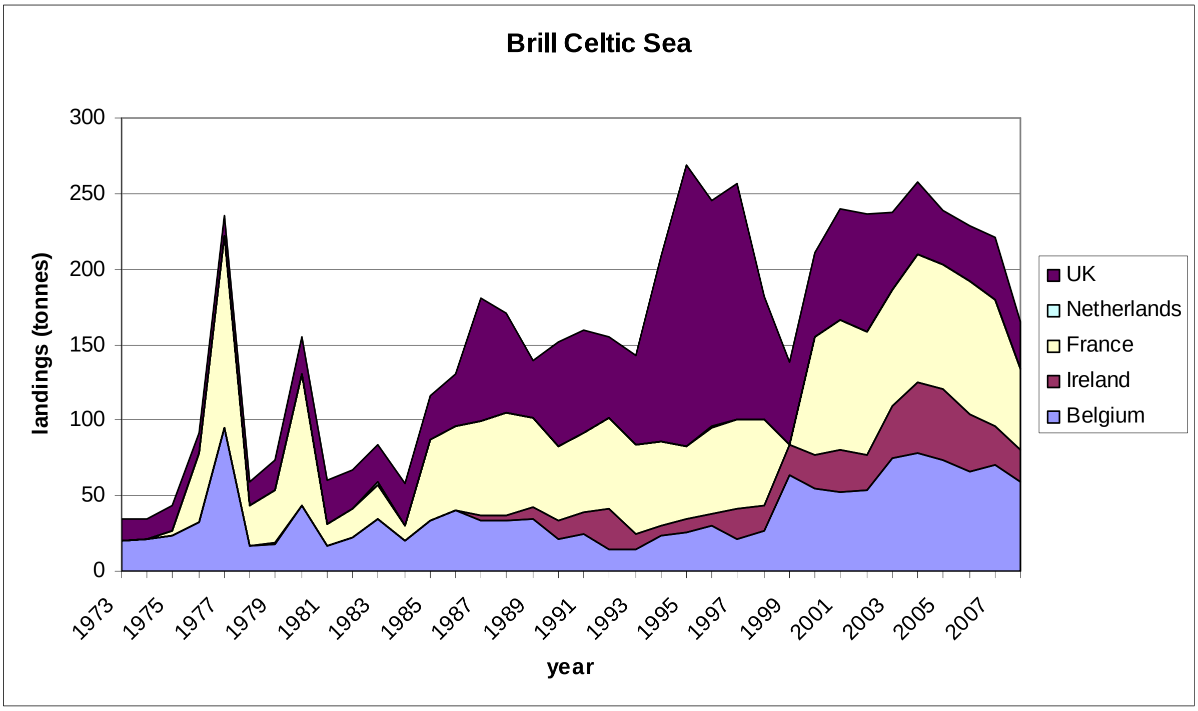


Figure 3.6.7 – International landings of brill in the Celtic Sea VIIfgh (in tonnes).

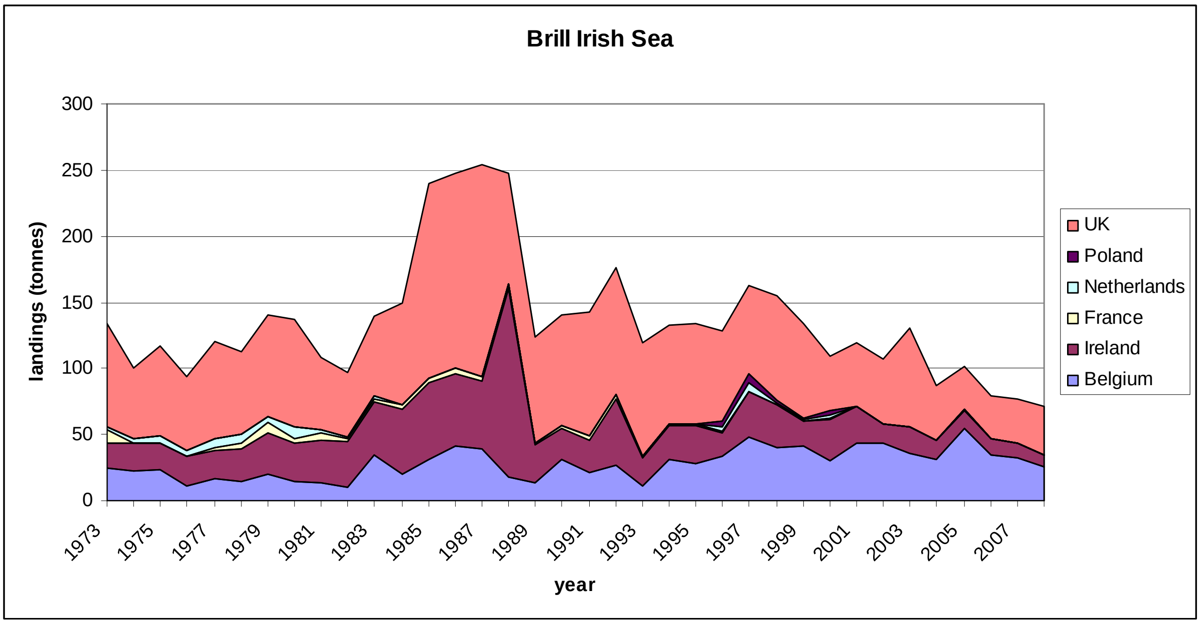


Figure 3.6.8 – International landings of brill in the Irish Sea VIIa (in tonnes).

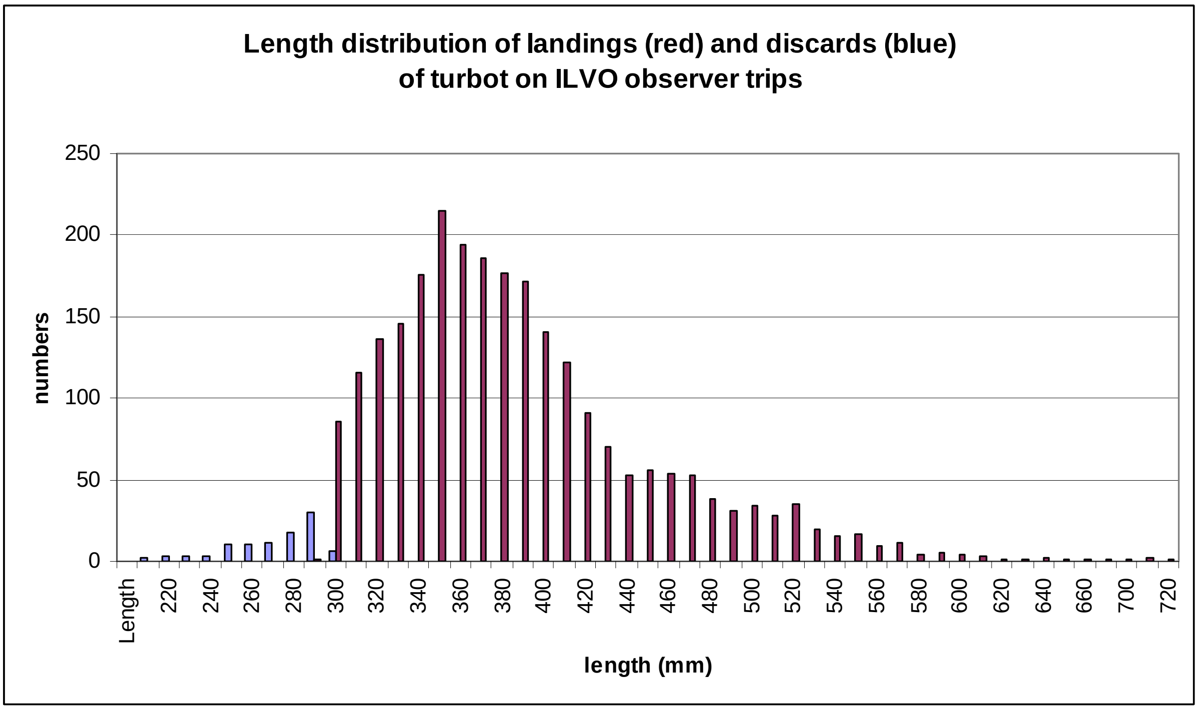


Figure 3.6.9 – Length-distribution of landings and discards of turbot as recorded on observer trips in the Irish Sea, the Celtic Sea (only VIIf and VIIg) and the English Channel by ILVO during 2007-2008.

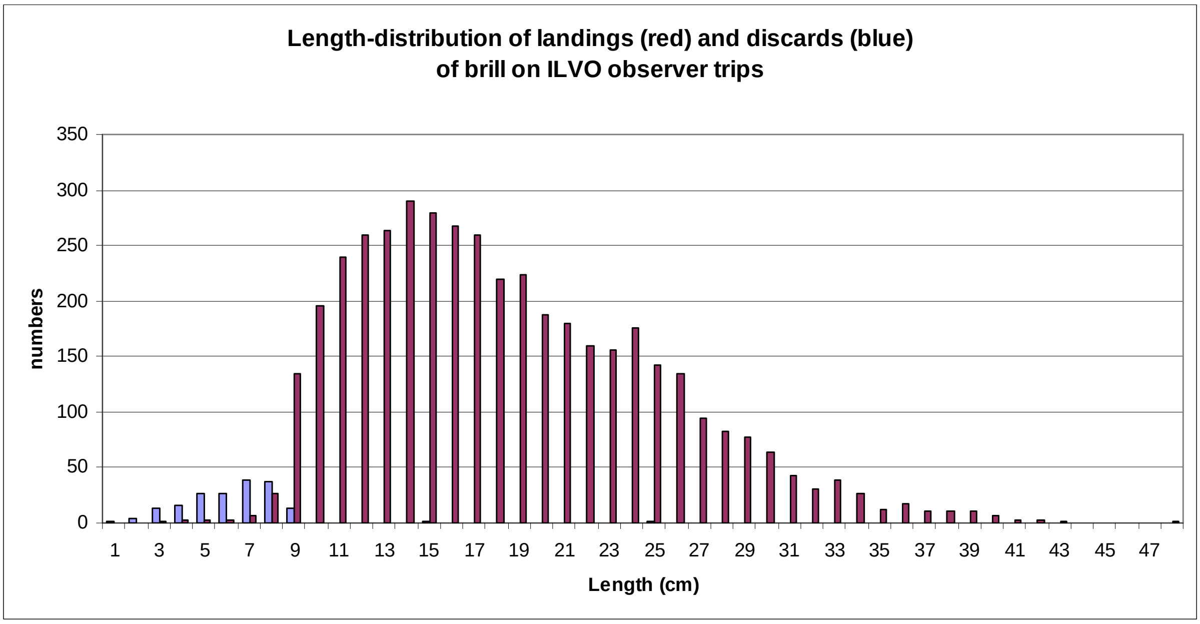


Figure 3.6.10 – Length-distribution of landings and discards of brill as recorded on observer trips in the Irish Sea, the Celtic Sea (only VIIf and VIIg) and the English Channel by ILVO during 2007-2008.

3.7 DTU-Aqua[15]

3.7.1 Small scale sampling for witch flounder

Length samples of landings of witch flounder have in recent years been taken occasionally. However, with the onset of the NESPMAN project regular sampling of the landings in the ports of Skagen and Hirtshals begun in the 4th quarter of 2009. The delay of the project start also created further delays of the sampling because of changes in local planning. Sampling has been stratified according to the three size categories of the landings. Otoliths have been collected from all samples, although not all otoliths have been read yet. In this analysis all samples collected until March 2010 have been used.

The samples have been obtained from by-catch landings both from shrimp fisheries and mixed demersal trawl fisheries. Further samples have been collected, but these have not yet been analysed. Until now all samples have been taken from IIIa landings. However, since the distribution of this species is continuous from Skagerrak into the eastern part of the North sea, the IIIa samples are assumed to also cover IVa.

Similar biological data on this species have been collected from IMR from the Swedish fisheries. The data from both countries are being analysed and the first results are given below

Analyses of length and weight data.
All fish in the Danish samples, by size category, are measured and individual weights recorded. The total size distribution has been estimated taking the magnitude of the landings by size category into account. The size distribution for 2009 is shown in Figure 3.7.1, which also gives the size distribution in the Swedish landings in 2009. In the same figure also the size distribution in Danish landings in 1981 is shown.

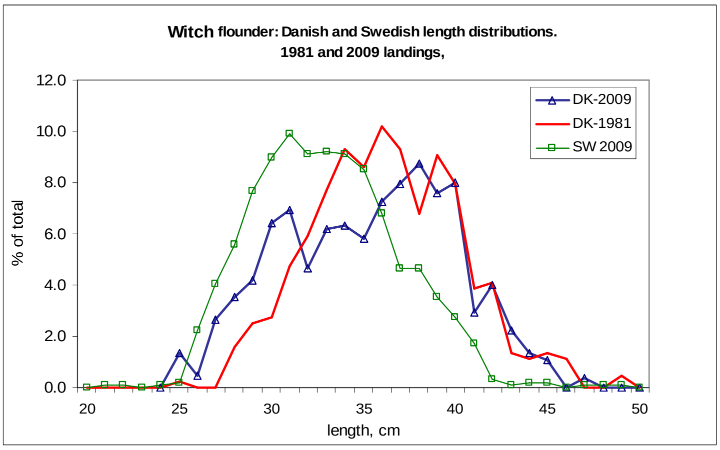


Figure 3.7.1 – Size distribution of the landings of witch flounder in Danish and Swedish landings in 2009 and in Danish landings in 1981.

Notice the difference between the 3 data sets. In 2009 the mean size in Swedish landings appears to be smaller than the Danish landings in 2009, and the 1981 data indicate greater mean size in that year than in 2009 (Table 3.7.1). In fact, statistically the three means are significantly different (t-test), but more data would probably be needed to make any firm conclusions on whether these differences are more than 'technical', reflecting local or annual variations.

Figure 3.7.2 shows the pooled Danish and Swedish data for 2009 together with the data from 1981.

15 Author: Sten Munch-Petersen

Table 3.7.1 - Mean lengths in landings of witch flounder.

	S 2009	DK 2009	DK 1981
Mean length, cm	33.0	35.3	36.3
St. dev.	3.797	4.643	4.003
N in sample	989	409	441

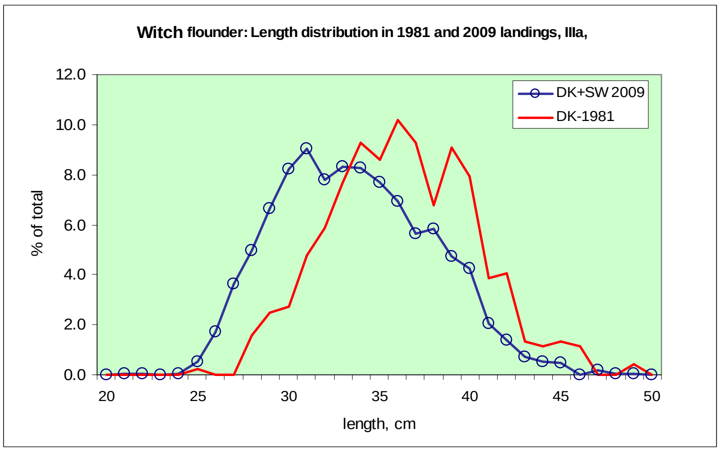


Figure 3.7.2 – The length distribution of witch flounder in 2009 for Danish and Swedish landings combined, compared with the Danish landings in 1981.

The length weight relationship.

Based on the Danish data, the parameters of the length-weight relationship were estimated (Table 3.7.2). Notice, the similarity of the estimates based on 2009 data with the estimates from the 1981 data. These parameters are also expected to vary according the for instance the maturity condition of the fish.

Table 3.7.2 – Parameters for the length-weight relationship of witch flounder based data collected in 1981 and in 2009.

		1981	2009
allometric	a	0.000003	0.0000016
	b	3.2457	3.41
isometric	q	0.000007	0.0000069

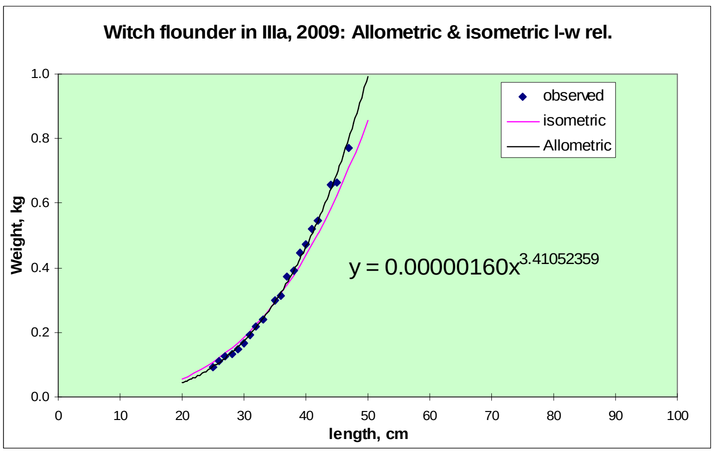


Figure 3.7.3 – Length-weight relationship for witch flounder.

3.7.2 The Danish fishery for witch flounder

The Danish witch flounder landings are taken in Skagerrak (IIIa) and in the Norwegian Deep (IVa East). At present, the majority of the landings are by-catches in mixed demersal trawl fisheries, see Figure 3.7.4 and Table 3.7.3.

Notice that in this connection ‘demersal trawl’ includes both Nephrops trawls and trawls for demersal fish. In IIIa these are defined as trawls with a mesh size > 70 mm in the cod-end, while in the North Sea the term covers trawls with mesh sizes > 90 mm in the cod-end. Witch flounder constitutes a stable by-catch component in the Danish shrimp fishery in Skagerrak (trawls with mesh size 35-45 mm). Some of the Danish seine landings of witch come from trips targeting this species. However, the number such trips has been declining in recent years.

The other species caught in the Danish fisheries taking witch flounder are mentioned in the section on the Swedish fisheries for this species (section 3.9).

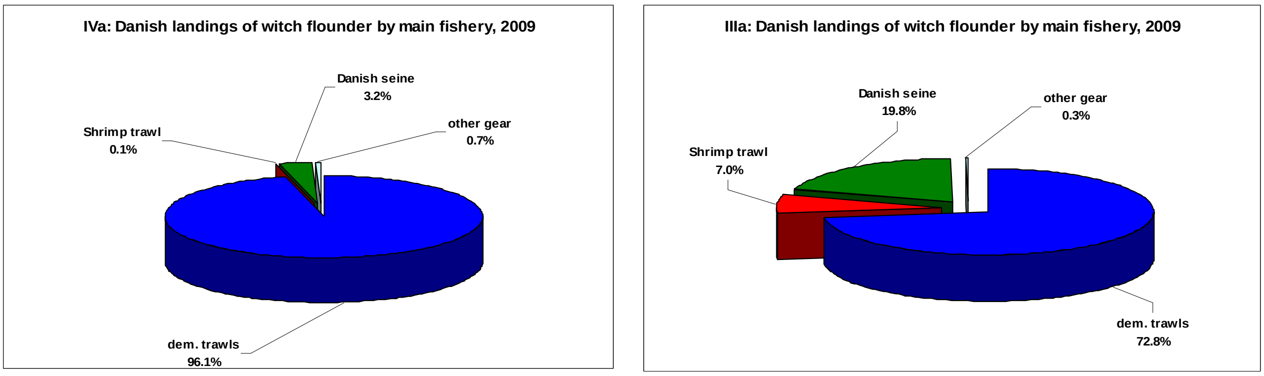


Figure 3.7.4 - Danish landings of witch flounder by gear type/fishery in 2009.

Table 3.7.3 - Composition by gear (%) of total Danish landings of witch flounder, 2002-2009.

		Year							
	Gear	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Skagerrak IIIa	dem. trawls	84.5	85.8	85.6	76.9	83.0	77.0	77.9	72.8
	Shrimp trawl	3.4	4.9	4.9	6.3	4.2	8.3	9.1	7.0
	Danish seine	11.7	8.9	9.2	16.7	12.7	14.5	13.0	19.8
	other gear	0.4	0.4	0.2	0.1	0.1	0.2	0.0	0.3
	Landings, in t	**1366**	**1037**	**1188**	**635**	**635**	**618**	**476**	**589**
	Gear	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
North Sea IVa	dem. trawls	89.6	91.6	92.1	90.9	93.1	96.5	96.8	96.1
	Shrimp trawl	0.7	0.8	1.0	0.3	0.1	0.1	0.1	0.1
	Danish seine	8.3	6.7	6.4	7.5	6.7	2.5	3.1	3.2
	other gear	1.4	1.0	0.5	1.3	0.1	0.8	0.1	0.7
	Landings, in t	**541**	**767**	**623**	**714**	**654**	**529**	**350**	**345**

3.8 IMR: Analysis of Swedish data for witch flounder[16]

The fisheries where witch flounder are caught, apart from the witch flounder directed fishery, are mainly the Pandalus, and demersal fish fisheries, i.e. fishing for demersal and benthic species. Here the fisheries were classified into métiers; the combination of a given fishing gear, targeting a species or species group in a given area (Mesnil & Shepherd, 1990; Laurec *et al.*, 1991; Salas & Gaertner, 2004). Logbook data from 1991-2008 were used to classify fishing trips into their respective métiers based on gear, mesh size and/ or landing compositions (Figure 3.8.1). N.B. Fishing trips classified as mixed trips are trips that have performed hauls that have taken place in two or more different métiers.

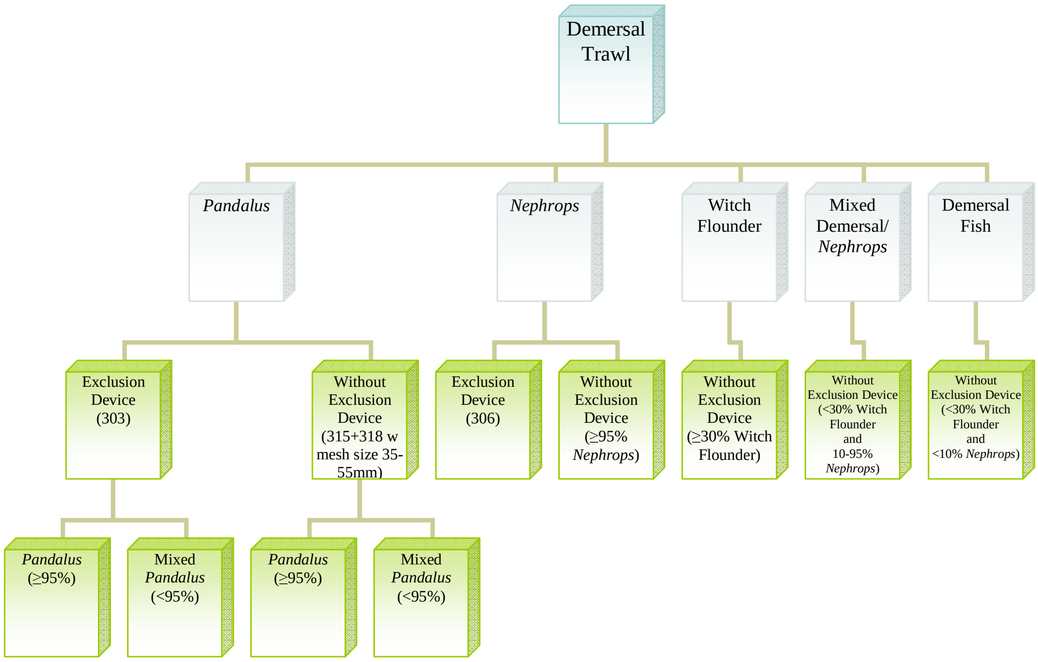


Figure 3.8.1 - Demersal fisheries classification pyramid.

The definition of the fisheries is not straightforward because the Swedish demersal fisheries on the west coast do not focus on a single target species. A tow containing 30% witch flounder may actually be considered as by-catch if the rest of the catch is, for example, cod, and this being the real target species. At the same time, a haul that is meant to capture witch flounder, can accidentally capture significant amounts of other species and is thus classified in the demersal fish fisheries.

Throughout the study period (1997-2008) approximately 98% of witch flounder landings occurred in the Skagerrak. Landings of witch flounder from all the fisheries in Sweden increased markedly until 2000, when it remained stable until 2005 and then declined significantly to 2008 (Figure 3.8.2). 2005 was the year when landings of witch flounder were at their peak of approximately 550 t. Landings since 2005 have fallen by more than 50%.

16 Author: Francesca Vitale and Jordan Feelings

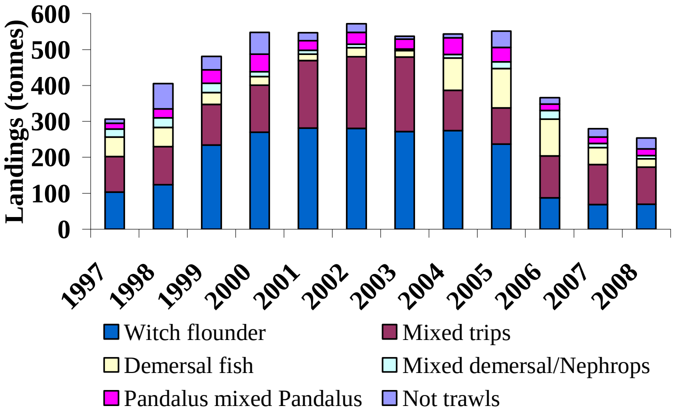
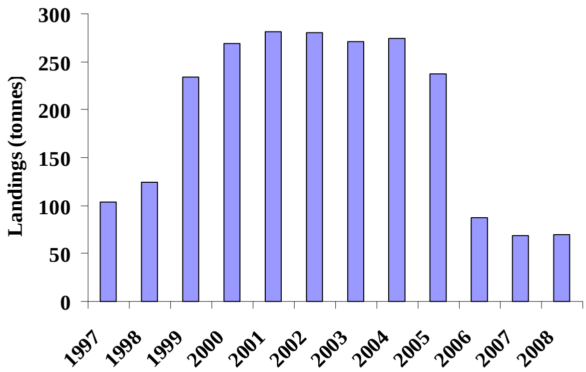


Figure 3.8.2 - Total landings of witch flounder within Skagerrak during 1997-2008 divided by types of fishery.

Directed fishery for witch flounder

Of the total landings of witch flounder in 2008, roughly 27% (70 t) came from the witch flounder directed fishery (Figure 3.8.3). Around 2002 when the directed fishery was at its peak the contribution was much greater, around 50%. The contribution from the mixed trips métier has increased in the last three years and now accounts for approximately 40%. Therefore, fishing for witch flounder has changed in a mixed fishery in the last years compared to what it was in the beginning of the 2000's. From 1997 to 2001 landings increased 178 t and then decreased markedly to 2008, where 70 t were landed.



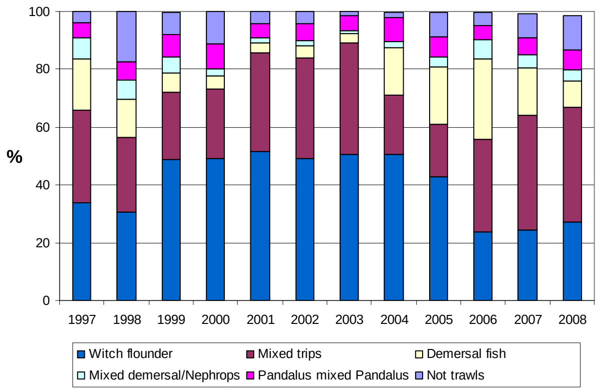


Figure 3.8.3 – Landings (t) within the witch flounder directed fishery and contribution per métier in the period 1997-2008.

Fishing patterns

The spatial distribution of effort has been analysed using both logbook and vessel monitoring system (VMS) data. VMS data were used to provide a highly temporal and spatial distribution of fishing effort within the witch flounder directed fishery. Although VMS data are independent of fishers' declarations and provide far greater spatial resolution than what can be obtained from logbooks, it is only available from 2005 to 2008 and for vessels greater than 15 m. Therefore, logbook data were also used to analyse spatial patterns in effort on a greater time scale. Logbook data for all years 1997 to 2008 were used to analyse fishing effort per ICES rectangle.

Effort in 2005 had already begun to decline and had returned to a similar level as in 2000 when the witch flounder fishery was on the rise (Figure 3.8.4). The spatial distribution of effort in 2005 was concentrated along the Norwegian, Swedish, and Danish verges of the Norwegian trench. In 2006 total effort was greatly reduced which resulted in a large reduction of effort along the Norwegian and Danish verges. Subsequently, effort off the Norwegian coast in 2007 and 2008 was non existent. Effort in 2008 remained low, while expanding spatially, especially along the Danish border.

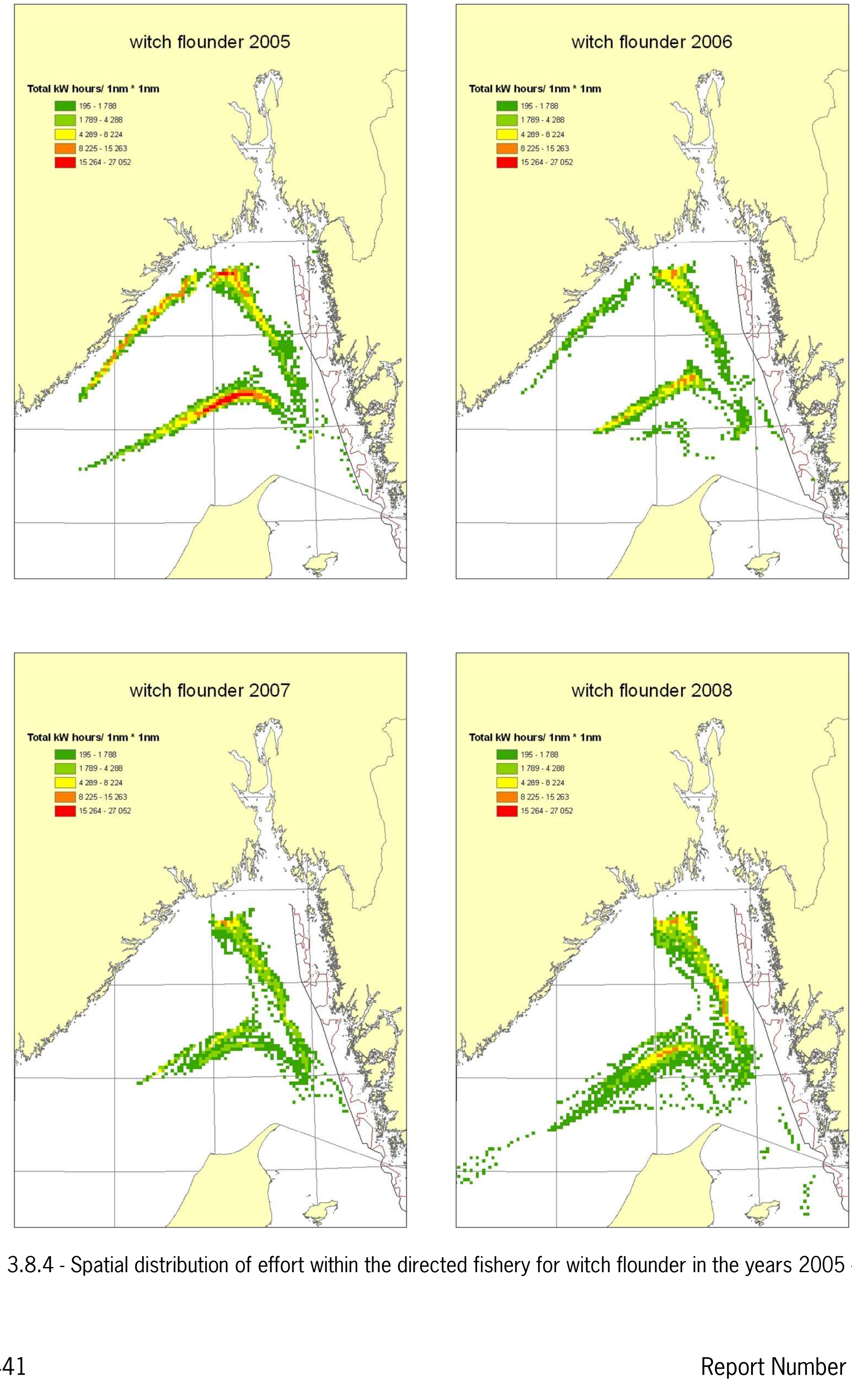


Figure 3.8.4 - Spatial distribution of effort within the directed fishery for witch flounder in the years 2005 – 2008.

Approximately 90 % of witch flounder landings are taken around the Norwegian Trench in the four ICES rectangles 45F9, 46F9, 45G0 and 46G0 (Figure 3.8.5). The fishing pattern in the area has changed during the investigated period. In 1997 effort was mainly concentrated in ICES rectangle 46G0. In 2004 landings became increasingly distributed over the area and were of similar magnitude in all four rectangles. The pattern in 2008 reverted back to a similar state as observed in 1997. Total landings have decreased by approximately 50% and what remained was largely concentrated in ICES rectangles 46G0 and 45G0.

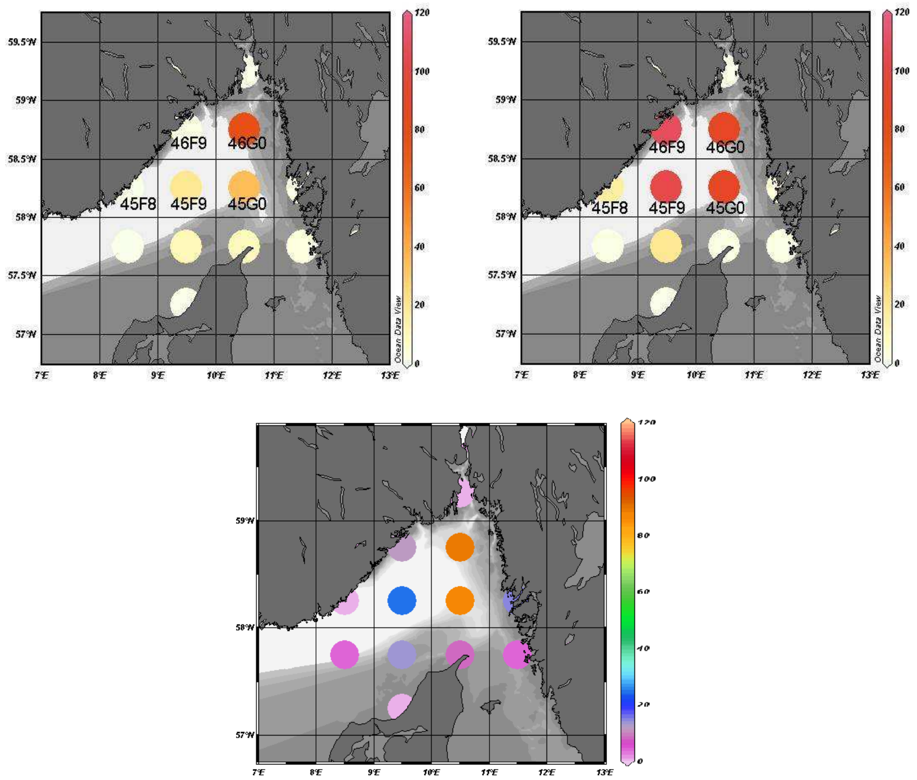


Figure 3.8.5 – Landings (t) of witch flounder per ICES rectangle in 1997, 2004 and 2008, respectively. N.B. the 2008 colour scheme differs from 1997 and 2004.

Fishing effort, is reported as energy consumption (kWh), and based on both trawl time (hours) and engine size (kW). Between 1997 and 2001 effort increased in the Skagerrak from 1.5 million kWh to just over 4 million kWh (Figure 3.8.6). Landings and effort followed a similar pattern, with the exception of 2002, when the effort fell by over 700 000 kWh, but the landings were on the same level as the year before. In 2006 landings and effort declined drastically and have remained low for the past few years.

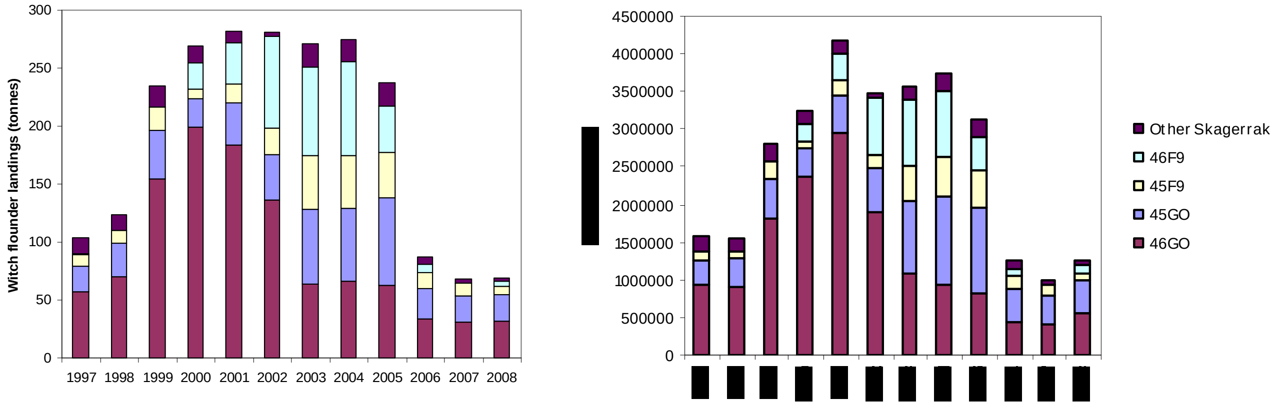


Figure 3.8.6 - Landings and effort from the 4 ices rectangles where witch flounder is prominently fished.

In Figure 3.8.7 the progression is shown of landings and effort in the individual ICES rectangles where witch flounder is mainly fished.

In 45G0 landings and effort increased gradually up to and including 2005 (Figure 3.8.7a). In 2006, the two decreased and were at a similar level as observed in the beginning of the study period. In 46G0 (Figure 3.8.7b) landings and effort increased between 1998 and 2000. From 2000 to 2001 effort increased but the landings remained at the same level as in 2000. From 2001 onwards, both landings and effort decreased. In 2004 the effort and landing were back to the same level as 1998. In 45F9 (Figure 3.8.7c) landings and effort increased from 1998 to 2003. Between 2003 and 2004, effort increased but landings declined slightly. Since 2005 landings and effort have declined significantly. In 46F9 (Figure 3.8.7d) no significant fisheries were conducted until 2000 but then rose sharply until 2002. Between 2002 and 2003 landings were constant while effort increased. In 2004, both effort and landings were at their peak and have since declined markedly, returning to similar levels as observed in 1997.

In conclusion it is noted that effort and landings increased in all rectangles during the early 2000's and have since returned to levels equally low or lower than what was observed in the beginning of the study period. From 2000 to 2001, CPUE in 46G0 declined, and since then landings and effort have declined steadily. This corresponds with effort and landings increasing in all other rectangles, suggesting that the reduction in CPUE in 46G0 may have led to a spatial expansion of fishing effort.

Bycatch in the witch flounder directed fishery

Approximately 40% of the total landings in the witch flounder directed fishery consists of species other than witch flounder. Most of the landed by-catch is saithe, cod and monkfish (Figure 3.8.8 and 3.8.9 left). The proportion of saithe increased substantially, from almost 13 t in 2001 to approximately 65 t in 2004, and has since returned to similar levels as observed in 1997. Since 2002, landings of cod in the witch flounder directed fishery have decreased from approximately 70 t in 2002 to around 10 t in 2006. This is probably due to the cod quota being reduced, not because of reduced landings. Landings of monkfish increased steadily from approximately 9 t in 1997 to 30 t to 2004, but have since declined, returning to a similar level as in 1997. Haddock, Norway lobster, ling, hake, plaice and shrimps are also landed, but in smaller quantities.

Also landed are by-catches of elasmobranchs (Figure 3.8.9 right). Skates are not separated into individual species in the landings data and therefore it is unknown which species are landed. Unlike skates, sharks are classified to species level and within the witch flounder directed fishery dogfish is landed exclusively. Landings of both skates and dogfish in the directed fishery increased markedly from 2000 but have since returned to similar levels as observed at the end of the 1990s.

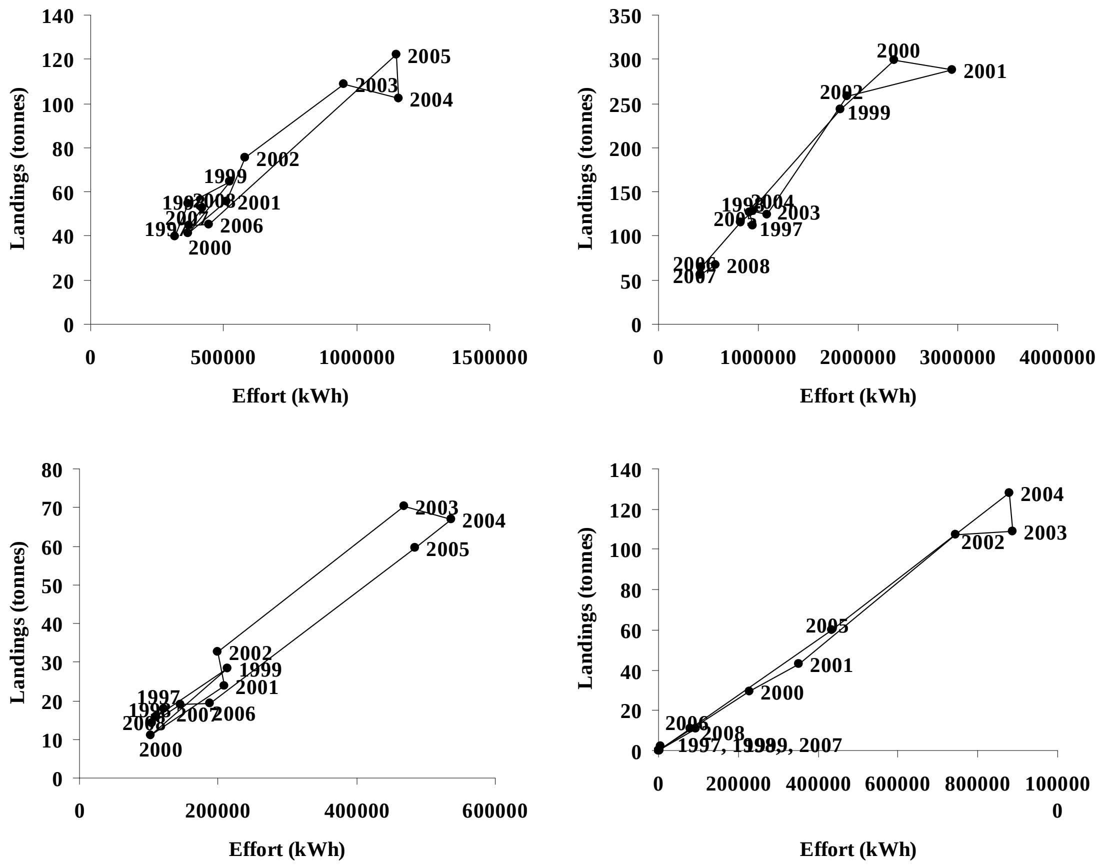


Figure 3.8.7 - Changes in landings of witch flounder and effort from 1997 to 2008 in four ICES-rectangles a) 45G0, b) 46G0, c) 45F9, d) 46F9 where witch flounder is fished most. Note that scales are different.

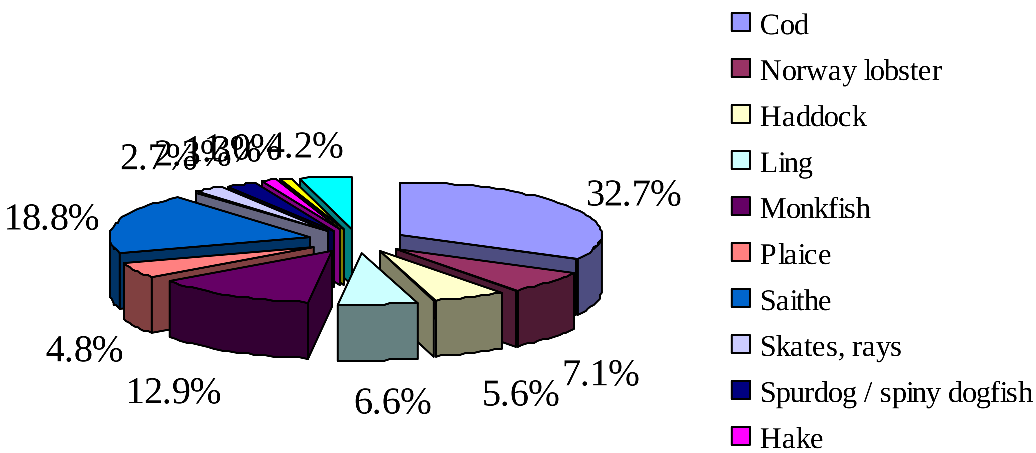


Figure 3.8.8 - Mean percent of by-catch species within landings from the witch flounder directed fishery 1997 to 2008.

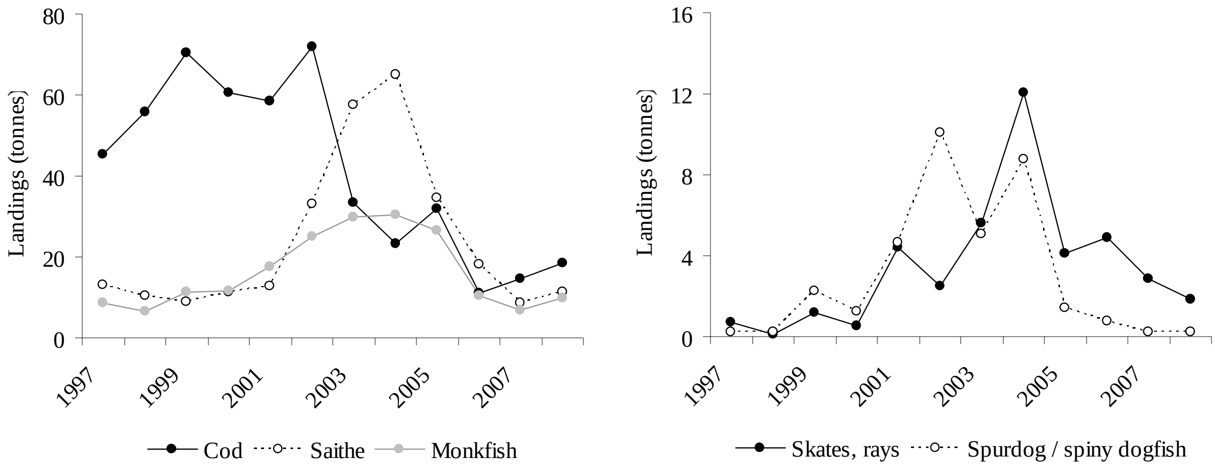


Figure 3.8.9 - Landed by-catch for a selection of species of teleosts and elasmobranchs.

Discards in the witch flounder fishery

Data on discards were collected from three trips in the Skagerrak (in May 2003 and June 2005) with a total of 18 hauls in the directed witch flounder fishery. The amount of data is not sufficient to make a quantitative analysis of the discards of various species. The species that occurred as discards in most hauls are blue whiting (*Micromesistius poutassou*), fourbeard rockling (*Enchelyopus cimbrius*), rabbit fish (*Chimaera monstrosa*), starry ray (*Amblyraja radiata*), and cod (*Gadus morhua*). On two of the trips, however, the cod quota had been filled, which led to cod of legal size, which would normally have been landed, being included in the discard portion of the catch.

Witch flounder as by-catch in other fisheries

Witch flounder is caught as by-catch in all fisheries where bottom trawling is used, i.e. Pandalus, Norway lobster and fishing for demersal/benthic fish. The total landings of witch flounder in the non-target fisheries in 2008 were around 190 t (Figure 3.8.10). Of these landings, 102 t were within the mixed trips métier, 21 t were within the shrimp fishery, about 33 t in the demersal fish fishery, which was equivalent to 40%, 8% and 12% of the total witch flounder landings.

Table 3.8.1 - Number of hauls (tot=18) where each species has been recorded either as discard or by-catch hauls in the witch flounder direct fishery

	Discard			By-catch		
Species	**1-5 hauls**	**6-15 hauls**	**16-18 hauls**	**1-5 hauls**	**6-15 hauls**	**16-18 hauls**
Amblyraja radiata			x			
Anarhichas lupus				x		
Argentina silus		x				
Argentina sphyraena	x					
Brosme brosme				x		
Callionymus lyra	x					
Chimaera monstrosa			x			
Coryphaenoides rupestris		x				
Crayfish		x				x
Cyclopterus lumpus	x					
Dipturus linteus	x			x		
Dipturus oxyrinchus				x		
Enchelyopus cimbrius			x			
Etmopterus spinax		x				
Gadiculus argenteus	x					
Gadus morhua			x	x		
Hippoglossoides platessoides		x				
Hippoglossus hippoglossus				x		
Limanda limanda	x					
Loligo ssp	x			x	x	
Lophius piscatorius	x				x	
Lumpenus lampretaeformis	x					
Lycodes gracilis						
Melanogrammus aeglefinus		x			x	
Merluccius merluccius		x			x	
Micromesistius poutassou			x			
Microstomus kitt	x			x		
Molva molva	x				x	
Myxine glutinosa	x					
Pleuronectes platessa		x			x	
Pollachius virens	x				x	
Sebastes norvegicus	x					
Sebastes viviparus	x					
Squalus acanthias				x		
Trisopterus esmarkii	x					
Trisopterus minutus	x					

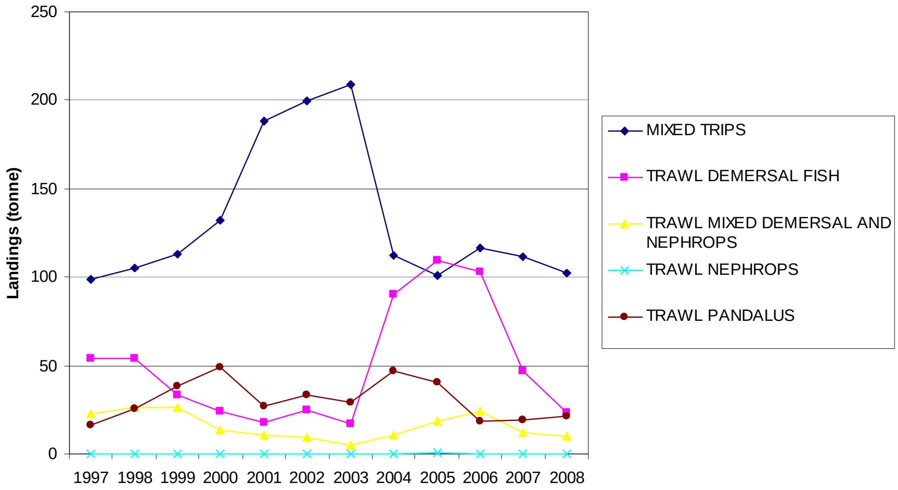
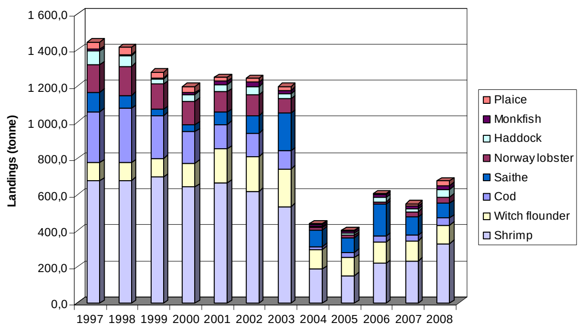


Figure 3.8.10 - Landings of witch flounder from fisheries other than the witch flounder directed fishery.

As for the mixed trips metier, some of the hauls within trips may have been classified within the witch flounder fishery and some, for example, within the Pandalus fishery, and have therefore ended up in the mixed trips metier. This is more than likely why there are such high levels of witch flounder in landings. Since the mixed trips metier landed the largest amount of by-catch of witch flounder it has been studied more closely. Pandalus landings within the mixed hauls metier accounted for around 50% in 1999 and declined steadily until 2006 when it started increasing again. Although landings of witch flounder in the directed fishery reached its peak in 2001, by-catch of witch flounder in the mixed hauls metier continued to increase until 2005. This could be a result of landings per unit effort beginning to decline, resulting in more fishers switching to a mixture of Pandalus and witch flounder hauls within trips.



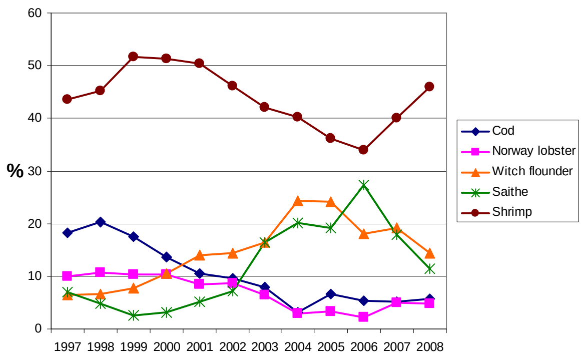


Figure 3.8.11 - Real and relative species composition within the mixed trips metier 1997 – 2008.

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4 WP3 – Analysis of biological parameters

4.1 IMARES: Biological sampling of 8 NEW species[17]

Biological sampling data (length, weight, age, sex and maturity) are available at IMARES for several species for a number of years (Table 4.1.1). The data originate from several research vessel surveys, market sampling and discard sampling all carried out by IMARES. For some species (lemon sole, dab and brill) a part of the weight data are only available for the gutted fish. Therefore, a conversion factor was used to determine the fresh weight of these individuals. The data have been used to create length-weight and age-length relationships for the different species. In addition, the maturity data of brill and turbot have also been analysed.

Table 4.1.1 – Overview of data available at IMARES

English name	Scientific name	Source	Years
Flounder	*Platichys flesus*	Survey	1992-1995 1998 2000-2001 2005-2009
Lemon sole	*Microstomus kitt*	Surveys Market sampling	2002-2008
Brill	*Scophthalmus rhombus*	Market sampling	1982 1984-1990 1998 2004-2009
Dab	*Limanda limanda*	Surveys Market sampling Discard sampling	1978 1980-1998 2003-2009
Turbot	*Psetta maxima*	Market sampling	1984-1990 1998 2004-2009
Seabass	*Dicentrarchus labrax*	Market sampling	2005-2008
Grey gurnard	*Eutrigla gurnardus*	Surveys	2010
Striped red mullet	*Mullus surmuletus*	Surveys	2008

Length-weight relationship
Length was plotted against weight per sampled calendar year for the different species to determine for which years sufficient data were available. Thereafter a power function was fitted to the data of the selected years to determine whether the relationship differed between years and for some species between sexes (Equation 1):

$$y \sim a * x^{b} \qquad \text{Equation 1}$$

In which y is weight, x is length and a and b are constant parameters.

Age-length relationship
The von Bertalanffy growth curve (Equation 2) was fitted to the age-length data to follow this relationship through the different cohorts:

$$L_t \sim L_\infty (1 - e^{-K(t-t_0)}) \qquad \text{Equation 2}$$

17 Author: Harriët van Overzee

In which L_t is length, t is age, L_∞ is the ultimate length of an individual, K is the growth coefficient and t_0 is the time at which in theory the fish has a weight of 0 (this was set at 0). The parameters give insight on whether the age-length relationship has changed through time. The growth curve could only be fitted to cohorts for which enough data were available.

Maturity ogive estimation

For brill and turbot the percentage of the number of mature individuals was plotted against age per sampled calendar year to determine for which years sufficient data were available. A modified logistic curve (Equation 3) was fitted to the data of the selected years:

$$y \sim \frac{1}{1+e^{(a+bx)}} \qquad \text{Equation 3}$$

In which y is the fraction of the number of mature individuals, x is age and a and b are constant parameters. The age at which 50% of the fish population reaches maturity can be calculated as follows:

$$Age_{50\%} = \frac{-a}{b} \qquad \text{Equation 4}$$

In which a and b are the parameters from Equation 3.

Flounder

Data on flounder are available for a number of years from several surveys (Table 4.1.1). These data have been used to create a length-weight and age-length relationship for males and females separately.

A power function (Equation 1) was fitted to the selected length-weight data to determine whether the relationship differs between years. Based on these results it was decided to pool all data over the different years for males and females separately (Figures 4.1.1 and 4.1.2). The results show that the larger individuals that are caught are females; the maximum length observed for females is 42.7 cm while the maximum length observed for males is 36.0 cm. Nonetheless, the length-weight relationship for the different sexes seems comparable.

The von Bertalanffy growth curve (Equation 2) was fitted to the data for males and females separately. Unfortunately, there was not sufficient data to follow the age-length relationship through the different cohorts. It was therefore decided to fit the growth curve to all the cohorts together[18]; the L_∞ was estimated at 36.2 cm for females and 29.6 cm for males.

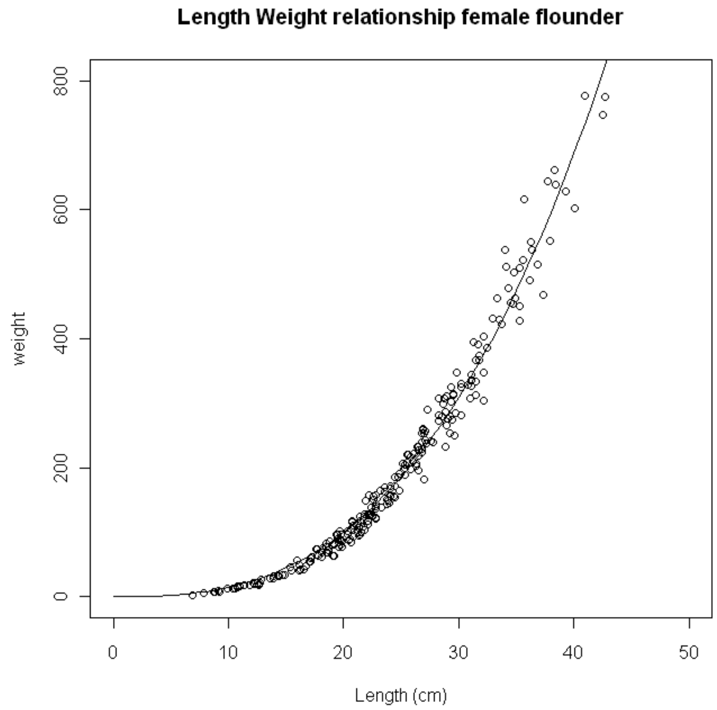

Figure 4.1.1 – Length-weight relationship of female flounder for 1998, 2000, 2005, 2007-2009 and corresponding fitted power function ($y \sim 0.0242 * x^{2.78}$). Based on survey data.

18 Age-length relationships for all cohorts together are shown in Appendix 4.1

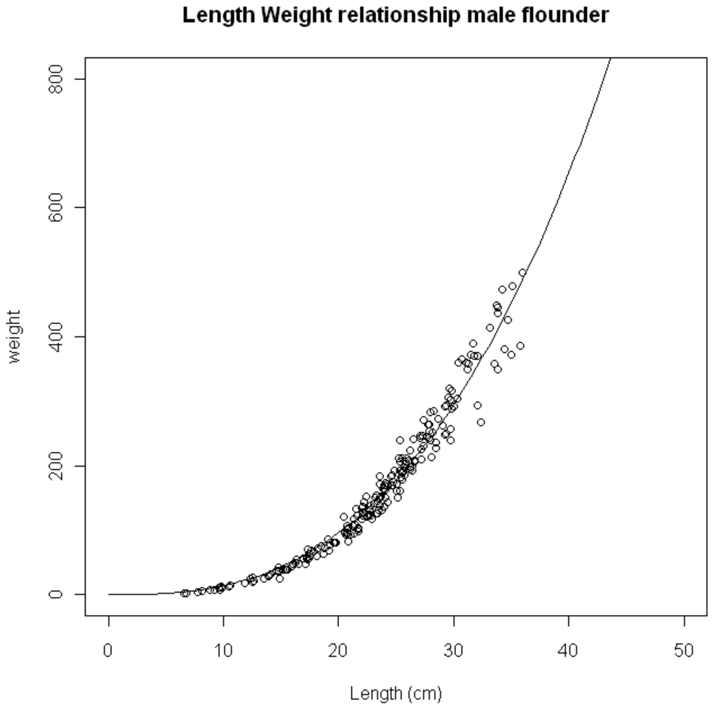

Figure 4.1.2 – Length-weight relationship of male flounder for 1998, 2005, 2007-2009 and corresponding fitted power function ($y \sim 0.0239*x^{2.77}$). Based on survey data.

Lemon sole

Data on lemon sole are available for a number of years from several surveys and the market sampling programme (Table 4.1.1). These data have been used to create a length-weight and age-length relationship for males and females separately.

A power function (Equation 1) was fitted to the selected length-weight data to determine whether the relationship differs between years. The length-weight relationship for 2002 seems different from the other years (especially for the males). However, it should be noted that the length-weight relationship for this year is based on only a few data points in comparison with the other years. Based on these results it was decided to pool all data for the period 2004-2008 for males and females separately (Figures 4.1.3 and 4.1.4). The larger individuals that are caught appear to be females; the maximum length observed for females is 46.1 cm while the maximum length observed for males is 41.8 cm.

The von Bertalanffy growth curve (Equation 2) was fitted to both the survey and the market data for males and females separately. The estimated parameter L_∞ remained stable throughout the cohorts while the estimated growth parameter, K, shows some variation through the different cohorts (Figures 4.1.5 and 4.1.6).

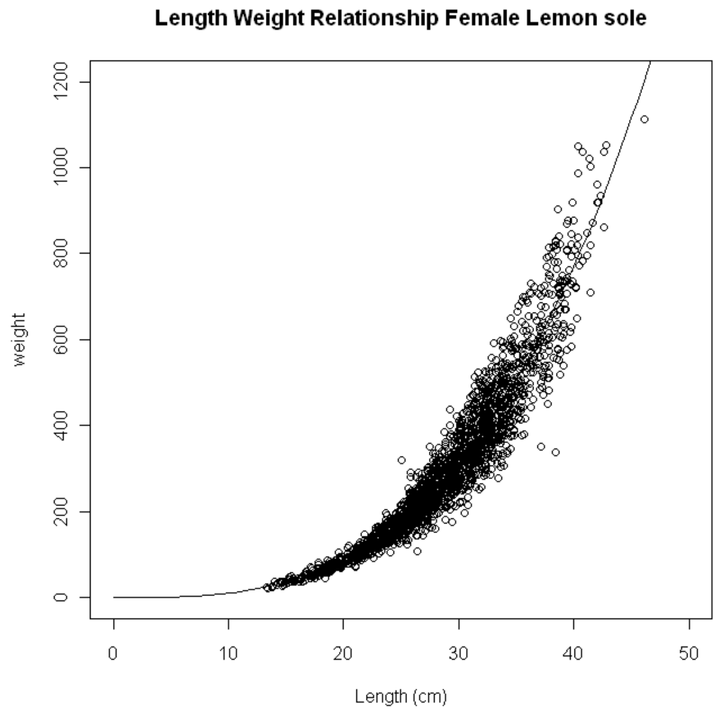

Figure 4.1.4 – Length-weight relationship of male lemon sole for 2004-2008 and corresponding fitted power function (y ~ $0.0075*x^{3.128}$). Based on survey and market data.

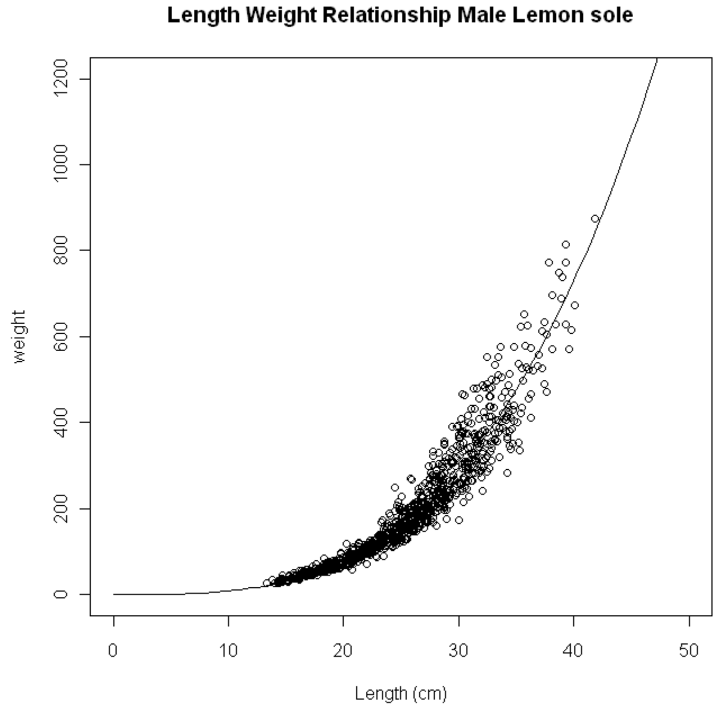

Figure 4.1.4 – Length-weight relationship of male lemon sole for 2004-2008 and corresponding fitted power function (y ~ $0.0054*x^{3.205}$). Based on survey and market data.

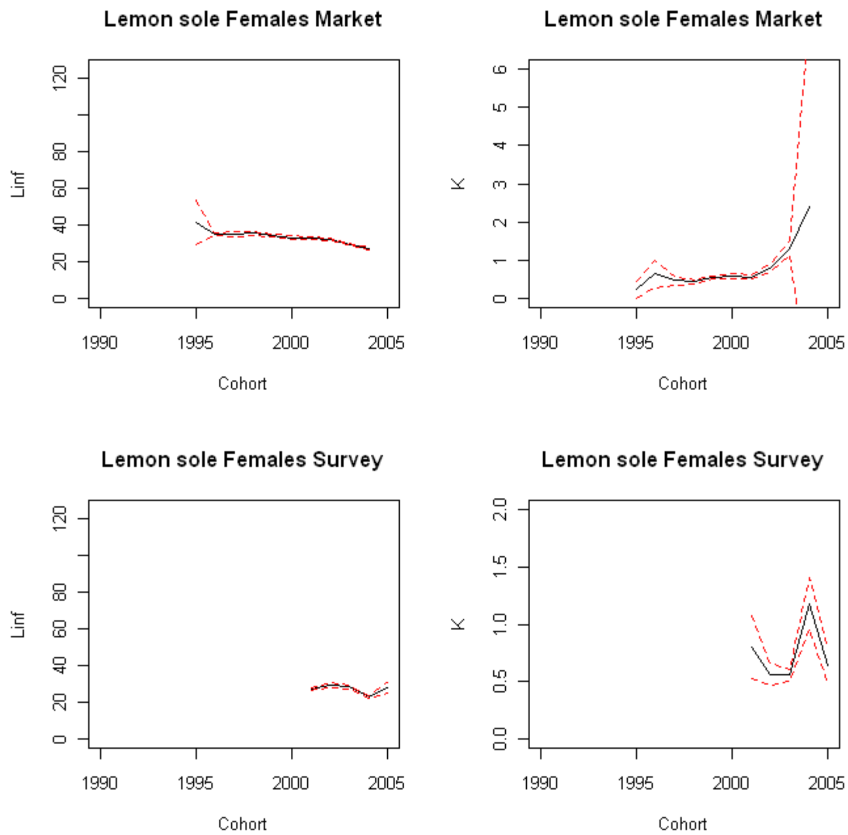

Figure 4.1.5 – Estimated parameters L_∞ (± S.E.) and K (± S.E.) from the von Bertalanffy growth curve for the different cohorts of female lemon sole. Based on survey (upper) and market (lower) data.

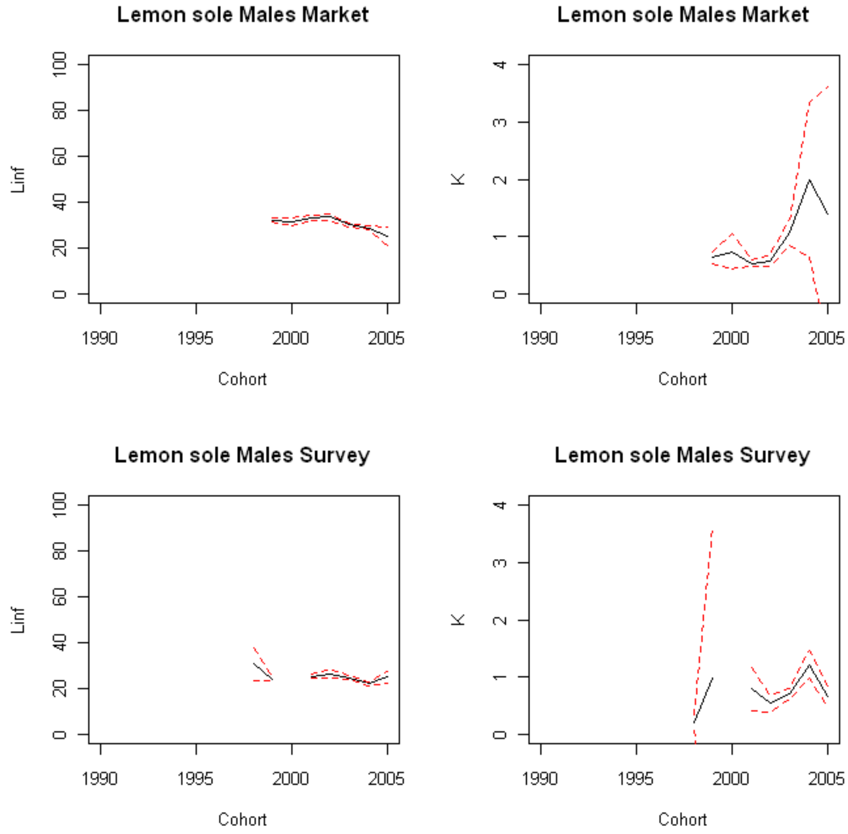

Figure 4.1.6 – Estimated parameters L_∞ (± S.E.) and K (± S.E.) from the von Bertalanffy growth curve for the different cohorts of male lemon sole. Based on survey (upper) and market (lower) data.

Brill

Data on brill are available for a number of years from several surveys, the market and the discard sampling programme (Table 4.1.1). These data have been used to analyse the maturity data and to create a length-weight and age-length relationship for males and females separately.

A power function (Equation 1) was fitted to the selected data to determine whether the relationship differs between years. Based on these results it was decided to pool all data over the different years for males and females separately (Figures 4.1.7 and 4.1.8). The data clearly show that the larger individuals are females; the maximum length observed for females is 67.1 cm while the maximum length observed for males is 54.9 cm.

The von Bertalanffy growth curve (Equation 2) was only fitted to the market data as the surveys do not provide sufficient data. The estimated parameter L_∞ for the female and male data shows a decline in the period 1975-1988. This decline coincides with an increase in the estimated growth parameter, K (Figure 4.1.9).

The logistic curve (Equation 3) was fitted to the maturity data (Figure 4.1.10). The estimated parameters, a and b, for the different years indicate that the age at which 50% of the fish population reaches maturity (Equation 4) for females is 1 to 2 years (Table 4.1.2). The L at 50% maturity for the different years is given in Table 4.1.3.

Table 4.1.2 – Estimated parameters a and b from the modified logistic curve (Equation 3) that was fitted to the age-maturity data of brill (See also Figure 4.1.10)

	Females		**Males**	
Year	**a**	**b**	**a**	**b**
1982	3.767129	-1.7628439		
1984	3.301303	-1.4538890	1.512447	-1.2713270
1985	4.861973	-2.8791436		
1986	4.180890	-2.1936410		
1987	30.432869	-15.1603759		
1988	0.435674	-0.7351128		
1989	1.547709	-1.2639868		
1990	2.481746	-1.5963514		

Table 4.1.3 – Estimated L50 (cm) derived from the modified logistic curve (Equation 3) that was fitted to the length-maturity data of brill

	L50 females	L50 males
1982	35.7	
1984	33.1	20.3
1985	29.4	
1986	34.0	19.9
1987	34.6	
1988	33.7	
1989	33.9	
1990	35.3	

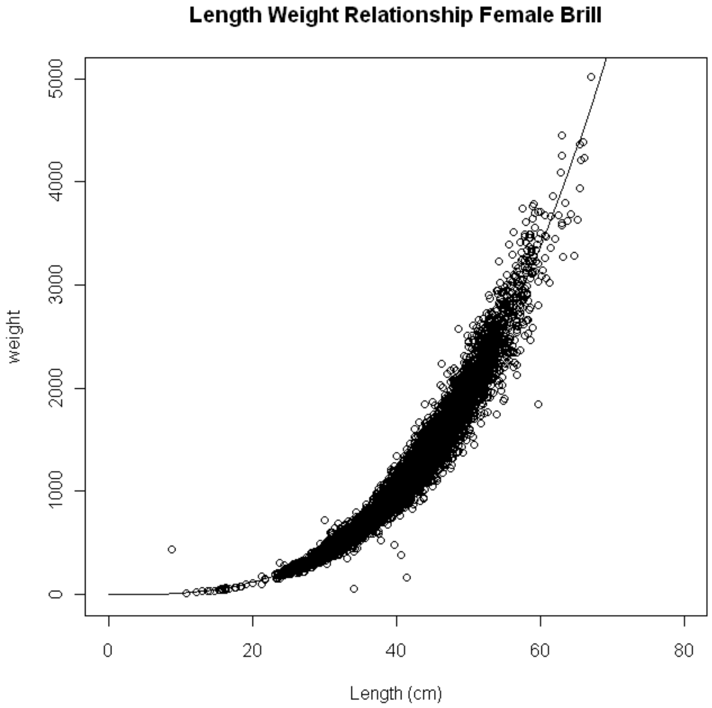

Figure 4.1.7 – Length-weight relationship of female brill for 1982, 1984-1990, 1998, 2004-2009 and corresponding fitted power function ($y \sim 0.014{*}x^{3.072}$). Based on survey, market and discard data.

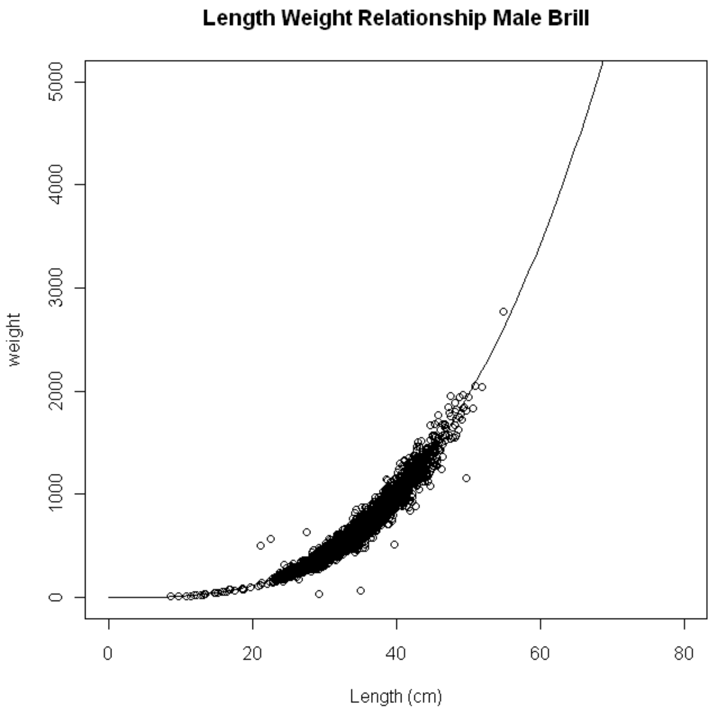

Figure 4.1.8 – Length-weight relationship of male brill for 1982, 1984-1990, 1998, 2004-2009 and corresponding fitted power function ($y \sim 0.012{*}x^{3.069}$). Based on survey, market and discard data.

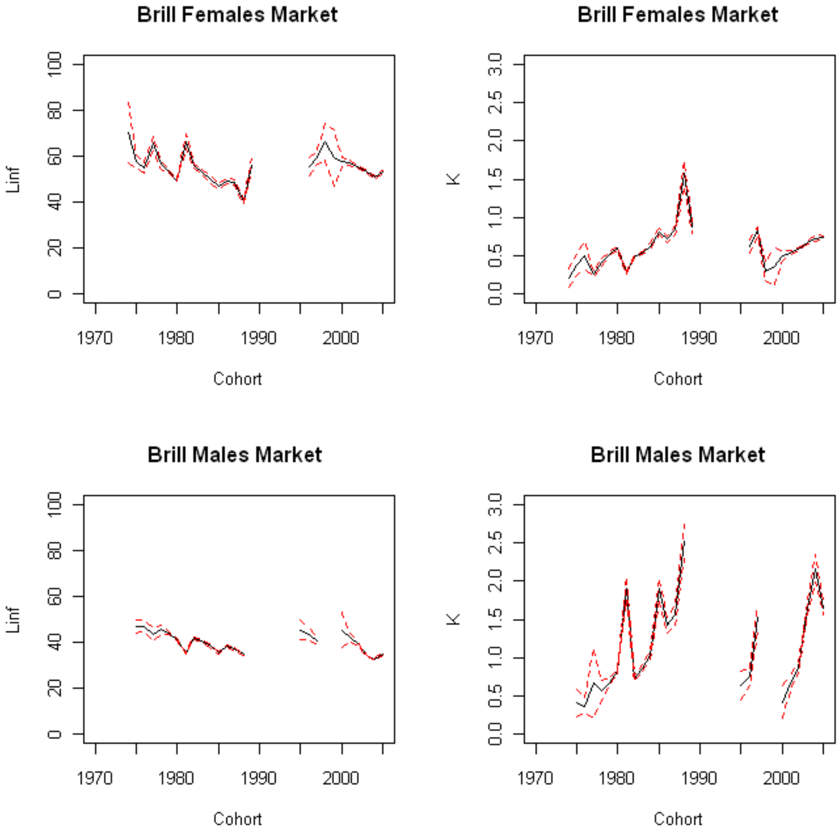

Figure 4.1.9 – Estimated parameters L_∞ (± S.E.) and K (± S.E.) from the von Bertalanffy growth curve for the different cohorts of female (upper) and male (lower) brill. Based on market data.

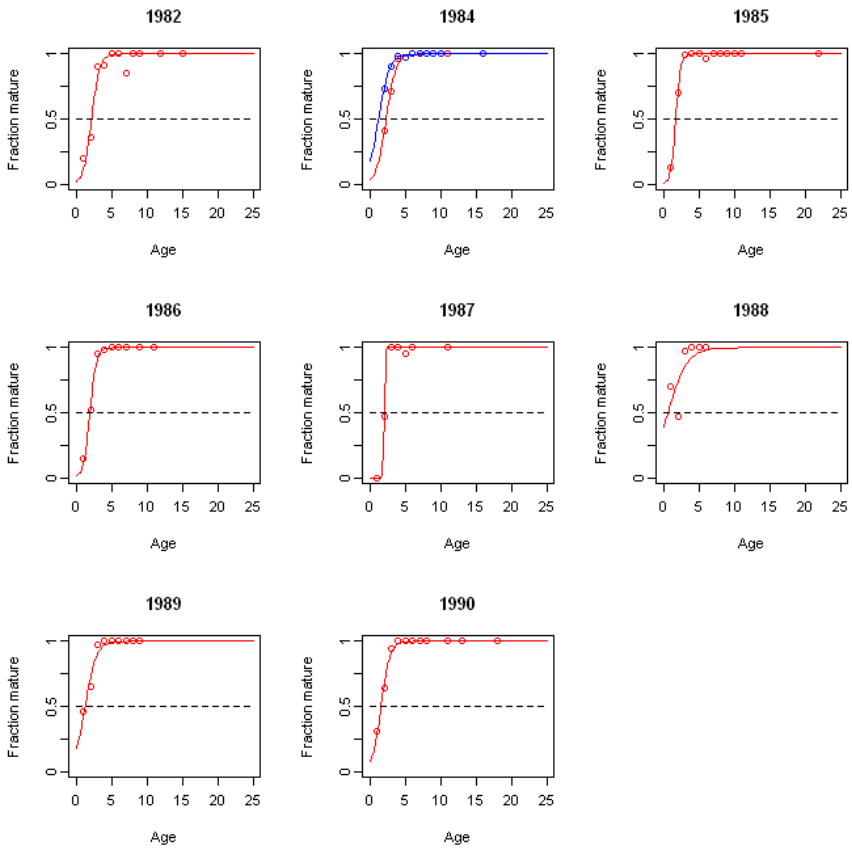

Figure 4.1.10 – Age data plotted against the fraction of mature female (red) and male (blue) brill for the sampled years 1982, 1984-1990 with corresponding fitted maturity ogive. Based on survey, market and discard data.

Dab

Data on dab are available for a number of years from several surveys, the market and discard sampling programme (Table 4.1.1). These data have been used to create a length-weight relationship and age-length relationship for males and females separately.

A power function (Equation 1) was fitted to the selected data to determine whether the relationship differs between years. Based on these results it was decided to pool all data over the different years for males and females separately (Figures 4.1.11 and 4.1.12). The data show that the larger individuals that are caught are females; the maximum length of the females is 37.4 cm while the maximum length of males is 29.5 cm.

The von Bertalanffy growth curve (Equation 2) was only fitted to the market data as the surveys do not provide sufficient data. The estimated parameter L_∞ shows a stable pattern through the different cohorts for both males and females, while the growth parameter, K, shows some fluctuations (Figure 4.1.13).

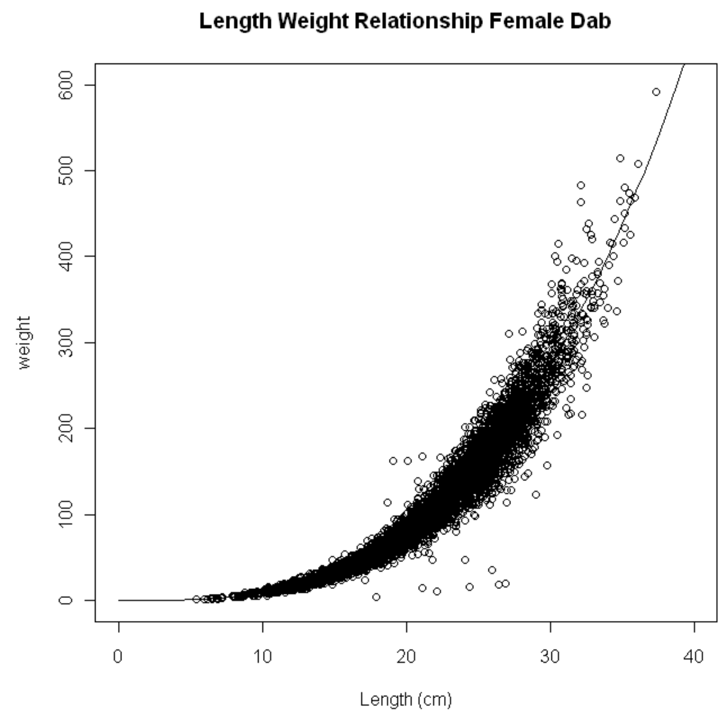

Figure 4.1.11 – Length-weight relationship of female dab for 1996-1998, 2003-2009 and corresponding fitted power function ($y \sim 0.008 * x^{3.053}$). Based on survey, market and discard data.

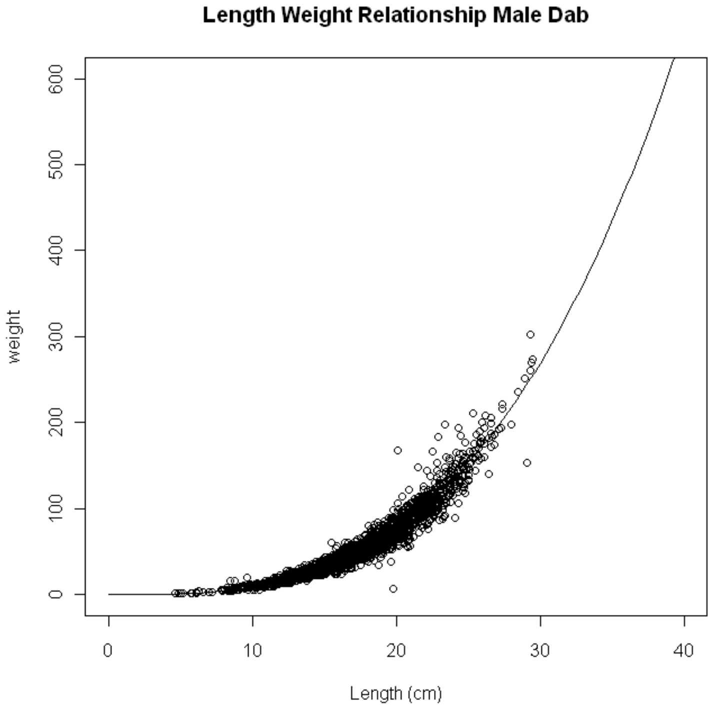

Figure 4.1.12 – Length-weight relationship of male dab for 1996-1998, 2003-2009 and corresponding fitted power function ($y \sim 0.007{*}x^{3.103}$). Based on survey, market and discard data.

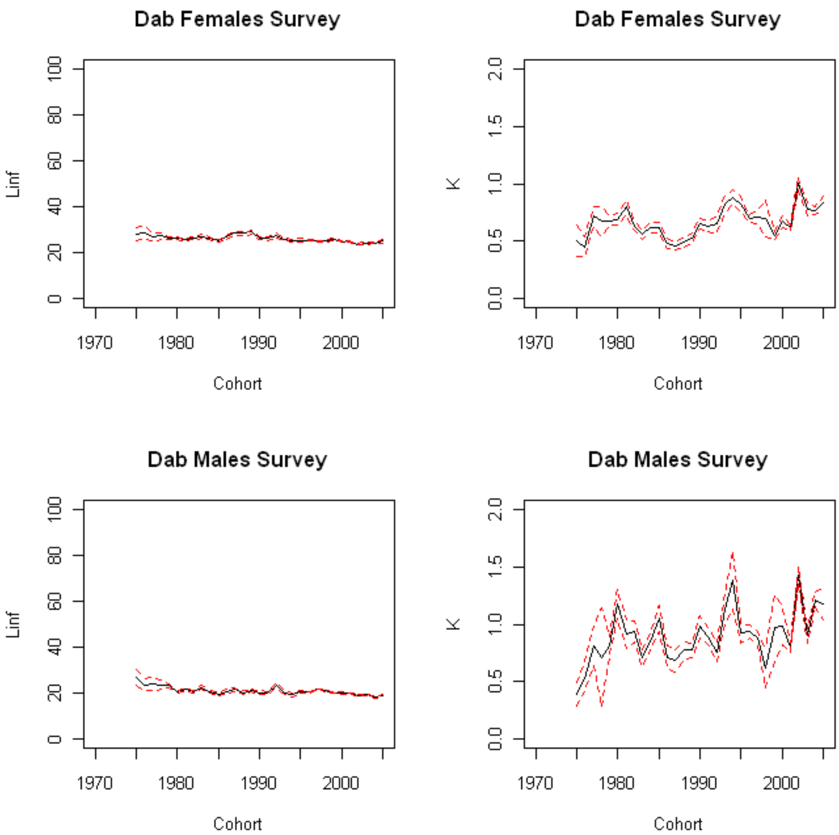

Figure 4.1.13 – Estimated parameters L_{∞} (± S.E.) and K (± S.E.) from the von Bertalanffy growth curve for the different cohorts of female (upper) and male (lower) data. Based on survey data.

Turbot

Data on turbot are available for a number of years from several surveys and the market sampling programme (Table 4.1.1). These data have been used to create a length-weight and age-length relationship for males and females separately.

A power function (Equation 1) was fitted to the selected data to determine whether the relationship differs between years. Based on these results it was decided to pool all data over the different years for males and females separately (Figures 4.1.14 and 4.1.15). The data clearly show that the larger individuals that are caught are females; the maximum length of the females is 84.2 cm while the maximum length of males is 68.3 cm.

The von Bertalanffy growth curve (Equation 2) was only fitted to the market data as the surveys do not provide sufficient data. The estimated parameter L_∞ for the female data shows a decline in the period 1973-1989. This decline coincides with an increase in the estimated growth parameter, K (Figure 4.1.16). The estimated parameter L_∞ for the male data shows a stable pattern while the growth parameter, K, shows some fluctuations (Figure 4.1.16). The logistic curve (Equation 3) was fitted to the maturity data (Figure 4.1.17). The estimated parameters, a and b, for the different years indicate that the age at which 50% of the fish population reaches maturity (Equation 4) is around 2 years for females and 1 year for males (Table 4.1.4). The L at 50% maturity for the different years is given in Table 4.1.5.

Table 4.1.4 – Estimated parameters a and b from the modified logistic curve (Equation 3) that was fitted to the age-maturity data of turbot (See also Figure 4.1.17)

	Females		**Males**	
Year	**a**	**b**	**a**	**b**
1984	3.364266	-1.593823		
1985	3.101099	-1.366092		
1986	3.994601	-1.649612		
1987	6.170777	-2.869328	4.00931046	-2.032888
1988	5.193620	-2.094275		
1989	2.019143	-1.022230		
1990	2.295337	-1.109923		
2004	11.983879	-5.953154	4.00612859	-3.695962
2005	10.611843	-4.551719	2.39229871	-1.810687
2006	3.742142	-1.834937		
2007	2.202774	-1.390019		
2008	9.496143	-4.731311	4.34556699	-3.364051
2009	2.553615	-1.426789	5.55564692	-6.807421

Table 4.1.5 – Estimated L50 (cm) derived from the modified logistic curve (Equation 3) that was fitted to the length-maturity data of turbot

	L50 females	L50 males
1984	35.2	
1985	35.9	
1986	37.6	
1987	37.1	26.9
1988	40.1	
1989	39.7	
1990	40.3	
2004	33.8	
2005	35.5	
2006	33.7	
2007	34.0	18.4
2008	35.2	24.1
2009	32.9	19.8

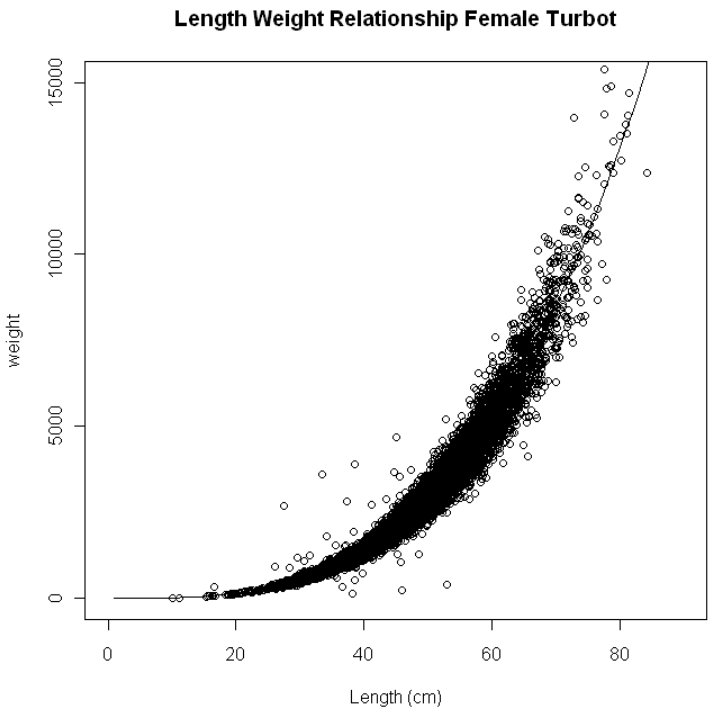

Figure 4.1.14 – Length-weight relationship of female turbot for 1984-1990, 1998, 2004-2009 and corresponding fitted power function (y ~ $0.010*x^{3.207}$). Based on survey and market data.

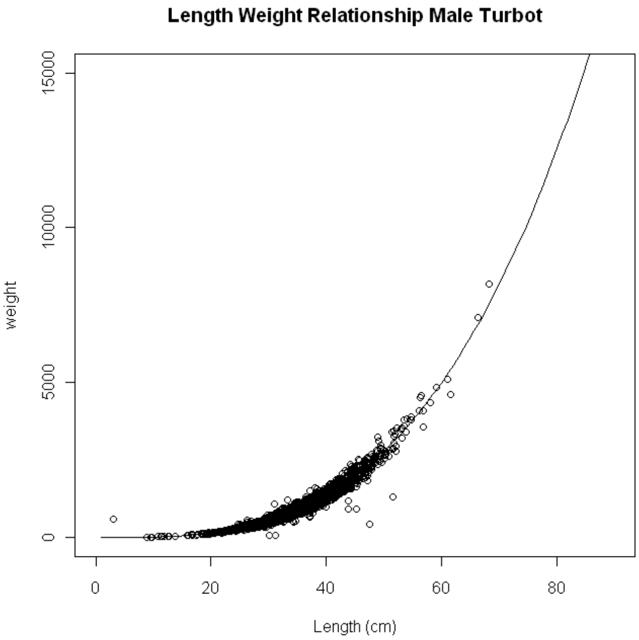

Figure 4.1.15 – Length-weight relationship of male turbot for 1984-1990, 1998, 2004-2009 and corresponding fitted power function (y ~ $0.011*x^{3.198}$). Based on survey and market data.

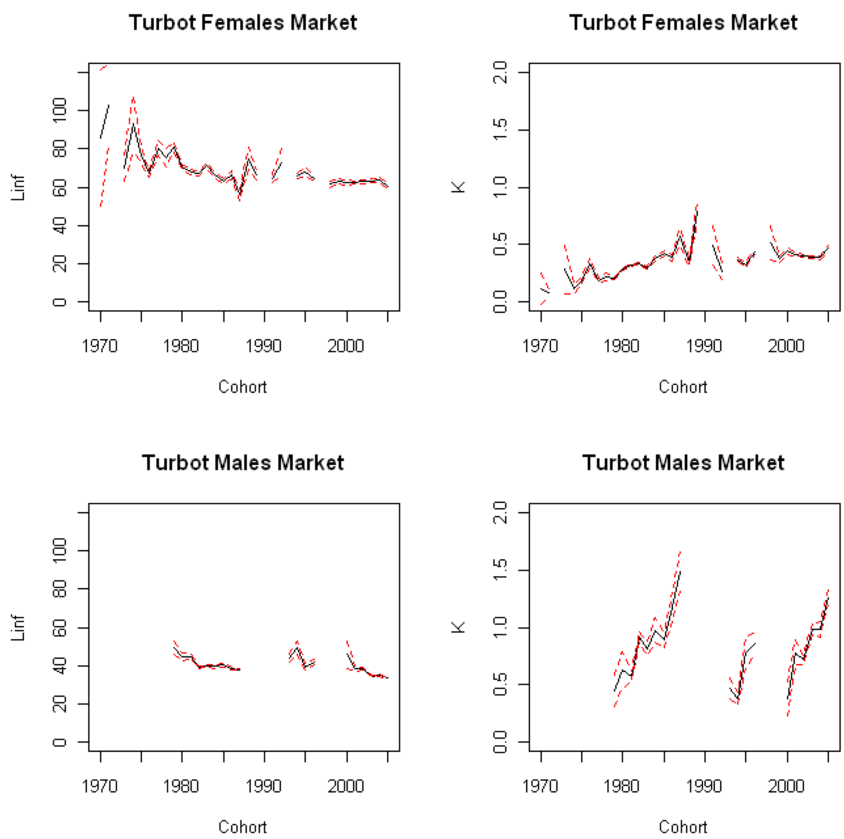

Figure 4.1.16 – Estimated parameters L_∞ (± S.E.) and K (± S.E.) from the von Bertalanffy growth curve for the different cohorts of female (upper) and male (lower) turbot. Based on market data.

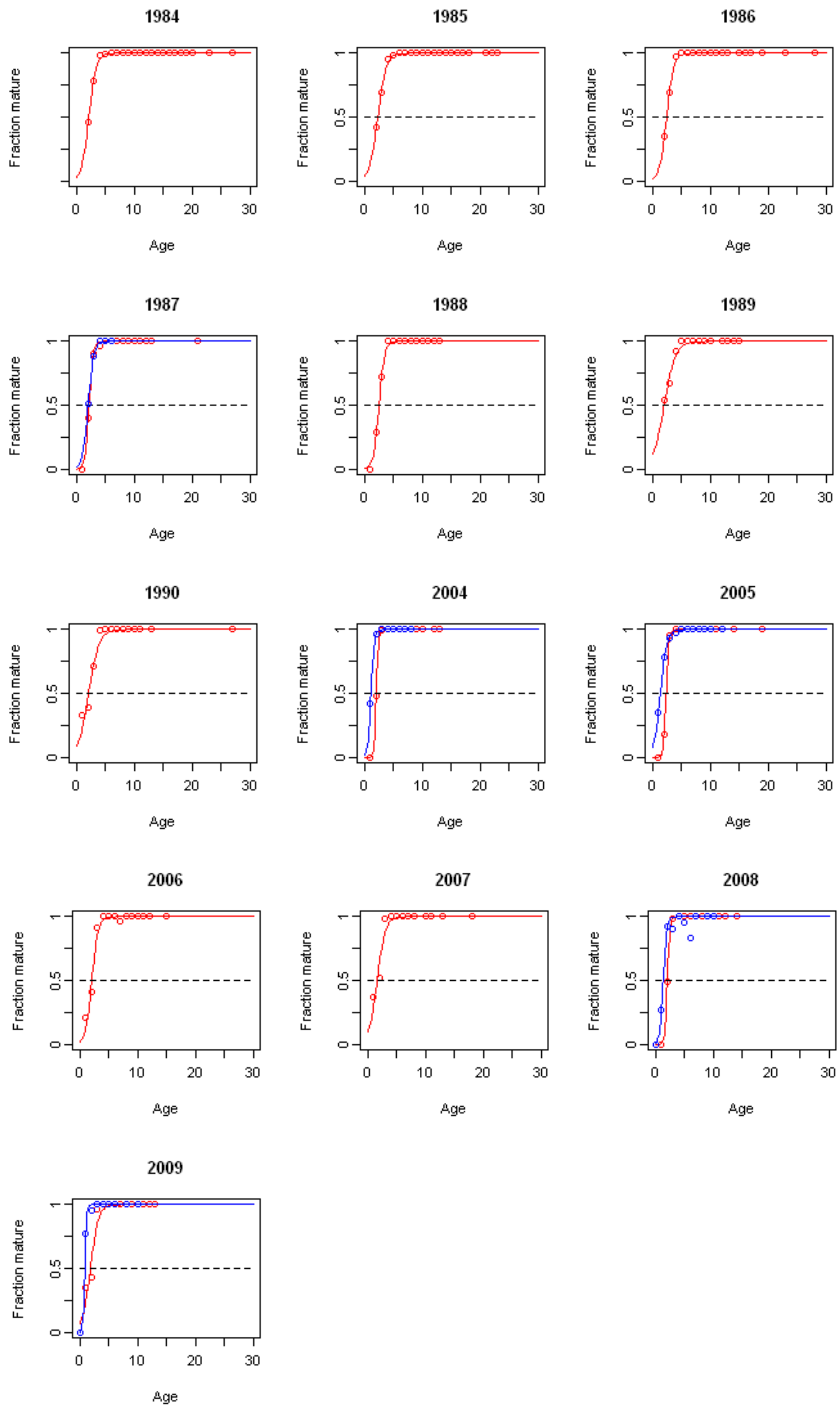

Figure 4.1.17 – Age data plotted against the fraction of mature female (red) and male (blue) turbot for the sampled years 1984-1990, 2004-2009 with corresponding fitted maturity ogive. Based on survey and market data.

Seabass

Data on seabass are available for a number of years from the market sampling programme (Table 4.1.1). These data have been used to create a length-weight and age-length relationship for males and females separately.

A power function (Equation 1) was fitted to the selected data to determine whether the relationship differs between years. Based on these results it was decided to pool all data over the different years for both sexes together (Figure 4.1.18). As the data originate from the market sampling programme, smaller individuals are missing in the analysis.

The von Bertalanffy growth curve (Equation 2) was fitted to the market data. The estimated parameter L_{∞} shows a decline and the estimated growth parameter, K, a slight increase, throughout the different cohorts (Figure 4.1.19).

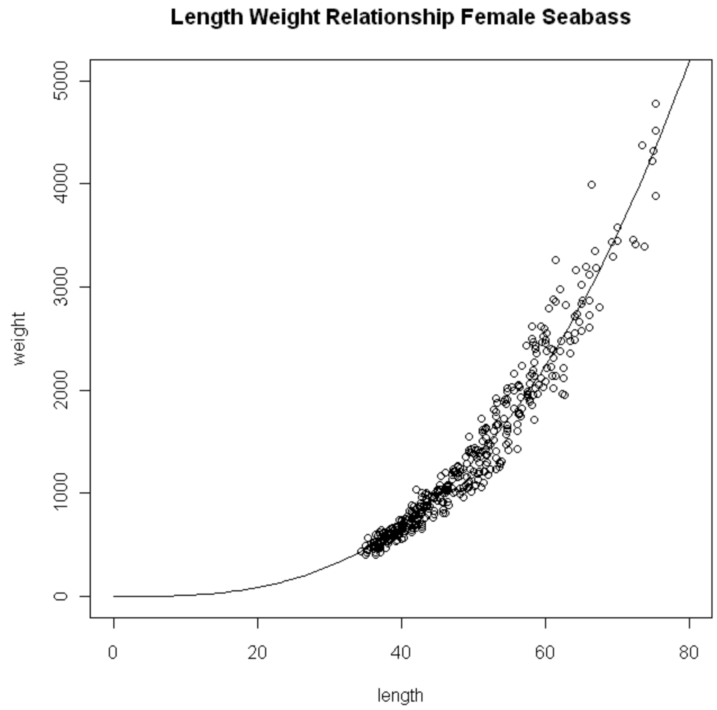

Figure 4.1.18 – Length-weight relationship of seabass for 2005-2009 and corresponding fitted power function (y ~ $0.013*x^{2.923}$). Based on market data.

Figure 4.1.19 – Estimated parameters L_{∞} (± S.E.) and K (± S.E.) from the von Bertalanffy growth curve for the different cohorts. Based on market data.

Grey gurnard

For grey gurnard data are available for 2010 from a single survey (Table 4.1.1). These data have been used to create a length-weight relationship (Figure 4.1.20). Unfortunately, it is not possible to follow the age-length relationship through the different cohorts as data are available for only one year.

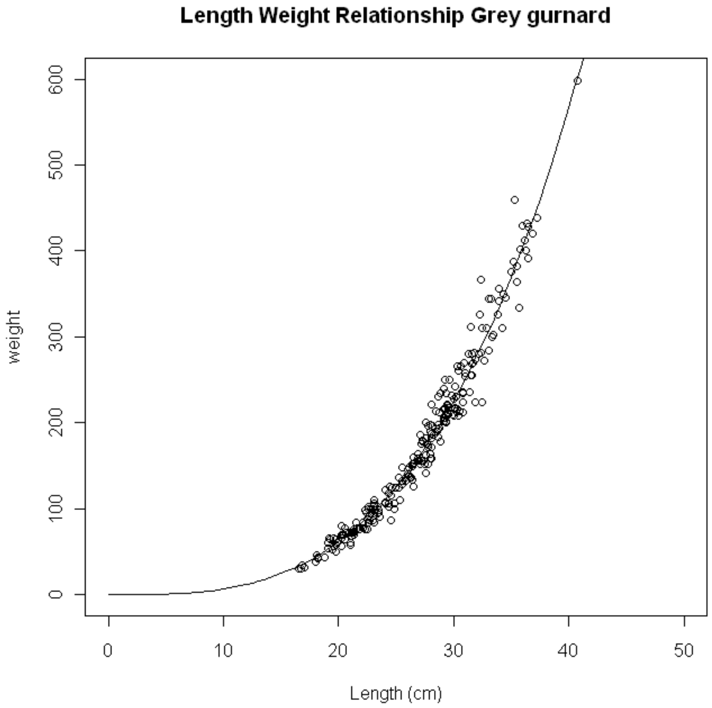

Figure 4.1.20 – Length-weight relationship of grey gurnard for 2010 and corresponding fitted power function ($y \sim 0.004 * x^{3.202}$). Based on survey data.

Striped red mullet
For striped red mullet data are available for 2008 from a single survey (Table 4.1.1). These data have been used to create a length-weight relationship (Figure 4.1.21). Unfortunately, it is not possible to follow the age-length relationship through the different cohorts as data are available for only one year.

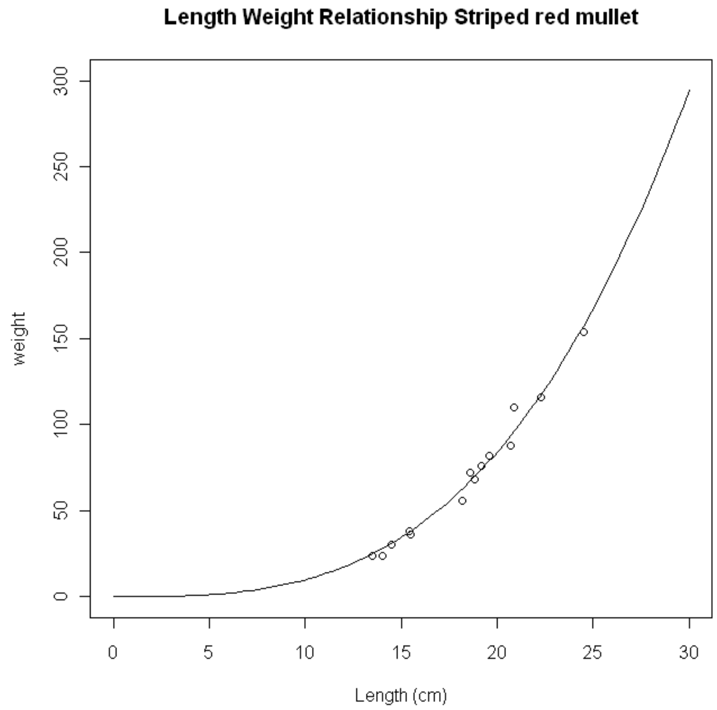

Figure 4.1.21 – Length-weight relationship of grey gurnard for 2008 and corresponding fitted power function (y ~ $0.008{*}x^{3.089}$). Based on survey data.

4.2 vTI: Growth and maturity of dab[19]

4.2.1 Length-at-age

Five data sets were available for age-length analysis, i.e. BTS survey series from the UK, The Netherlands and Germany, and commercial samples from the ICES division IVb (metier TBB80-89.>221kW) and division IIIc22 (OTB100-119.<=221kW).

Age readings in the UK survey were available from 1990 to 1999, and in the German BTS from 1999 to 2008. In the Dutch BTS survey, age readings were provided in two years, 2006 and 2008. Data are tabulated in Appendix 4.2 in Tables App4.2.1-4.2.2.

Commercial data were available for the Baltic Sea only for 2008. In the North Sea, 4 years 2006 to 2009 were analysed, i.e. age readings were not available from all commercial samples taken for discard analyses (see Table 3.5.3).

Survey samples
Length-at-age differed considerably between surveys and areas (Fig. 4.2.1). UK data indicate, that in the time period 1990 to 1999 in ICES divisions VIId and IVc corresponding to strata 9 and 5 of the dab stratification scheme, resp., length-at-age was considerably larger than in the following period in the German BTS in ICES division IVb in strata 4, 6 and 7 (see Fig. 2.4.1 for strata delineations). Whereas 0-group specimens seemingly differed only little in size between UK and German BTS samples, UK samples at age 1 indicate a much larger size as compared to German samples. This difference appears in all age groups until age 4. Older ages were only rarely recorded in the UK data set, so that no sound averages could be calculated.

UK samples indicate, that after age 2 growth rate is declining and length increments between older age groups are decreasing. In the German BTS, the decline in growth rate is more gradual. In 2003, length-at-age increased for all age groups, and markedly for age group 6. In 2007 and 2008, length-at-age for age groups 1, 2, and 3 has increased. These increases can be likely linked to relatively warm conditions in respective years, in particular 2003 was a very warm year (see Table 4.2.1).

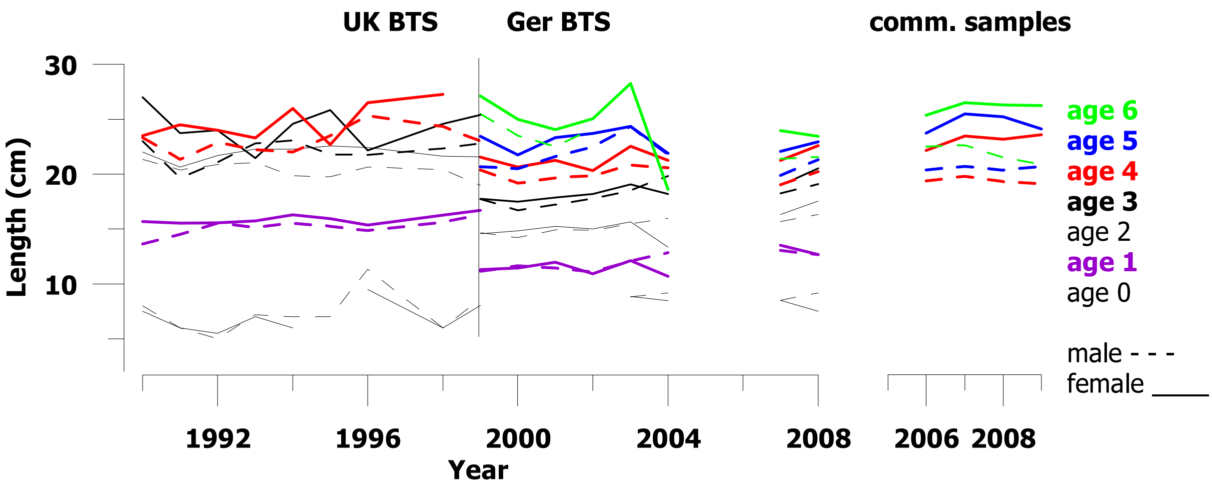

Fig. 4.2.1 – Average length-at-age for dab from surveys and commercial samples. UK beam trawl survey (BTS) in VIId and IVc (left), German BTS in IVb (middle) and commercial samples from IVb from metier TBB80-89 (right panel). Age 2 and 3 are not included in the right panel. Years indicated; male – broken lines, female – full lines; ages indicated by colour.

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[19] Authors: Maren Odefey and Heino Fock

Table 4.2.1 – Water temperature in strata 4, 5, 6, 7, and 9 of the dab stratification scheme from German CTD casts. Temperature in °C. * Water temperature at 20 m depth, mean annual values calculated.

Year	Water temperature *
1999	14.94
2000	13.94
2001	13.32
2002	14.55
2003	15.64
2004	15.38
2005	14.82
2006	14.67
2007	15.29

Ages of 6 and older are only rarely encountered in the samples of the German BTS, so that mean values are based on only few measurements. Thus, mean values for older age groups are less accurate than for younger age groups. For example, in 2004, age 6 comprising only two specimens were smaller in size than even age 4 specimens, for which 94 were measured.

Males are on average smaller than females at the same age. In extensive studies on the biology of dab (Bohl, 1959; Poulsen, 1933), the difference in growth between sexes has been attributed to differential maturation between males and females, i.e. males attain earlier maturation, so that in turn females on average can invest more energy in somatic growth and reach a larger size. This is analysed in detail in section 4.2.3.

A comparison with historic samples shows (Fig 4.2.2) (Bohl, 1959), that average length-at-age for ages 5-7 has not changed significantly between 1955 and 2008, taking into account that 2008 was a warm year with higher length-at-age (see Fig. 4.2.1). Data obtained during March 1990 (Rijnsdorp *et al.*, 1992) further corroborate the finding, that in general length-at-age relationships remained stable in the German Bight. Lengths measured in the 1990 study were slightly shorter, but seasonality must be accounted for. In 1955, a so-called 'Kuttertrawl' as German standard trawl was deployed with a codend meshsize of 40 mm as for the BTS (see Bückmann, 1932, for details on Kuttertrawl). The slight difference between 1955 and 2008 with regard to age class 2 could be due to density dependent effects in 2008 suppressing growth rates of younger, highly abundant age groups (see next section).

Commercial samples
Length-at-age from North Sea commercial samples is larger than for BTS survey samples (Fig. 4.2.1). Here, commercial samples were taken from metier TBB80-89 in stratum 4 and 6. A further comparison with OTB100-119 samples from the Baltic shows first, the importance of mesh size for establishing the length-at-age curve (Fig. 4.2.3), i.e. length-at-age increases with mesh size due to decreasing selectivity of the trawl. Second, it points out that growth differences between Baltic and North Sea are likely. Both these findings are reflected in Table 3.5.7, when the mean size for the catch increased with mesh size (North Sea TBB.80-99 to OTB.100-119), and when major differences in mean size appeared for OTB.100-119 between North Sea and Baltic. Poulsen (1933) linked higher size-at-age for Baltic dab (his Belt Sea, likely corresponding to b23 and c22) as compared to North Sea dab from Horns Reef to density dependent changes in growth, when for larger populations (North Sea) competition for food hinders growth.

Thus, only scientific samples with trawls of high selectivity for all size classes satisfy needs of length-at-age analysis.

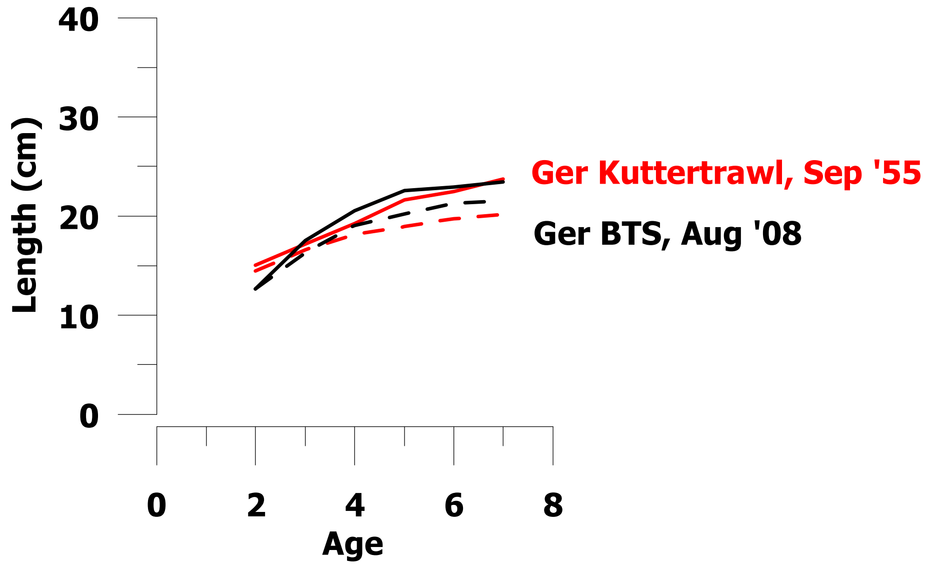

Fig. 4.2.2 – Comparison of length-at-age for two time periods, i.e. September 1955 from the German Bight, and August 2008 for ICES division IVb. Males – broken lines, females – full line.

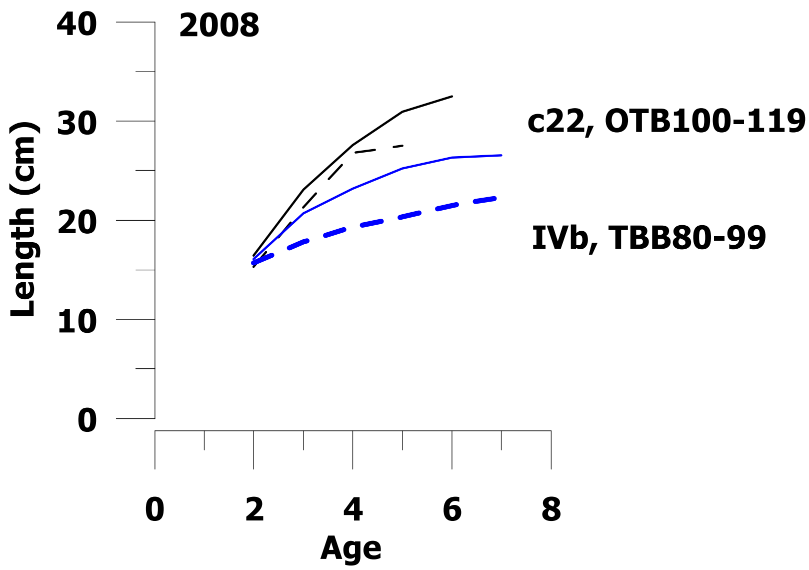

Fig. 4.2.3 – Length-at-age curves for two metiers and two areas, i.e. ICES divisions IVb and IIIc22. Year sampled =2008. Males – broken lines; females – full lines.

4.2.2 Growth

Growth patterns are analysed by means of the van Bertalanffy growth function (VBGF):

$$L_{age} = L_{\inf}(1 - e^{-k(age - t_0)}),$$

where Linf is length at infinity, k is the growth parameter and t0 is a correction factor to adjust for size at age 0. The growth parameter k can be modelled to include environmental and seasonal factors (Haddon, 2001), and Tyler (1958) established a relationship between environmental temperature T and growth parameter k as:

$$\log k \sim \log T$$

Tyler (Tyler, 1958) and later Pauly (1974) showed that natural mortality increases with environmental temperature, i.e. faster growth leads to higher natural mortality and smaller body size.

Growth functions need to be modelled for year classes in the same stratum. This means, that temperature is treated as a long-term variable, i.e. as a climatological parameter. Inter-annual variability with regard to temperature must be treated by length-at-age analysis (see section before).

From German CTD data, the following climatological pattern can be derived, again based on water samples from 20 m depth. Based on the dab stratification scheme, temperature decreases gradually from the southernmost stratum 9 to stratum 7. It is noteworthy, that in stratum 4, the wider Dogger Bank area, seasonal temperatures on average are higher than in stratum 6, the German Bight area, in three quarters of the year, i.e. 1-3.

Table 4.2.2 – Seasonal temperature values 1999-2008 by stratum from dab stratification scheme. Data basis : German CTD casts. Values in °C.

Season	Stratum 9	Stratum 5	Stratum 6	Stratum 4	Stratum 7
quarter 1		5.96	5.86	6.79	
quarter 2			10.91	12.12	
quarter 3		16.07	14.45	14.63	14.09
quarter 4	10.89	9.84	9.70	9.28	

In the analysis, t0 was constrained to -0.75 to account for autumn sampling in Q3 surveys, i.e. the true age of 0-groups is then 0.75 but not zero.

The results show high variability for the growth parameter k from 0.27 to 0.65 and correspondingly a range of Linf from 21.9 to 29.93 (Table 4.2.3). Results are in the range published by Pauly (1974) for Pleuronectiformes with growth parameters k from .08 to .40. Females have lower growth factors k (except for stratum 5) and larger sizes Linf as compared to male specimens from the same stratum. This is in line with the length-at-age analysis. Stratum 4 has the lowest Linf both for male and female dab with medium values for growth parameter k. In turn, highest growth parameters are indicated for stratum 9.

The distribution of k is correlated to the climatological temperature pattern, with highest values for k observed in stratum 9, and lowest values in stratum 7. There is also a difference between stratum 4 and 6 in accordance with the temperature difference between them, with stratum 4 having slightly higher values both for k and for sea temperature in 3 quarters of the year.

Linf is modelled too small and thus k in turn is modelled likely too high. The length-at-age analysis showed, that male specimens very well reach sizes of > 25 cm. Model fit would improve with more data available. It is not clear, whether the different time periods covered by the UK and German BTS has an effect on the analysis. However, the findings underline the importance of climatological parameters such as temperature in determining growth. They further provide indications on how extended migrations and thus stock boundaries might be, since stocks with high migration rates should on a multi-annual level show only little differences in growth rates by stratum. The results will be further discussed in relation to identifying stock boundaries (Chapter 5.1).

4.2.3 Maturity

Recent maturity data were available from commercial samples only, both for the North Sea (IVb, 2006-2008) and the Baltic (c22, 2008). Dab maturity in the North Sea was evaluated with a 4-level key, and status 2 and further were estimated as mature. For the Baltic, an 8-level key was employed, and status 3 and further was estimated as mature (Bohl, 1959).

Findings are in line with earlier work on dab maturity (Bohl, 1959; Poulsen, 1933) in that first, maturity in the Baltic is delayed as compared to the North Sea, and second, in that male specimens attain maturity earlier as compared to females (Table 4.2.4). This is more pronounced in the Baltic than in the North Sea. Our data indicate that already specimens at age 1 in the North Sea can reach maturity. However, Bohl (1959) provides no data on maturity for age 1 specimens but reports from two male specimens of size 11.5 and 13.5 cm for which maturity state could not be properly distinguished between juvenile or spent.

Table 4.2.3 – Results for VBGF parameters t0, k and Linf for dab from non-linear analysis (SAS NLIN).

Source	Stratum	Sex	Convergence Status	Error Sums of Squares	K	t0	linf
UK BTS 1990-1999	9	F	Converged	8622.96	0.55	-0.46	29.0
	9	M	Converged	7457.88	0.65	-0.5	25.0
	5	F	Converged	627.9	0.496	-0.4	28.25
	5	M	Converged	368.05	0.49	-0.55	25.52
Ger BTSs 1999-2008	4	F	Converged	7523.71	0.35	-0.75	25.35
	4	M	Converged	5080.54	0.46	-0.75	21.90
	6	F	Converged	11416.72	0.33	-0.75	27.91
	6	M	Converged	5402.98	0.43	-0.75	23.33
	7	F	Converged	5375.1	0.27	-0.75	29.93
	7	M	Converged	3554.32	0.36	-0.75	25.04

Table 4.2.4 – Proportion of dab attaining maturity by age, sex and region. Age 1 data were not available from the Baltic. North Sea (2006-2008), Baltic (2008).

Age	Baltic – male (n=92)	Baltic – female (n=165)	North Sea – male (n=721)	North Sea – female (n=1935)
1			0.38	0.43
2	0.61	0.25	0.89	0.82
3	0.82	0.26	0.97	0.93
4	1	0.62	0.99	0.97
5	1	0.81	0.98	0.97
6		1	1	1

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Tyler, C.C. 1958. Cod Growth and Temperature. Journal du Conseil, 23: 366-370.

4.3 ILVO: Life history characteristics of turbot and brill from different areas[20]

Due to the relatively low numbers of both turbot and brill in commercial catches (per trip) and the high commercial value of both species, it is very difficult to collect data on biological variables in sufficient numbers for a meaningful analysis. Fishermen very often don't allow observers to take otoliths from these species on board of commercial vessels (even when informing them that it is possible to sample the otoliths through the operculum in these species, making it unnecessary to cut open the heads and thus not influencing the appearance of individual fish and their value to buyers in this way), set aside sampling gonads for maturity staging (although the fish are gutted on board anyhow). Buying turbot and brill as part of the market sampling hasn't been an option for most countries either, because of their high prices. On surveys, catches of turbot and brill are generally even lower than on commercial vessels. Most likely this is due to the lower trawling speeds on surveys compared to commercial vessels, making it easier for bigger fish like turbot and brill to actively escape the nets. Both species grow relatively fast and generally reach a certain length faster (at younger ages) than other flatfish species in the same areas, leading to a higher proportion of bigger fish in the younger age-classes than in slower growing species such as sole *Solea solea* and plaice *Pleuronectes platessa*. This also means that it is much more difficult to obtain sufficient information on the bigger length classes for turbot and brill. Additionally, the shorter trawl durations on surveys decrease the chance to encounter an individual turbot or brill, that occur more scattered over a given area than other co-occurring flatfish species because of their predatory feeding behaviour (turbot and brill are piscivorous and could be regarded as top predators, except for the smaller larval stages).

4.3.1 Turbot

Age

ILVO extracted already existing age-information on turbot from its own database, and collected similar information from relevant project partners and some other countries that are not involved in the NESPMAN-project. This resulted in only very few data due to the problems of low occurrence in commercial catches and on surveys, in combination with a high commercial value, as explained above. For (some of) the areas covered in this study, only Belgium, Germany, the Netherlands and the United Kingdom currently still collect and read turbot-otoliths, but the time series are sometimes fragmented and therefore of little use for assessment-purposes.

The PGCCDBS meeting in Valetta, Malta, March 2007 (ICES 2007a), identified turbot as a species requiring an ageing workshop to evaluate and improve the age interpretation based on stained slides of the otoliths. One of the main difficulties in reading turbot-otoliths is the interpretation of the first annual ring, causing uncertainty among readers in national laboratories, and in the first turbot-otolith exchange that was organized in 2004. The WKART (Workshop on Age Reading of Turbot, 2008) could build on the results of this exchange and was the first ageing workshop for turbot. Because validated otoliths or agreed reference collections did not exist, the final debate on whether or not the first ring is indeed the first annual ring is still ongoing. The workshop therefore dedicated its effort to conclude to a common interpretation of this particular first ring and thus improve the agreement among readers. Also a manual on the preparation of turbot otoliths has been compiled, and documented with a reference set of annotated images (that should be used as an international approved set). This document can be used as a guideline and can form the template for discussion when refining the interpretation of the growth pattern and for identifying gaps and opportunities concerning the current knowledge of the age estimation of turbot. The overall agreement rate of the North Sea sample (N=110, besides this there was also a Baltic sample) was 82.8%. The range of agreement with the modal age was 70.5–91.1%. The results for this first turbot age reading workshop were evaluated by the participants as positive. For the North Sea area, expert readers should be able to reach an agreement of more than 90%. This indicates that the age estimation of turbot can be highly precise when the agreed interpretation is used, and applied on sufficient samples of good quality. Nevertheless, among the final recommendations of WKART some aspects illustrating the need for further research still remained: 1) compare different methods for the preparation of otoliths to determine a standard international procedure, 4) build a collection of otoliths that documents the edge growth, and 6) compile certified otoliths to determine the status of the first ring. A new turbot-otolith exchange was proposed by WKART (2008) for the Baltic, and approved by ICES PGCCDBS 2010 for the North Sea, the Baltic Sea and the Black Sea.

[20] Author: Kelle Moreau

Annemie Zenner (ILVO, Belgium) will act as a coordinator for this exchange which will be carried out in 2010-2011. Meanwhile, for the North Sea, Skagerrak, English Channel, Celtic and Irish Seas, ILVO started collecting more turbot-otoliths through increasing the Belgian sampling-effort for this species and engaging in regional coordination contracts with other European Member States regarding the sampling and reading of turbot otoliths within the framework of the RCM NS-EA (Regional Coordination Meeting for the North Sea and the Eastern Arctic) and the RCM NA (Regional Coordination Meeting for the North Atlantic). Under these contracts, other Member States can send the otoliths they collected to ILVO for reading.

Reproductive characteristics (sex-ratio, maturity)
A lot of work on the maturation of turbot has been carried out in the past by various authors (e.g., see Boon & Delbare 2000, and references therein). Some important findings on sex-ratio and maturity of turbot (mainly females) are summarized in Table 4.3.1. Due to sampling outside the main spawning months (fisheries scientists and observers are often dependent on seasonal fisheries for data collection) no certain assumptions could be made on the length range during first maturation for turbot in the English Channel, Celtic and Irish Seas.

Table 4.3.1 – Summary of reproductive characteristics of female turbot from different ICES areas.

	North Sea/ Skagerrak	English Channel	Celtic Sea	Irish Sea
Proportion females (age 2 - 5 years)	50 - 80 %	30 - 50 %	40 - 60 %	40 - 50 %
Proportion females (age > 5 years)	60 - 80 %	10 - 100 %	35 - 100 %	30 - 100 %
Spawning period	Apr – Aug	May - Sep	Apr - Jul?	May – Aug?
Length at 0% maturity	30 cm	35 cm	35 cm	35 cm
Length at full maturity	47 cm	ND	ND	ND
Age at maturity males	3 years	3 years	3 years	3 years
Age at maturity females	4-5 years	4-5 years	4-5 years	4-5 years
Monthly variation in condition factor	NO	NO	NO	NO

ND* : not determined

After checking the databases of ILVO and the relevant project partners, it proved impossible to find series of maturity-data for turbot that could add to this knowledge and could already be used for assessment-purposes. Since no biological sampling for turbot was scheduled under the NESPMAN contract, additional maturity information could not be gathered. However, the maturity stage is an important biological parameter to be used in the calculation of maturity ogives (and therefore of Spawning Stock Biomass), for the definition of the spawning season of a species, for the monitoring of long-term changes in the spawning cycle, and for many other research needs regarding the biology of fish, illustrating the need for reliable maturity staging abilities. Also judging from WKMSSPDF (2010), a workshop on maturity staging for other commercial flatfish species (including turbot and brill) might be useful. However, the lemon sole staging during WKMSSPDF shows that having the expertise in staging one species of flatfish can be adequate to stage other species of flatfish. After reviewing the species list of Appendix VII of the DCF against the details of previously held workshops, PGCCDBS (2010) considered that there is sufficient interest and need to hold a maturity staging workshop on turbot, as national maturity scales exist for this species but no maturity staging workshop has previously been held. As this is a group 2 species in the DCF and there are constraints on the number of workshops that should be held in 2011, the workshop is proposed for 2012 and will take place in Ijmuiden (WKMSTB – Workshop on Maturity Staging of turbot and brill). This timing will also allow for sufficient opportunities to organize the collection of suitable fresh samples. The workshop will focus on the following issues: agree on a common maturity scale for turbot across laboratories comprising a comparison of existing scales and standardization of maturity determination criteria, reduce sources of error on maturity determination validating macroscopic staging, establish correspondence between old and new scales to convert time series, and propose optimal sampling strategy to estimate accurate maturity ogives.

4.3.2 Brill

Age
As for turbot, ILVO extracted already existing age-information on brill from its own database, and collected similar information from relevant project partners and some other countries that are not involved in the NESPMAN-project. Also for brill this resulted in only very few data due to the problems of low occurrence in commercial catches and on surveys, in combination with a high commercial value, as explained above. For (some of) the areas covered in this study, only Belgium, the Netherlands and the United Kingdom currently still collect and read brill-otoliths, but the time series are sometimes fragmented and therefore of little use for assessment-purposes.

The last brill otolith exchange took place in 2005. A small-scale exchange comprising mainly the North Sea countries (but open to other participants) was recommended by PGCCBDS 2009, and will be carried out in 2010. Annemie Zenner (ILVO, Belgium) will act as coordinator for the exchange. Depending on the results of this otolith exchange (overall agreement among readers, CV's), an age reading workshop might be recommended afterwards.

Reproductive characteristics (sex-ratio, maturity)
For brill, less work on the maturation has been carried out in the past than for turbot. Especially the studies of Delbare & De Clerck (1999) and Boon & Delbare (2000) (and the references therein) are worth mentioning in this respect. Some important findings on sex-ratio and maturity of brill (mainly females) are taken over from Delbare & De Clerck (1999), and summarized in Table 4.3.2.

Table 4.3.2 – Summary of reproductive characteristics of female brill Scophthalmus rhombus from different ICES areas (after Delbare & De Clerck, 1999).

	North Sea	English Channel	Celtic Sea	Irish Sea
Proportion females (age 2 - 7 years)	30 - 60 %	10 -60 %	15 - 50 %	40 - 70 %
Proportion females (age > 7 years)	15 -100 %	10 - 15 %	5 - 100 %	100%
Spawning period	March – June	March - April	February - May?	March – May?
Length at 0% maturity	39 cm	46 cm	39 cm	37 cm
Length at full maturity	ND*	47 cm	49 cm	46 cm
Age at maturity (sexes combined)	3 years	4 years	3 years	4 years
Monthly variation in condition factor	NO	NO	NO	NO

ND* : not determined

At present, the databases of ILVO and the relevant project partners don't contain additional series of maturity-data for brill that could add to this knowledge and could already be used for assessment-purposes. Since no biological sampling for brill was scheduled under the NESPMAN contract, additional maturity information could not be gathered. Since the maturity stage is an important biological parameter to be used in the calculation of maturity ogives (and therefore of Spawning Stock Biomass), for the definition of the spawning season of a species, for the monitoring of long-term changes in the spawning cycle, and for many other research needs regarding the biology of fish, it is important to proceed studying the maturation for species for which management advice is requested and analytical assessments are to be developed, such as brill. This species also emerged as a species deserving a maturity staging workshop from the review of the species list of Appendix VII of the DCF against the details of previously held workshops by PGCCDBS (2010), and is therefore included in the workshop that will be organized on turbot (WKMSTB – Workshop on Maturity Staging of turbot and brill – Ijmuiden, 2012) (see section 4.3.1.2).

4.3.3 Recommendations to improve sampling of biological parameters for assessment-purposes in turbot and brill

Turbot and brill are currently classified under the DCF as Group 2 species. This group comprises internationally regulated species that don't drive the international management process, and major non-internationally regulated by-catch species. For Group 2 species, the collection of data on biological parameters such as age, sex-ratio and maturity, is only required under the DCF once every three years. No analytical age-based assessment techniques can cope with non-yearly time series, making the development of an (age-based) assessment Therefore, a transfer of turbot and brill from Group 2 to Group 1 (species that drive the international management process, including species under EU management plans or EU recovery plans or EU long term multiannual plans or EU action plans for conservation and management based on Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and the sustainable exploitation of fisheries resources under the common fisheries policy) might be required, since the DCF prescribes a yearly collection of these data for Group 1 species, enhancing the evolution towards analytically supported management advice.

Given the problems in collecting age- and maturity-samples in turbot and brill, and the relatively high dependence on market sampling for these species, Member States should incorporate financial means for market sampling of turbot and brill in the financial files of their National Programmes so the high commercial values of these species won't create sampling problems anymore.

4.3.4 Maturation or discarding?

In several geographical areas, Minimum Landing Sizes (MLS) have been installed for turbot and brill by different authorities. The most frequently applied Minimum Landing Size (MLS) for both species is 30 cm (e.g., in Belgium, the Baltic, the English Sea Fisheries District Cornwall, …). But does a MLS of 30 cm make biological sense for these species? To answer this question we refer to Tables 4.3.1 and 4.3.2, and work out an example for brill in the North Sea.

In all areas covered in this project, not a single brill was found that measured less than 37 cm and already reached sexual maturity. The first individuals mature at 37 cm, while all are mature only at lengths from 46-49 cm. Remember that Table 4.3.2 only represents data on females! In other words, when a MLS of 30 cm is used, all landed females measuring 30 to 37 cm are sexually immature and didn't have the chance to reproduce themselves. Given the fact that males generally mature at shorter lengths in related species (mature at the same age as females, but grow slower), the impact of a too small MLS is higher on females. Based on the results of Delbare & De Clerck (1999), and taking the length at 0% maturity as a criterion, a MLS of 40 cm would make much more sense in a biological way. In the English channel and the Gulf of Biscay (where brill grow faster and generally mature at greater lengths), MLS's should be even higher. Table 4.3.3 gives the mean discard percentages of brill per area in 2007-2008, as documented in the Belgian observer programme. Discard percentages range from 0 – 7 %, which are values that are sufficiently low to be considered acceptable under the current legislations. So it seems justified to state that the MLS of 30 cm doesn't raise any problems for brill from a discard perspective. Increasing the MLS to a higher length, which makes sense from the maturity viewpoint, would quickly lead to higher discard percentages (e.g., put the MLS at 40 cm in Tab. 3.6.10 and compare the numbers of fish that should be discarded now with the ones when a MLS of 30 cm was retained), that cannot be lowered using the technical adaptations that are currently used and tested in bottom trawl fisheries. In this context, the survival of discarded brill should be documented.

Table 4.3.3 – Mean discard percentages of brill per area in the Belgian observer programme in 2007-2008.

Area	Mesh size	# Trips	Discard percentage
VIId	80-89	11	0.0036
VIIe	80-89	1	0
VIIfgh	80-89	8	0.0152
VIIa	80-89	6	0.0788
Mean			0.0244

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5 WP4 – Analysis of stock ID

5.1 vTI-SF: Stock ID in dab and possible assessment areas[21]

In this section, evidence is provided through the analysis of spawning grounds and tagging experiments, meristic data, landings and catches, and length and growth parameters and reconciled in the form of a synopsis to outline possible stock boundaries of dab.

Under the EU Data Collection Regulation, 5 stocks/management units have been defined (those underlined are subject to sampling under the DCR):

- II, V, VI, VII (excl. d), VIII, IX, X, XII, XIV
- IIIa north
- IIIa south, IIIb-d
- IV, VIId
- VIId.

Spawning grounds
Several spawning grounds are known and the wide distribution of dab indicates the presence of more than one stock (Table 5.1.1). For ICES division IVb, repeated analyses (Rijnsdorp *et al.*, 1992, and references therein) revealed two major spawning grounds for the North Sea, i.e. the German Bight proper and the Frisian islands (stratum 6 according to the dab stratification scheme) and off the southern edge of the Dogger Bank, referring to stratum 4. The spawning area in the German Bight proper is linked to spawning locations further along the Dutch coast (see Table 5.1.1), resulting in a network of spawning locations in coastal areas along the Dutch and German coasts. The next spawning locations outside the North Sea are identified in the western Channel, the Irish Sea and Kattegat.

In the Baltic, historic data reveal a no longer existing spawning ground for the stock associated to the Baltic proper in the Bornholm Basin (IIId25) (Nissling et al., 2002). However, egg surveys for other areas are available to only a limited extent to verify potential spawning grounds, and information on spawning in III c22 was not available.

Based on the spawning information, the German Bight and the adjacent part of the Dutch and Belgium coast appear as major spawning locations in the North Sea.

Meristic data
Meristic data (Lozán, 1988) corroborate the hypothesis of several stocks for dab, distinguishing significantly between populations from western British waters, the North Sea and the Baltic. Further, tagging experiments and significant meristic differences within Baltic populations led Temming et al. (1989b) to suggest an individual stock around Bornholm, separated from IIIc22. As mentioned above, this stock or stock component has disappeared. Findings from Poulsen (1933) indicate a rather gradual shift for meristic features from the North Sea to Baltic, reflecting rather environmental changes than stock specific features.

Thus, meristic differences on the scale of ICES divisions must be interpreted with caution.

[21] Authors: Heino Fock and Maren Odefey

Table 5.1.1 – Dab spawning grounds, nurseries and affiliated populations

Spawning Ground (ref)	Nursery Ground (ref)	Adult population (ref)	Remarks (ref)
	Kattegat (8)		Referring to ICES IIIa
	Bridgwater Bay (1)	Bristol Channel (1)	Referring to ICES VII f
Off Flamborough Head (2), Dogger Bank (4,5)		Humber-The Wash - Doggerbank (?)	Adult population delineated by means of survey results in (3). Ref. to ICES IV b
Central German Bight (5)	E Coastal zone & Wadden Sea	German Bight-Doggerbank-Southern Bight	Referring to ICES IV b According to findings from Campos et al. (1994) spawning grounds in the German Bight and the Southern Bight are not separated
Southern Bight (5) Eastern Channel (5)	SE Coastal zone of Southern Bight (6) Eastern Channel (7)		Referring to ICES IV c
	Western Scottish waters (9)		Referring to ICES VI a
		Western Channel (10)	

1- Henderson and Holmes (1991), 2 - Harding and Nicholls (1987), 3- Rijnsdorp et al. (1992), 4 - van der Land (1991), 5 - Bohl (1959), 6 - Bolle et al. (1994), 7 - Amara et al. (2001), 8 - Pihl (1989), 9 - Steele and Edwards (1970), Edwards and Steele (1968), 10 - Ortega-Salas (1979), Ph.D. thesis 1981

Survey catches and landings

According to IBTS Q1 data for the North Sea, the abundance of dab has increased markedly in the long-term (ICES, 2005). The increase was partly related to opportunistic adaptations to trawl fisheries (Kaiser & Ramsey, 1997). It is not fully clear whether this approach is sufficient to fully explain the increase in strata 4 and 6 of the dab stratification scheme as shown in Chapter 2.4, i.e. the German Bight proper and the Dogger Bank. In turn, major landings are realised from the German Bight and the Dutch coast, and a fairly contiguous fishing ground is present in the eastern North Sea from the Dutch coast to the Skagerrak (see Chapter 3.5). Only minor landings are obtained from the Channel in VIId and from the Belt Sea (i.e IIIa south).

For the Baltic, an analysis of long-term data since the 1920s revealed a severe decline in dab stocks, potentially related to bottom oxygen deficiencies in the 1970s observed in the Baltic proper and to cod predation (Temming et al., 1989a). As a consequence, dab fisheries in the Baltic proper collapsed and only fisheries in c22 and – to a very little extent – d24 remained (Florin, 2005).

In the Baltic, a persistent increase in abundance is observed for c22. In IIIa, only sporadic high values are recorded.

Based on these landings and survey data, two main centres of distribution can be discerned, i.e. strata 4 and 6 in the North Sea referring to ICES div. IVb, and III c22 in the Baltic. For IVb and IVc, this connectivity is evidenced through extensive tagging experiments (de Clerck, 1984; Rijnsdorp et al., 1992).

LFDs, Length-at-age and VBGF parameters

Analysis of length-frequency distributions (LFDs) for the period 1998-2005 for which a consistent catch record is available reveals considerable differences between ICES divisions IVb and VIId,e. In IVb with high dab catches, LFDs are truncated to lengths <30 cm (see Chapter 3.5). This is consistent with LFDs from BTS surveys for area IVb (Fig. 5.1.1). Specimens < 20 cm are usually discarded.

On average, in IVb one to two length groups can be discerned in the BTS catch. In turn, in VIId,e where in particular in VIIe catches are low and declining, a diverse structure of the LFDs is evident (Figure 5.1.2). On average, three to four length groups are present. Specimens older than 5 years (app. length >28 cm) are frequently present in the stock (see Fig. 4.2.1 for UK BTS samples).

For the Baltic III c22, length data from commercial samples was very different to findings for the same métier from ICES division IVb, both in terms of catch composition (Chapter 3.5) and length-at-age (Chapter 4.2).

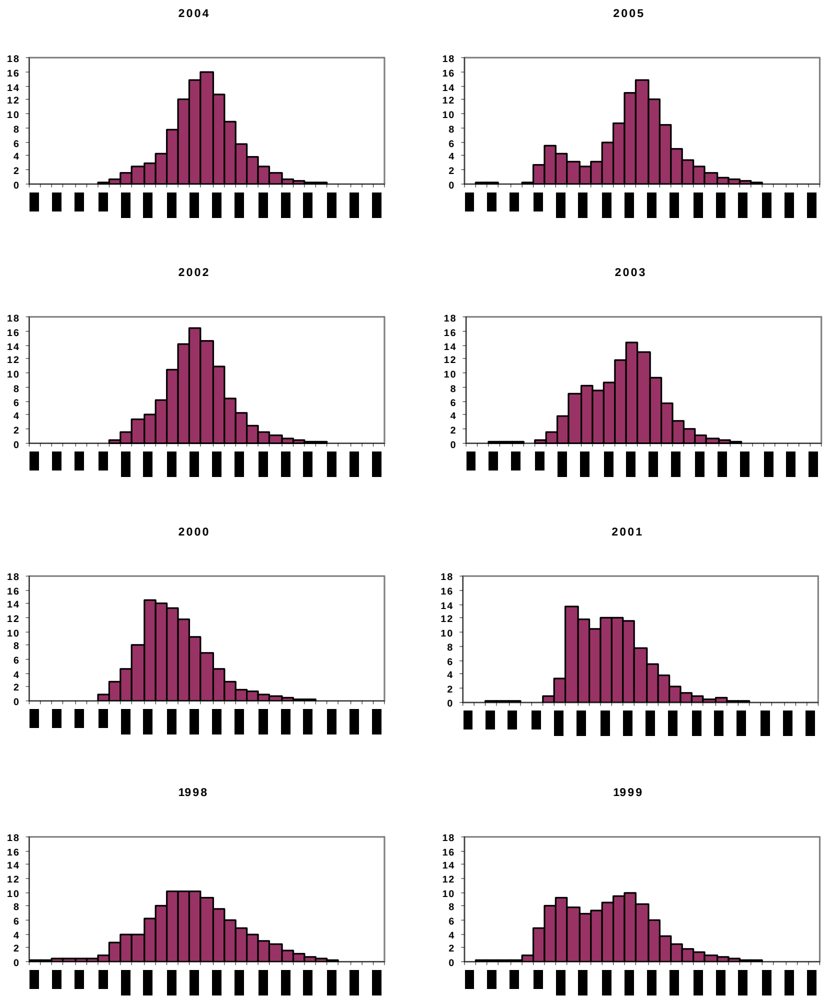

Figure 5.1.1 – Length-frequency distribution (LFD) of dab from the German Q3-survey, ICES area IVb. Frequency in %.

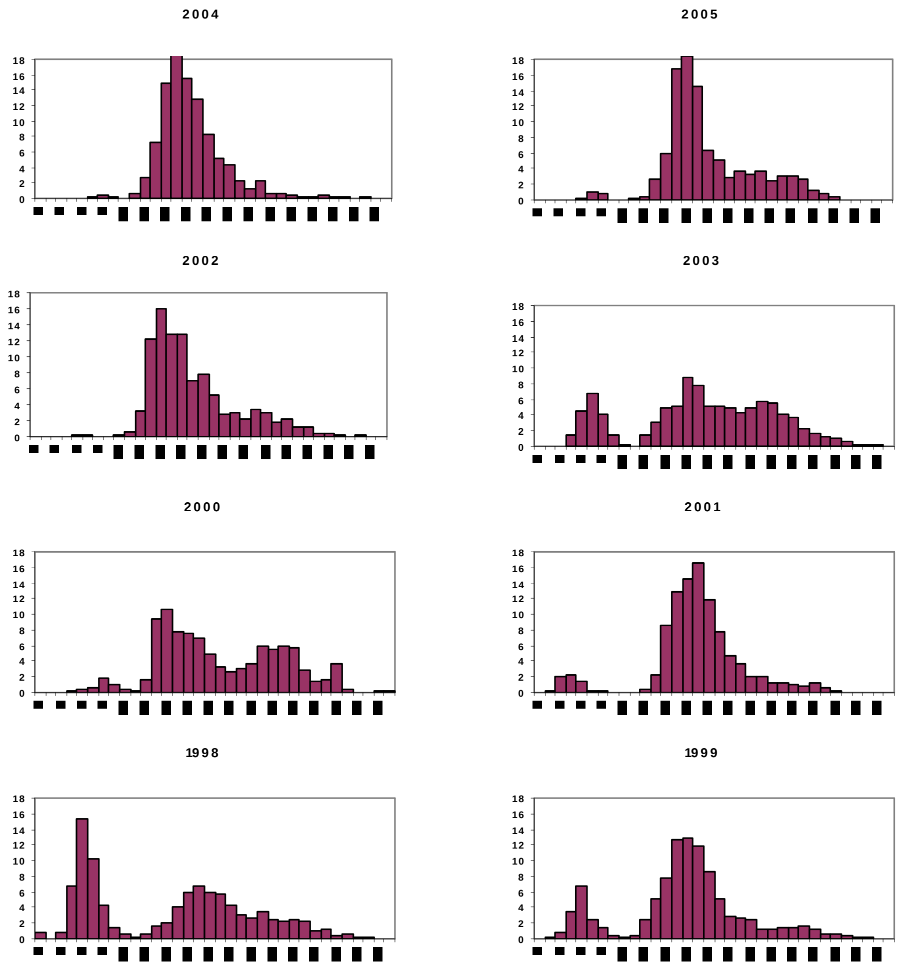

Figure 5.1.2 – LFD from the French Q4 survey, ICES area VII d,e. Frequency in %.

The difference between VIId and IVb as evidenced by LFDs is further corroborated by analysis of growth parameters (Chapter 4.2). Here, the Linf-k relationship can be applied to identify stock components or stocks (Begg, 2005). Linf-k is highly negatively correlated (Pauly, 1974), and deviations from the linear relationship indicate presence of more than one component.

Based on results presented in the VBGF analysis in Chapter 4.2, Linf-k combinations can be interpreted as three groups. The first group comprises both sexes in the strata 4, 6 and 7 (Fig. 5.1.3). The six points available form an almost perfect line with negative slope. The adjacent stratum 5 has a likely intermediate character for Linf and k and a non-negative slope, whereas in stratum 9 again a negative relationship is achieved. Length-at-age for the UK BTS referring to stratum 9 was very different to the corresponding figures for IVb, in particular for strata 4 and 6. This leads to the interpretation of stratum 5 as transient zone between strata 9 and 4, 6 and 7.

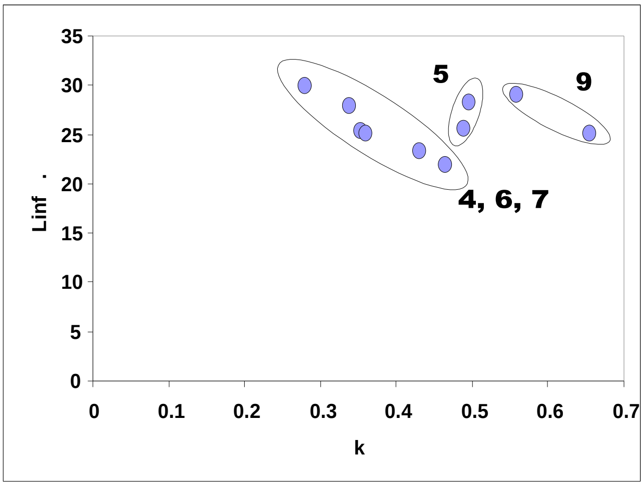

Figure 5.1.3 – Linf-k diagram of results from VBGF analysis (see Table 4.2.3). Three groups of strata can be separated, for which stratum 5 is a transition between 9 and 4,6,7.

Reconciling evidence

Based on three lines of information, i.e. (1) abundance and landings show two major centres of distribution, one in c22 and the other in the North Sea; (2) VBGF parameters and correspondingly length-at-age and LFDs show clear differences between southern areas, i.e. stratum 9 and VIIe, and the North Sea strata 4, 6, 7, and the Baltic and (3) spawning concentrations are evidenced for the German Bight, supported by tagging results; two major stock components can be identified, i.e. one in the western Baltic in III c22, and the other in the eastern North Sea in IVb. A transitional zone in IVc links the North Sea to the Channel populations. This is in accordance to the present sampling scheme suggested by the EU Data Collection Regulation.

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5.2 ENIB and IFREMER: Stock ID in striped red mullet[22]

For stock assessment and management, it is necessary to identify the different stocks that occur in the distribution area of a certain species. Stock structure is often investigated using morphometrics, morphologics, genetics, or some combination of the above. Otolith shape reflects the growth pattern of a fish as well as being markedly species specific. As a result the shape of the otoliths can be used to differentiate stocks of the same species. ENIB has co-ordinated a study of stock ID of striped red mullet that has been carried out in close co-operation with IFREMER.

Otoliths were collected, by IFREMER, during research vessel surveys and from the market, primarily during 2009. In all cases, the sagitta otoliths were used and cleaned beforehand. The otoliths are burned before ageing (ICES, 2007).

Before burning, images of whole otoliths were made for processing using both transmitted and reflected light with fixed light direction, angle and intensity. Each otolith was digitised and interpreted with the TNPC software dedicated by IFREMER.

A total of 800 otoliths and 1600 images (reflected and transmitted light) were planned and achieved for this project. For the samples, a database was created comprising all information required for the project: fish information (case-study, capture date, fish length) and otolith information (estimated age).

In this WP, three techniques have been applied: a Fourier, PCA and Geodesic approach. For more details on these methods see Nasredinne *et al.* (2009). Images of whole otoliths have been acquired for processing using both transmitted and reflected light. From 800 otoliths coming from six different parts of the distribution area of striped red mullet (Figure 5.2.1), we will consider five different image datasets in this analysis:

Dataset 1: 600 otoliths sampled from six different areas (100 otoliths per area):

- NS: North Sea (IVab) - 2009
- EEC08: Eastern Channel (VIId) - 2008
- WEC: Western Channel (VIIe) - 2009
- CS: Celtic Sea (VIIh) - 2009
- NBB: North Bay of Biscay (VIIIa) - 2009
- SBB: South Bay of Biscay (VIIIb) - 2009

Dataset 2: 600 otoliths with the 100 Eastern English Channel otoliths from year 2007 instead of 2008:

- EEC07: Eastern English Channel (VIId) - 2007

Dataset 3: 700 otoliths: the 600 otoliths of dataset 1 with the 100 otoliths EEC07 in addition.

Dataset 4: 200 otoliths, those from the Eastern Channel over the two consecutive years 2007 and 2008:

- EEC07: Eastern Channel (VIId) - 2007
- EEC08: Eastern Channel (VIId) - 2008

[22] Authors: Sébastien Carbini, Abdesslam Benzinou, Kélig Mahé &Romain Elleboode

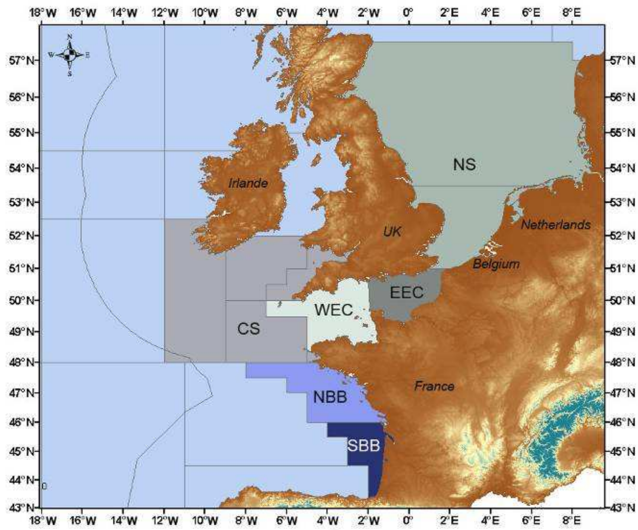

Figure 5.2.1 - The parts of the distribution area of striped red mullet involved in this study.

Dataset 5: 200 otoliths from the North Sea (IVab) from the same year 2009 randomly divided in 2 classes:

- NS09a: North Sea (IVab) - 2009 a
- NS09b: North Sea (IVab) - 2009 b

These datasets illustrate two different types of applications of otolith shape classification: stock discrimination (datasets 1, 2 and 3) and year discrimination (datasets 4 and 5). Both issues are quite hard for current state of the art computer vision techniques because the external shapes of otoliths exhibit very few differences.

For the year discrimination issue, the test is carried out on dataset 4 and dataset 5 separately. As dataset 5 is composed of randomized classes, the classification performances on this dataset should be close to those of a theoretical random classifier (i.e. 50%). The difference in performances between dataset 4 and dataset 5 gives an idea of the validity of the results.

Outline extraction

Otolith outlines were extracted using the Matlab image processing toolbox. To extract the otolith outline, a mixed image is built in order to integrate information available in both transmitted and reflected imaging modalities (Figure 5.2.2). This mixed image is a mean between the transmitted light image and the negative of the reflected light image.

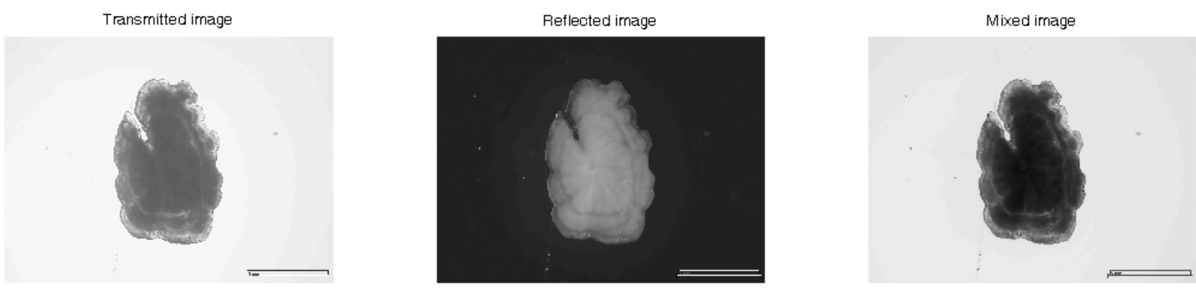

Figure 5.2.2: Transmitted light (left), reflected light (middle) and resulting mixed image (right).

Then the contours are detected as maximum of the image gradient, approximated using a Sobel filtering. The resulting contours are filtered and some basic operations such as erosion and dilatation are applied so that the remaining contour corresponds to the edge of the otolith.

A normalization procedure is then applied to these raw contours to be invariant in translation, rotation and scaling, so that the normalized shape is the result of the fish history, independently of acquisition settings. The translation invariance is obtained simply by subtracting the coordinates of the center of mass to the coordinates of all points, so that the shape is centred on the origin. Scale invariance is also simply obtained by dividing each point of the contour in polar coordinates by the mean radius. The most difficult part of the normalization step is rotation normalization. A simple way to do that would be to normalize in rotation according to the main axis of the shape (i.e. the axis defined by the two farthest points of the shape) but here this axis does not correspond to a meaningful biological feature. Instead, we automatically detect the point corresponding to the center of excisura major. We then align each shape in rotation using the axis that passes through this point and the center of mass of the otolith contour. As a result, the normalized shape is independent of acquisition settings and can be used for stock identification (Figure 5.2.3).

Primary test
From the normalized external shape of the otolith, we compare three approaches (Fourier, PCA and Geodesic) to estimate the distance between the shapes of the two selected stocks: North Sea (NS) and Eastern English Channel (EEC07). Each stock is represented by 100 otolith images. The discriminative power of each distance estimation method is evaluated using its own distance matrix as input for a k-nearest neighbours classifier tested with the "leave one out" heuristic (Figure 5.2.4). Experimentally, we have set k to 4 for all classification tests.

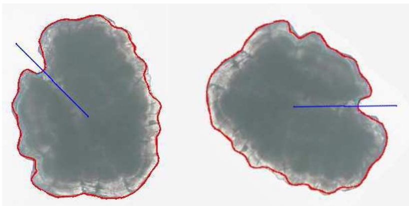

Figure 5.2.3 - Otolith contour extraction and normalization. Left: contour before normalization, right: contour after rotation normalization. Red: contour, Blue: main axis passing through the contour center and the excisura major center.

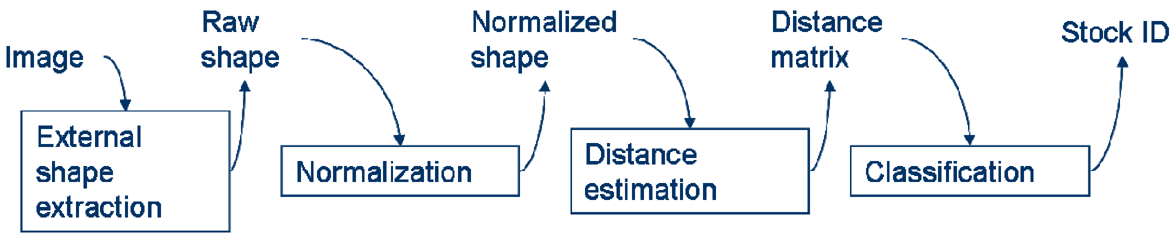

Figure 5.2.4 - Proposed classification scheme for primary test.

Table 5.2.1 - Mean percentage of correct classification per method on two selected striped red mullet stocks: North Sea (IVab) and Eastern Channel (VIId).

Method	% classification rate
Geodesic	64.0 %
Fourier	71.5 %
PCA	71.0 %

The results of this preliminary test (Table 5.2.1) were obtained using a preliminary version of the outline extraction algorithm. Moreover, this test was carried out on the two stocks available at this time and the two stocks are from neighbouring geographical zones which represents a challenging task. In addition, samples of the two stocks are from different years (2007 for EEC07 and 2009 for NS). However, the results are quite good and better than the theoretical results of a random classifier (50% for 2 classes).

Fourier approach

Regarding the year discrimination issue (Table 5.2.2), the mean classification rate on dataset 4 (56%) is too close to the theoretical mean classification rate of a random classifier (50% for 2 classes). The results on dataset 5 (43%) shows that try to discriminate random samples from the same stock and the same year with Fourier approach can lead to results slightly far away from the theoretical mean classification rate of a random classifier. Thus the results on dataset 4 do not show any differences between years and so the classical Fourier approach fails on this specific year discrimination issue.

Regarding geographical zones discrimination issue, the classes in Table 5.2.3a and 5.2.3b are ordered according to the position of their corresponding geographical zone, from north (NS) to south (SBB), thus neighbour classes are also neighbour geographical zones. Fourier approach reaches 19.7% of mean correct classification on dataset 1 (Table 5.2.3a). This score is better than a random classifier that would theoretically reach 16.7% (for 6 classes).

Table 5.2.2 - Confusion matrix and mean correct classification rate (in %) for the Fourier approach on dataset 4 (left) and dataset 5 (right).

Dataset 4 - Eastern English Channel		
	Actual Class	
Estimated Class	**2007**	**2008**
2007	**54**	42
2008	46	**58**
mean rate: 56%		

Dataset 5 - North Sea		
	Actual Class	
Estimated Class	**2009a**	**2009b**
2009a	**43**	57
2009b	57	**43**
mean rate: 43%		

Table 5.2.3a - Confusion matrix (in %) for the Fourier approach on dataset 1. Mean correct classification rate: 19.7%.

Dataset 1						
Estimated Class	Actual Class					
	NS	**EEC08**	**WEC**	**CS**	**NBB**	**SBB**
NS	**18**	20	11	18	18	12
EEC08	21	**28**	25	17	6	14
WEC	8	19	**12**	16	7	14
CS	21	12	18	**13**	11	14
NBB	16	9	14	16	**23**	22
SBB	16	12	20	20	35	**24**

Table 5.2.3b - Confusion matrix (in %) for the Fourier approach on dataset 3. Mean correct classification rate: 16.4%.

Dataset 3							
Estimated Class	Actual Class						
	NS	**EEC07**	**EEC08**	**WEC**	**CS**	**NBB**	**SBB**
NS	**15**	10	22	7	18	13	11
EEC07	15	**19**	12	23	14	11	11
EEC08	17	16	**24**	18	17	7	11
WEC	6	17	14	**7**	14	5	11
CS	20	14	8	17	**7**	12	11
NBB	16	14	8	12	15	**20**	22
SBB	11	10	12	16	15	32	**23**

PCA-approach

Regarding the year discrimination issue (Table 5.2.4), the mean classification rate on dataset 4 (60%) is higher than the mean classification rate on the random dataset 5 (49.5%). This shows that the otolith morphology varies over two consecutive years and that this difference in shape is higher than between two arbitrary groups of the same year and same stock.

Regarding the stock discrimination issue, PCA approach reaches 25% of correct classification on dataset 1 (Table 5.2.5a). This score is better than a random classifier that would theoretically reach 16.7% (for 6 classes).

Table 5.2.4 - Confusion matrix and mean correct classification rate (in %) for the PCA approach on dataset 4 (left) and dataset 5 (right).

Dataset 4 - Eastern English Channel		
Estimated Class	Actual Class	
	2007	**2008**
2007	**58**	38
2008	42	**62**
mean rate: 60%		

Dataset 5 - North Sea		
Estimated Class	Actual Class	
	2009a	**2009b**
2009a	**46**	47
2009b	54	**53**
mean rate: 49.5%		

Table 5.2.5a. Confusion matrix (in %) for the PCA approach on dataset 1. Mean correct classification rate: 25%.

Dataset 1						
Estimated Class	Actual Class					
	NS	**EEC08**	**WEC**	**CS**	**NBB**	**SBB**
NS	**29**	13	15	19	10	12
EEC08	18	**31**	16	21	10	10
WEC	14	13	**26**	11	21	18
CS	17	21	15	**20**	11	12
NBB	15	11	12	13	**21**	25
SBB	7	11	16	16	27	**23**

Table 5.2.5b - Confusion matrix (in %) for the PCA approach on dataset 3. Mean correct classification rate: 19%.

Dataset 3							
Estimated Class	Actual Class						
	NS	**EEC07**	**EEC08**	**WEC**	**CS**	**NBB**	**SBB**
NS	**20**	10	11	17	14	8	7
EEC07	16	**15**	17	8	14	16	14
EEC08	12	15	**24**	14	16	8	7
WEC	12	16	14	**22**	14	16	13
CS	19	12	16	14	**15**	11	9
NBB	13	19	9	10	14	**15**	28
SBB	8	13	9	15	13	26	**22**

Geodesic approach

Regarding the year discrimination issue (Table 5.2.6), the mean classification rate on dataset 4 (60.5%) is higher than the mean classification rate on the random dataset 5 (49.5%). This shows that the otolith morphology varies over two consecutive years and that this difference in shape is higher than between two arbitrary groups of the same year and same stock.

Regarding the stock discrimination issue (Table 5.2.7a-5.2.7c), the Geodesic approach reaches 30% of correct classification on dataset 1. This score is better than a random classifier that would theoretically reach 16.7% (for 6 classes). When comparing results on dataset 1 (Table 5.2.7a) with the results on dataset 2 (Table 5.2.7b), we can see that the mean correct classification rate falls from 30% to 26.2% when replacing otoliths of the Eastern Channel of the year 2008 by otoliths of the year 2007. Moreover, the correct classification for the EEC class drops from 44% (with EEC08) to 35% (with EEC07).

Table 5.2.6 - Confusion matrix and mean correct classification rate (in %) for the Geodesic approach on dataset 4 (left) and dataset 5 (right).

Dataset 4 - Eastern English Channel		
	Actual Class	
Estimated Class	**2007**	**2008**
2007	**64**	43
2008	36	**57**
mean rate: 60.5%		

Dataset 5 - North Sea		
	Actual Class	
Estimated Class	**2009a**	**2009b**
2009a	**54**	55
2009b	46	**45**
mean rate: 49.5%		

Table 5.2.7a - Confusion matrix (in %) for the Geodesic approach on dataset 1. Mean correct classification rate: 30%.

Dataset 1						
Estimated Class	Actual Class					
	NS	**EEC08**	**WEC**	**CS**	**NBB**	**SBB**
NS	**15**	20	11	8	5	11
EEC08	28	**44**	17	23	5	5
WEC	9	9	**22**	11	7	9
CS	24	15	24	**32**	15	13
NBB	10	5	16	13	**27**	22
SBB	14	7	10	13	41	**40**

Table 5.2.7b - Confusion matrix (in %) for the Geodesic approach on dataset 2. Mean correct classification rate: 26.2%.

Dataset 2						
Estimated Class	Actual Class					
	NS	**EEC07**	**WEC**	**CS**	**NBB**	**SBB**
NS	**28**	15	21	12	12	22
EEC07	32	**35**	28	20	15	29
WEC	8	18	**18**	4	10	10
CS	8	13	12	**25**	20	14
NBB	13	11	12	35	**35**	9
SBB	11	8	9	4	8	**16**

Table 5.2.7c - Confusion matrix (in %) for the Geodesic approach on dataset 3. Mean correct classification rate: 24.9%.

Dataset 3							
Estimated Class	Actual Class						
	NS	**EEC07**	**EEC08**	**WEC**	**CS**	**NBB**	**SBB**
NS	**10**	13	16	8	7	2	10
EEC07	23	**32**	22	27	28	19	13
EEC08	23	15	**36**	13	17	6	5
WEC	5	3	5	**15**	9	4	7
CS	18	13	13	16	**24**	10	11
NBB	9	13	3	12	6	**23**	20
SBB	12	11	5	9	9	36	**34**

Table 5.2.8 – Comparison of the mean correct classification rate (in %) obtained by the three approaches on dataset 1, 3 and 4.

	dataset 1	dataset 3	dataset 4
Fourier	19.7	16.4	56
PCA	25	19	60
Geodesic	30	24.9	60.5

Comparison

Performances of the three approaches are compared in Table 5.2.8. On both dataset 1 and dataset 2, the Geodesic approach exhibits the highest performance followed by the PCA approach and at last by the Fourier approach.

Regarding the year discrimination issue (Table 5.2.2, 5.2.4 and 5.2.6), the Fourier approach fails while the PCA and Geodesic approach exhibit some differences. These analyses shows that the otolith morphology varies over two consecutive years and that this difference in shape is higher than between two arbitrary groups of the same year and the same stock.

Regarding the stock discrimination issue on dataset 1 (Table 5.2.3a, 5.2.5a and 5.2.7a), the three methods show that the population of striped red mullet can be geographically divided in three zones:

- The Bay of Biscay (North and South)
- A mixing zone composed of the Celtic Sea and the Western Channel
- A northern zone composed of the Eastern English Channel and the North Sea

To further test the “three zones” hypothesis, the classification process has been tested on the same otoliths as those of dataset 1 but with the otoliths rearranged into the three classes corresponding to the three zones (Table 5.2.10). The mean correct classification rate of 55.2% clearly confirms the “three zones” hypothesis.

Table 5.2.10 – Classification results (in %) on dataset 1 with Geodesic approach when the otoliths are grouped in three classes according to their zones. Mean correct classification: 55.2%.

Dataset 1 (with otoliths grouped in class by zones)			
Estimated Class	Actual Class		
	Northern zone	**Mixing zone**	**Bay of Biscay**
Northern zone	**54**	29	14.5
Mixing zone	28	**46**	20
Bay of Biscay	18	25	**65.5**

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6 WP5 – Small scale sampling, age reading

6.1 IMARES: Age reading in a selection of NEW species

The results of the age-readings done for this WP are incorporated in the study of the biological parameters reported in Section 4.1 and also in the calculation of recruitment indices for turbot and brill, that are used in Section 8.1.

6.2 AZTI: Small scale sampling of striped red mullet and sea bass[23]

Length sampling of striped red mullet and sea bass landed in ICES Divisions VIIIabd and VIIIc have been performed regularly during 2009. Moreover, some sea bass and mullet market samples have been purchased, and weight-length relationships and sex ratios have been calculated as well as maturity ogives in the cases where this was possible.

6.2.1 Striped red mullet

6.2.1.1 Length sampling

Otter bottom trawlers and artisanal gillnetters have the highest striped red mullet landings in Divisions VIIIabd and VIIIc respectively. A quarterly based length sampling was deployed during 2009, in the main Basque ports for these fleets.

Different length ranges were observed. Landings in Division VIIIc presented a narrower length range, between 18 and 33 cm, with a mode in 24 cm, while landings from VIIIabd Divisions presented a range between 10 and 40 cm, with a mode in 15cm (Figures 6.2.1 & 6.2.2).

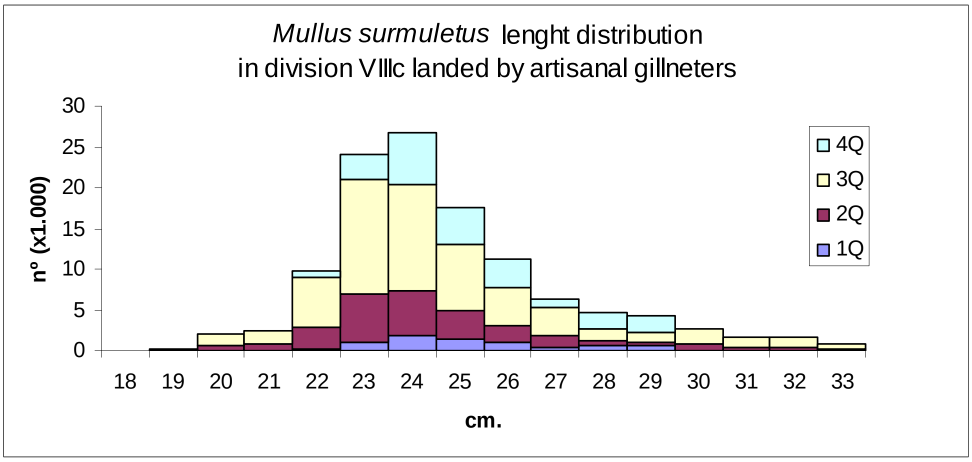

Figure 6.2.1 – Striped red mullet length distribution by quarter, in Division VIIIc landed by artisanal gillneters.

23 Authors: Jesus Martinez & Jon Ruiz

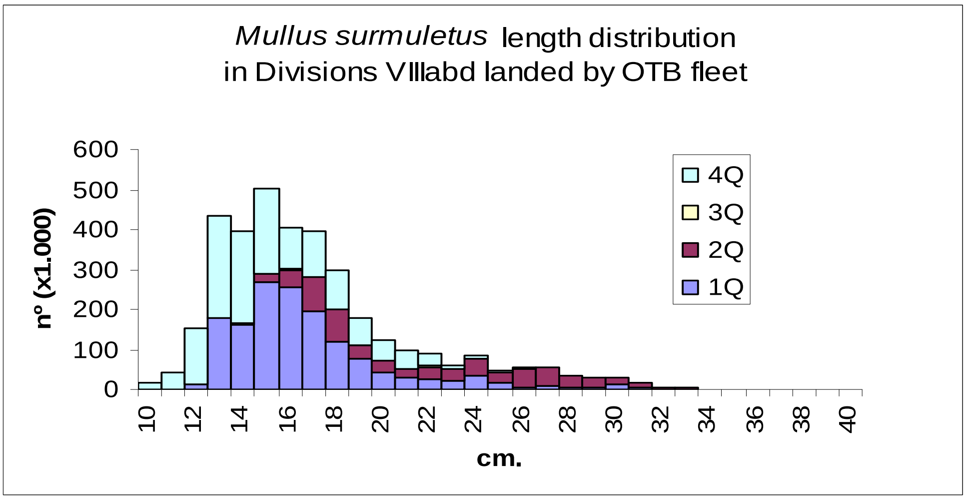

Figure 6.2.2 – Striped red mullet length distribution by quarter, in Divisions VIIIabd landed by otter trawlers.

6.2.1.2 Weight-length relationship, sex ratio and maturity

Some red mullet samples from the different study areas (VIIIabd & VIIIC) have been purchased and analysed. In both cases significant sex ratio differences have been observed. In Divisions VIIIabd males are more abundant, with 63 % of the total analysed individuals. However, around the Iberian Peninsula (Division VIIIc), females are more abundant, with 71.6 % of the total analysed fishes.

Figures 6.2.3 and 6.2.4 show the weight – length relationship, combined for both sexes, by ICES Divisions (VIIIabd & VIIIc).

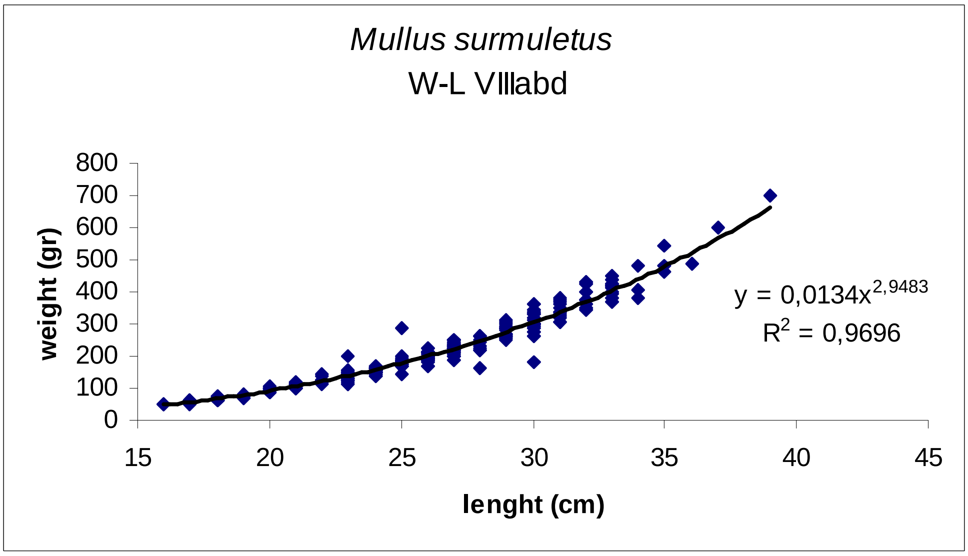

Figure 6.2.3 – Red mullet weight- length relationship in Divisions VIIIabd (for sexes combined)

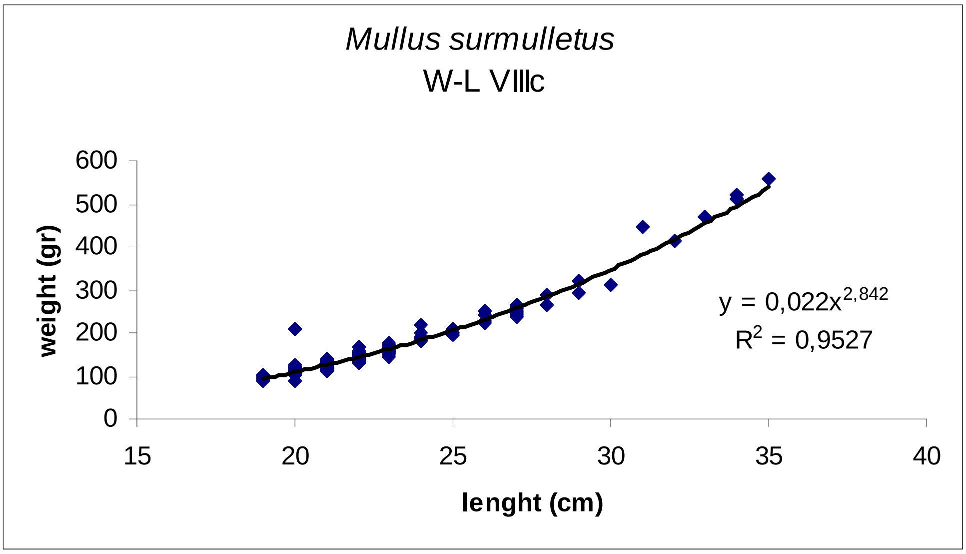

Figure 6.2.4 – Striped red mullet weight- length relationship in Divisions VIIIc (for sexes combined)

Figures 6.2.5 and 6.2.6 show the maturity ogives for mullet in both study areas. During the small scale sampling, it has been hard to obtain small size samples, and the number of immature individuals has not been as abundant as expected. It is difficult to separate these maturity ogives by sexes, so combined ogives are presented below. Around Iberian Peninsula (VIIIc) mature at 21.2 cm, and in South Bay of Biscay a bit earlier, at 19.9 cm.

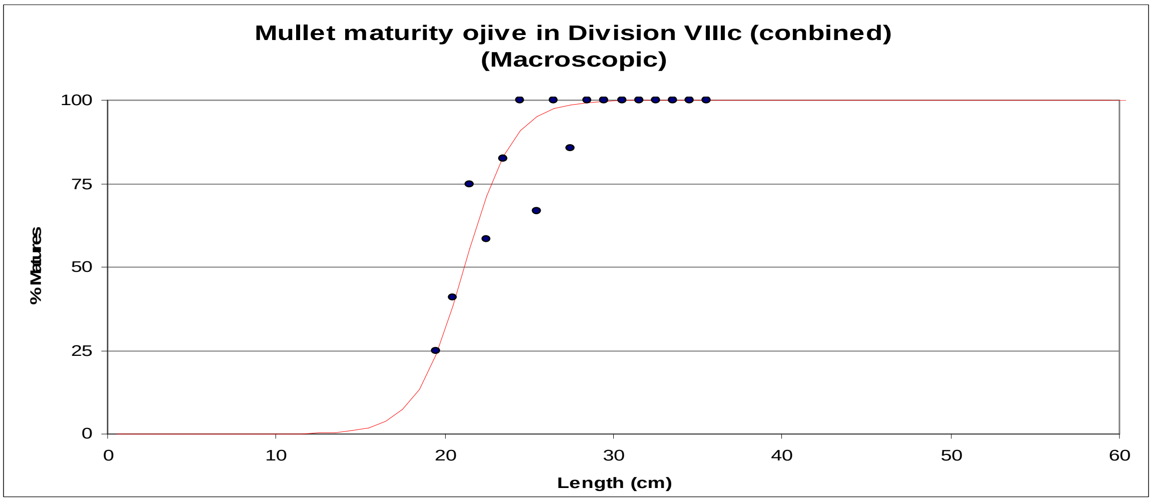

Figure 6.2.5 – Striped red mullet maturity ogive in Division VIIIc, for both sexes combined.

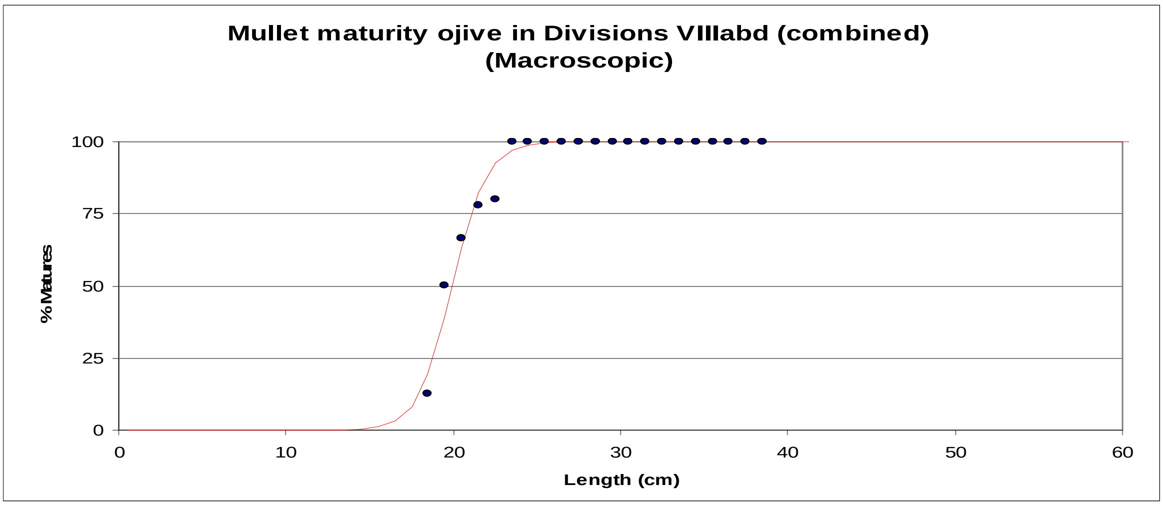

Figure 6.2.6 – Striped red mullet maturity ogive in Divisions VIIIabd, for both sexes combined.

6.2.2 Sea bass

6.2.2.1 Length sampling

Otter bottom trawlers and artisanal longliners have the highest sea bass landings in Divisions VIIIabd and VIIIc respectively. Sea bass landings present a marked seasonality in both fleets. In the case of otter trawlers operating in the southern Bay of Biscay, landings occur mainly during the first and fourth quarters, where a wide range of sea bass, between 31 and 86 cm, is landed; the majority is between 40 and 50 cm.

In the case of the sea bass catches around the Iberian Penisula, just taking into account the Basque artisanal fleet, landings are low and occur in many different ports, always in small amounts, which makes sampling difficult. Some length samples were collected during the first quarter, and the resulting length distribution is presented in figure 6.2.7. Due to the low number of individuals measured, this length distribution should be considered with care.

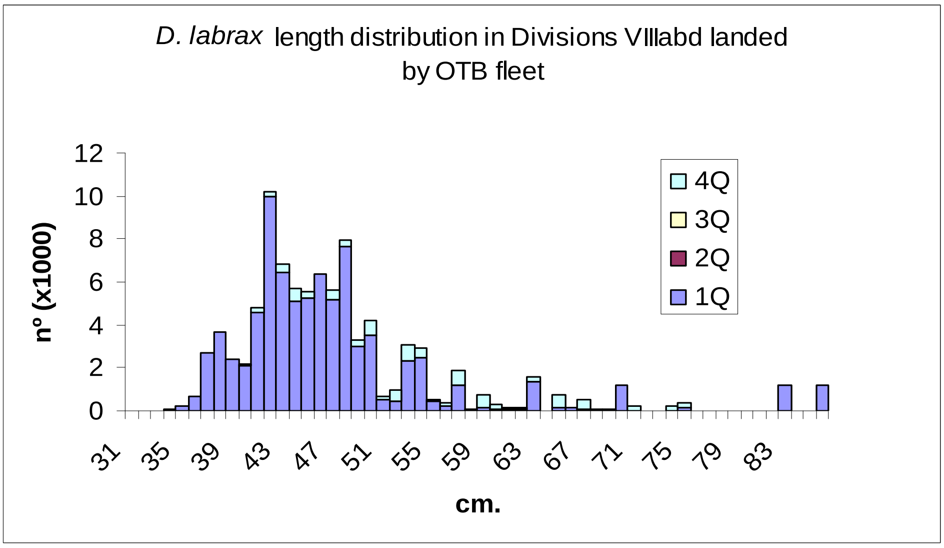

Figure 6.2.7 – Sea bass length distribution by quarter, in Divisions VIIIabd landed by otter trawlers.

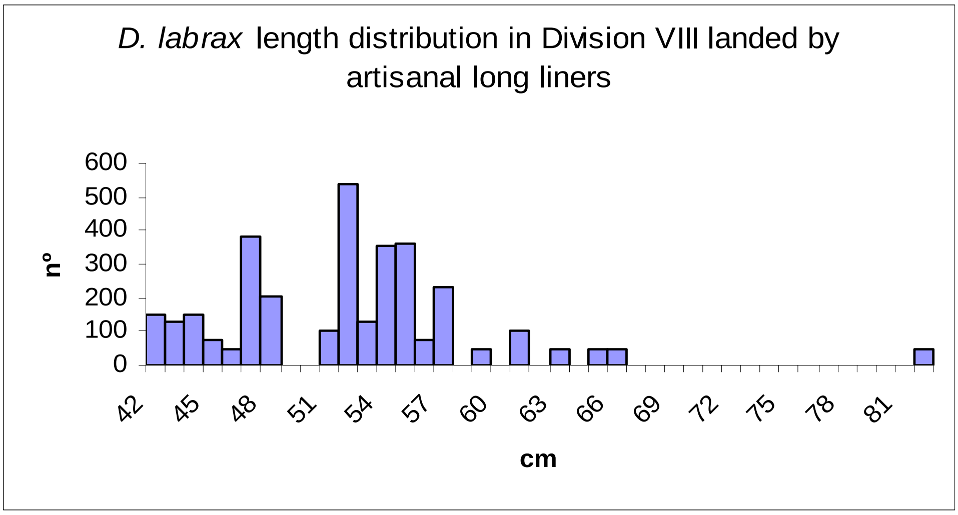

Figure 6.2.8 – Sea bass length distribution by quarter, in Division VIIIc landed by the artisanal fleet.

6.2.2.2 *Weight-length relationship, sex ratio and maturity*

Some sea bass samples were collected between December 2009 and March 2010 to analyse maturity. The construction of maturity ogives has been impossible, due the low number of small individuals collected (below the MLS, 36cm).

As in many other species, males are more abundant than females. 88.99 % of the analysed individuals were males. Almost all the males are in maturity stage "running", while the majority of the females were still in a pre-spawning stage.

Figure 6.2.9 shows the sea bass weight – length relationship in the southern Bay of Biscay.

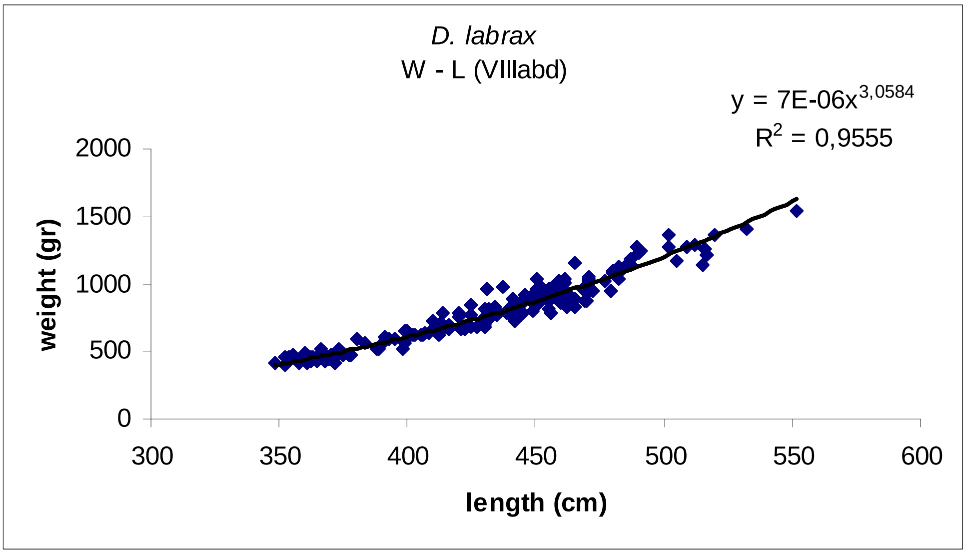

Figure 6.2.9 – Sea bass weight- length relationship in Divisions VIIIabd (for sexes combined)

6.3 IFREMER: Age reading in red gurnard and John dory[24]

For red gurnard and John dory, otoliths have been collected from EVHOE and IBTS surveys. In all cases, the sagitta otoliths were used. Before testing different preparation methods, all otoliths were cleaned in order to determine the age.

For red gurnard three age reading techniques were chosen:

- whole otolith
- burning
- sectioning

The whole otolith was not directly interpretable. Reading burnt otoliths by reflected light gave the best visual results. This technique is more comfortable. Besides, burning accentuates zones of slow growth. Sectioning the otoliths did not present an effective reading quality, compared to the burnt otolith technique.

The burning technique has also been used for another gurnard (*Chelidonichthys kumu*) (Staples, 1970). A total of 696 otoliths from EVHOE (the Bay of Biscay and the Celtic Sea) and IBTS (the North Sea) surveys were collected:

Surveys	2006	2007	2008	2009
EVHOE	236		222	222
IBTS		16		

Each otolith was digitised and interpreted with the TNPC software dedicated by IFREMER. A database with all age data and associated biological parameters (capture date, fish length) was created.

The resulting length at age and the age-length key are shown in Table 6.3.1 and 6.3.2 and in Figure 6.3.1.

Table 6.3.1 – Average size (cm) at age by sex (F: female ; I: unspecified and M: male) from EVHOE 2006, 2008 and 2009 (the Bay of Biscay and the Celtic Sea).

Age	F	I	M
0	15,50	11,44	
1	19,05	16,70	18,86
2	24,24	18,75	22,98
3	29,46		25,69
4	31,86		28,36
5	34,08		33,20

24 Authors: Kélig Mahé, Romain Elleboode & Jérôme Félix

Table 6.3.2 – Age-length key for red gurnard.

Length	0	1	2	3	4	5	6
8	5						
9	12						
10	8						
11	10						
12	10						
13	14	1					
14	10	5					
15	2	15					
16	1	22	2				
17	1	28	2				
18		37	3				
19		32	6				
20		30	10				
21		22	18	2			
22		9	25	1			
23		5	25	5			
24		1	25	6	1	1	
25		3	16	5	4		
26			9	14	5		
27			13	8	6	1	
28		1	6	10	8	2	
29			5	8	2	3	
30			1	5	6	1	
31			2	6	7	4	
32			2	5	1	1	
33			2	6	4		
34				5	3	2	
35				3	2	2	
36				2	1	3	
37					1	2	
38					3	2	
39						1	
40					2	2	
41				1	1	1	
42						1	1
44							1
45						1	

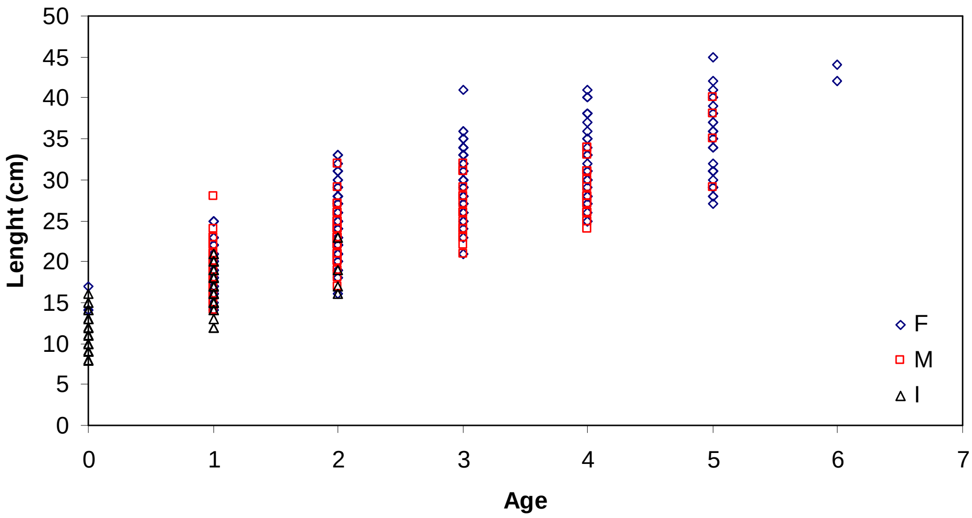

Figure 6.3.1 – Age-length relationship for red gurnard. Table 6.3.2 – Age-length key from EVHOE 2006, 2008 and 2009 (the Bay of Biscay and the Celtic Sea).

John Dory

Several reading techniques have been tested to read otoliths of John dory:

- whole otolith
- burning
- staining
- sectioning
- polishing.

Images of the result of these treatments are shown in Figure 6.3.2 and 6.3.3.

Age estimation was carried out, starting from a sample of 256 fishes from the EVHOE survey. Even if it is possible to identify a growth diagram from some otoliths, most of otoliths are not interpretable.

Also, when the TNPC software was used, the analysis of distances between rings and of the greyscale along the radial, did not permit to identify reproducible marks among otoliths.

So far, it has not been possible to estimate the age of John dory.

REFERENCE

Staples, D. J., 1970. Methods of ageing red gurnard (Teleosti : Triglidae) by fin rays and otoliths. N.Z. Journal of Marine and Freshwater Research 5 (1): 70079.

Figure 6.3.2 – Otoliths of John dory: transmitted light, reflected light, burnt otoliths and polished otolith.

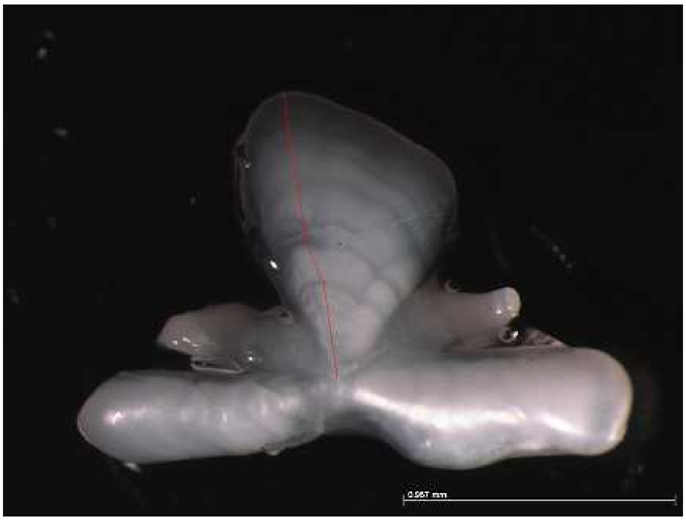

Figure 6.3.3 – Otolith of John Dory (50 cm) with easily identifiable rings.

6.4 IMR and DTU-Aqua: Ageing in witch flounder[25]

DTU-Aqua (Denmark) had no experience in ageing of witch flounder before the start of NESPMAN. However, there were already ongoing activities in otolith reading of this species at IMR (Sweden), indicating problems in reading the otoliths. At both institutes more samples of otoliths, either to be collected on board of survey vessels or alternatively purchased from commercial vessels, were necessary to allow a more extensive analysis.

In general, witch flounder otoliths are considered difficult to read. Therefore the Danish ageing has been and is continuing to be relying on the somewhat greater experience of the IMR, see below. The NESPMAN project has created a local network between Sweden and Denmark concerning ageing of this species. Furthermore, collaboration between Swedish, Danish and UK scientists will be important and necessary in order to improve the ageing technique and increase the quality of the data.

Status of witch flounder ageing in IMR.
By IMR, in agreement with the Data Collection Framework (DCF), samples for length measurements were regularly purchased from commercial boats, randomly selected on a quarterly basis during 2009. Individual length, weight and maturity status were recorded and otoliths collected for age determination.

Several techniques were tried in order to find the optimal way of reading the rings, including grinding the otolith whole, sectioning with or without staining, burning and breaking as well as reading the otolith whole and wet, straight after removal from the fish.

Brian Harley from the Centre for Environment, Fisheries and Aquaculture Science (CEFAS, Lowestoft, England) was visiting the IMR in Lysekil in June 2009 for evaluating together with the Swedish technicians the different ageing techniques.

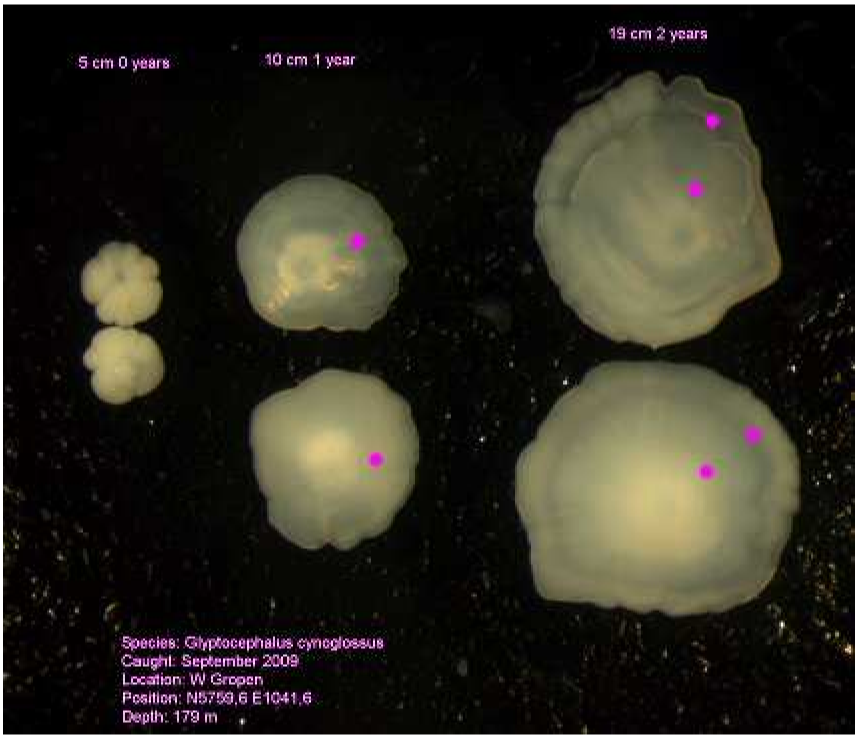

Figure 6.4.1 – Comparison between three age groups and the absence of the inner ring in the 0-group.

[25] Authors: Francesca Vitale, Barbara Bland and Sten Munch-Petersen

Table 6.4.1 – Age composition in the Swedish samples in quarters 1, 2 and 4.

Swedish ALK	Age group											
lgdcm quarter 1	1	2	3	4	5	6	7	8	9	10	>10	Grand Total
21				1								1
26				5								5
27				10								10
28				16	1	1						18
29				23	5							28
30				20	8	1					1	30
31				7	17	5					1	30
32				5	23	2	1	1				32
33	1			5	13	2	3	3				27
34					13	5						18
35					11	4	1	1		1	1	19
36					4	3	1	2			1	11
37					2	4	3				1	10
38					1	2	3	1				7
39						1	3		1			5
40								1	1		1	3
41							2		1			3
45											1	1
	1			92	98	30	17	9	3	1	7	258

quarter 2	1	2	3	4	5	6	7	8	9	10	>10	
18		1										1
22		1										1
24				1								1
25				2								2
26			1	14	2							17
27			1	25	2							28
28				25	6	1						32
29				30	8	3		1				42
30				23	16	6	1	1				47
31				18	28	5	6	1				58
32				9	27	5	5		1			47
33				3	18	7	8	4	1		1	42
34				4	24	12	8	2	1			51
35					15	13	8	4	1		1	42
36					6	3	8	9			2	28
37				1	5	6	7	4				23
38					1	7	3	1	1	1		14
39						2	3	2	1	3	1	12
40						2	2	4	1	2		11
41								2			1	3
42								1				1
44								1		1		2
		2	2	155	158	72	59	37	7	7	6	505

quarter 4	1	2	3	4	5	6	7	8	9	10	>10	
27				1	1							2
28				3	1	1						5
29				1	4	1						6
30				4	7	1						12
31				2	3	2	2	1				10
32				1	5	3	2					11
33				1	7	6	7		1			22
34					6	5	7	1		2		21
35					1	8	12	1	1			23
36				2	3	11	8	3	1			28
37					1	2	7	3				13
38					4	4	13	2	1	1		25
39						7	7	4				18
40						7	6					13
41						2	1	4	1	3		11
42									2			2
43						1						1
45					1							1
47											1	1
48										1		1
49										1		1
				15	44	61	72	19	7	8	1	227

Table 6.4.2 – Age composition in the Danish samples in quarter 4.

Danish ALK	Age											
lgdcm quarter 4	1	2	3	4	5	6	7	8	9	10	>10	Grand Total
25			5	1								6
26			2									2
27		1	7	4								12
28			7	7								14
29		1	5	9		1						16
30			8	9	4							21
31		1	2	13	1							17
32			3	9	1							13
33				11	6	1						18
34			3	6	3						1	13
35			1	2	5	2						10
36				4	6	2						12
37				4	4	2	3				1	14
38				1	1	5	3					10
39				2	1	2	1	1				7
40					3	3	3					9
41							1		1			2
42					2	3	1	1				7
43								2		2		4
44					1			2				3
45					1		1		1			3
47								1				1
Grand Total		3	43	82	39	21	13	7	2	2	2	214

Table 6.4.3 - Age-length key based on Danish and Swedish samples, quarter 4, 2009 .

Combined DK-S age length key, quarter 4, 2009					Age group							
length, cm	1	2	3	4	5	6	7	8	9	10	>10	Grand Total
25	0.0000	0.0000	0.0114	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0137
26	0.0000	0.0000	0.0046	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0046
27	0.0000	0.0023	0.0159	0.0114	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0319
28	0.0000	0.0000	0.0159	0.0228	0.0023	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0433
29	0.0000	0.0023	0.0114	0.0228	0.0091	0.0046	0.0000	0.0000	0.0000	0.0000	0.0000	0.0501
30	0.0000	0.0000	0.0182	0.0296	0.0251	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0752
31	0.0000	0.0023	0.0046	0.0342	0.0091	0.0046	0.0046	0.0023	0.0000	0.0000	0.0000	0.0615
32	0.0000	0.0000	0.0068	0.0228	0.0137	0.0068	0.0046	0.0000	0.0000	0.0000	0.0000	0.0547
33	0.0000	0.0000	0.0000	0.0273	0.0296	0.0159	0.0159	0.0000	0.0023	0.0000	0.0000	0.0911
34	0.0000	0.0000	0.0068	0.0137	0.0205	0.0114	0.0159	0.0023	0.0000	0.0046	0.0023	0.0774
35	0.0000	0.0000	0.0023	0.0046	0.0137	0.0228	0.0273	0.0023	0.0023	0.0000	0.0000	0.0752
36	0.0000	0.0000	0.0000	0.0137	0.0205	0.0296	0.0182	0.0068	0.0023	0.0000	0.0000	0.0911
37	0.0000	0.0000	0.0000	0.0091	0.0114	0.0091	0.0228	0.0068	0.0000	0.0000	0.0023	0.0615
38	0.0000	0.0000	0.0000	0.0023	0.0114	0.0205	0.0364	0.0046	0.0023	0.0023	0.0000	0.0797
39	0.0000	0.0000	0.0000	0.0046	0.0023	0.0205	0.0182	0.0114	0.0000	0.0000	0.0000	0.0569
40	0.0000	0.0000	0.0000	0.0000	0.0068	0.0228	0.0205	0.0000	0.0000	0.0000	0.0000	0.0501
41	0.0000	0.0000	0.0000	0.0000	0.0000	0.0046	0.0046	0.0091	0.0046	0.0068	0.0000	0.0296
42	0.0000	0.0000	0.0000	0.0000	0.0046	0.0068	0.0023	0.0023	0.0046	0.0000	0.0000	0.0205
43	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0000	0.0046	0.0000	0.0046	0.0000	0.0114
44	0.0000	0.0000	0.0000	0.0000	0.0023	0.0000	0.0000	0.0046	0.0000	0.0000	0.0000	0.0068
45	0.0000	0.0000	0.0000	0.0000	0.0023	0.0000	0.0023	0.0000	0.0023	0.0000	0.0023	0.0091
46	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
47	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
48	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0000	0.0023
49	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0000	0.0023
Grand Total	0.0000	0.0068	0.0979	0.2210	0.1868	0.1868	0.1936	0.0569	0.0205	0.0228	0.0068	1.0000

The best result was obtained by using a combination of two techniques, namely reading the otoliths right after the removal from the fish and if need be, grinding. The core of the otolith is asymmetrical (as in all flatfish) and the rings are clearer on the otolith with the central nucleus. The core of this otolith is relatively thick and the first ring is sometimes hard to discern and therefore one will in some cases have to grind the otolith for the ring to come through. This inner ring has also been verified by collecting witch flounder of the 0-group and comparing the distance from nucleus to edge/first ring (Figure 6.4.1).

A further attempt consisted in soaking dry whole otoliths in saline solution 0.9%. This method gave satisfying results, providing an easier handling of samples when personnel skilled in age reading are not at disposal are not at disposal at the moment that the otoliths are collected.

Status of witch flounder ageing in DTU-Aqua

The Danish otolith samples were collected as part of the sampling of size distributions. Since the Danish experience in ageing this species was very small, the majority of the Danish otoliths were read both at DTU-Aqua in Hirtshals and then sent to IMR in Sweden for comments or corrections. At this stage it seems that the Danish reader has been biased towards reading fewer rings and thus allocating younger ages to the otoliths than the Swedish reader. As stated above the problems have started a scientific collaboration between DTU-Aqua and IMR in Sweden on this topic.

Age data: Preliminary results

Tables 6.4.1 and 6.4.2 show the age compositions derived from the age readings until now. Table 6.4.3 gives the Danish/Swedish age-length key for 2009, quarter 4. When comparing the Swedish age compositions with the Danish, it is clearly seen that the Swedish age readings tend to give older individuals than the Danish. This is underlined by the fact that the mean size in the Swedish landings is lower than that of the Danish landings (see also Section 3.7).

The age composition in landings from one single year or quarter do not form a basis for reliable mortality estimates. Nevertheless, to get an idea of total mortality, Z, preliminary estimates were made based on Danish landings in the 4th quarter of 2009. Table 6.4.4 gives the estimated catch-at-age figures for the Danish landings.

Table 6.4.4 – Catch in numbers by age group in Danish landings 4th quarter, 2009.

Age group	C(a)
1	0
2	20440
3	292967
4	660879
5	558681
6	558681
7	579121
8	170330
9	61319
10	68132
>10	20440

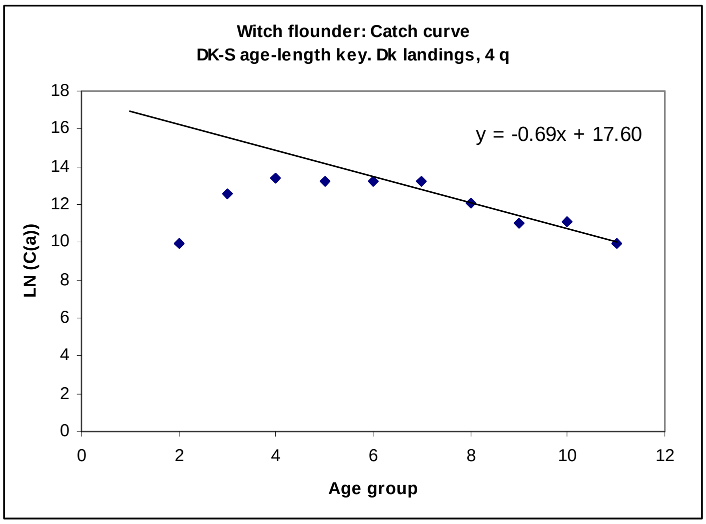

Figure 6.4 2 – Catch curve for witch flounder.

The corresponding catch curve is shown in Figure 6.4.2 and including age groups ≥ 6 in the estimation, gives a Z-value of around 0.7.

Similar analyses have been made for the Swedish data, where all samples collected during 2009 were aged and results were used to explore the age composition of the landings. The catch numbers at age (CANUM) were estimated and are shown in Figure 6.4.3. Results show that age 4 and 5 were the most represented ages in the landings, during Q1 and Q2 in 2009. This pattern could be a consequence of two strong consecutive year classes, i.e 2004 and 2005.

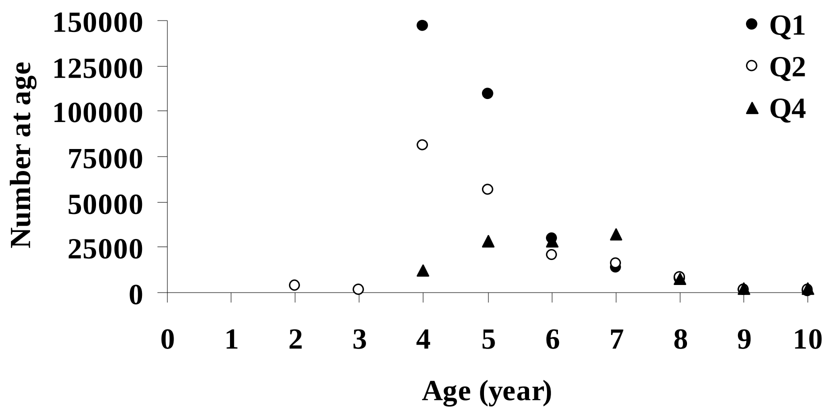

Figure 6.4.3 – Numbers at age in the catch for quarters 1, 2 and 4. Note that 10 is a plus-group.

7 WP6 – Data compilation, data provision to other partners

In the course of the project data have been exchanged between participants for certain surveys, national landings etc. The data or the results of the analyses of these data are reported throughout this report.

8 WP7 – Analytical assessment

8.1 IMARES: Assessment of North Sea turbot and brill[26]

Methods

Data collection.
Data on the spatial distribution, abundance and life history characteristics of turbot and brill can be collected from (i) the landings, discards data from different fleets in different countries, (ii) the market sampling of commercial landings, (iii) annual research vessel surveys.

Landings and discards data are available on different levels of aggregation. The total landings per country are available by area through the International Council for the Exploration of the Sea (ICES). These data have been published under the title "Bulletin Statistique des Pêches Maritimes" since 1903, renamed in 1990 to "ICES Fisheries Statistics". The data are held in a single database that can be accessed through the ICES website http://www.ices.dk.

Landings data
The landings data in ICES Fisheries Statistics are derived from STATLANT 27A forms officially submitted to either Eurostat or ICES by the national statistical offices of its member countries. These catch data cover the ICES Area (Northeast Atlantic, FAO Area 27). The statistics represent the live weight equivalent of the nominal commercial landings in tonnes. As such, discarded catch and other quantities not landed are excluded from the data.

The fishing areas are recorded in this database as they have been reported by the national authorities. The result is that the fishing area may not be recorded in the finest detail provided for in the ICES statistical system. However, the data here are used on the level of the ICES sub-area, which is provided in all years, and for all countries.

There is concern with respect to the quality of some of the reported catch data. Scientists from member countries participating in ICES stock assessment Working Groups have been aware of this and have frequently used supplementary information when analysing the status of the stocks. We use existing literature to collect this supplementary information.

Data for the German Democratic Republic and the German Federal Republic were submitted as separate landings reports for 1973-1990. After the German re-unification in 1990, Germany has submitted a single landings report. The United Kingdom England & Wales and Northern Ireland submitted separate landings reports for the period 1973-1988. From 1989 combined reports for these parts of the UK have been submitted. Scotland has submitted separate reports for the whole of the period since 1973. In our analysis, the data selection ensured that these changes in reporting were carefully dealt with.

Discard data
Discard data are available from discards sampling programmes. These sampling programmes do not include all important fleets, and all years for which landings data are available. Discard sampling data are available from the Dutch beam trawl fleet.

Market sampling data
Market sampling data on turbot and brill were collected in market-sampling programmes that have been carried out in several of the countries with substantial landings of turbot and brill since 1957. However, not for all years sampling has been carried out for which landings data are available, resulting in data for 5 different periods, from 4 different sources (Figure 8.1.1). The first source is a scientific paper on German data in the 1970s (Weber, 1979). The second source is the "Datubras" report on Dutch and Belgian data in the 1990s (Boon & Delbare, 2000). The third source are the recent data from the Ducth market sampling programme. Finally English data are available for a small number of years. Collection of market samples is stratified according to geographical areas

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[26] Author: Jan Jaap Poos

and to the market-size categories. Different countries have different strategies for raising the market samples to estimates of te age distribution of their total landings.

The Dutch market sampling programme – being the most extensive of the data sources – started in 1981 and ended in 1990, with a reprise of a single year in 1998, and continued again in 2004. Only landings from the North Sea (ICES area IV) were sampled. To ensure a representative data set, a stratified sampling scheme was set up, using quarters, auctions and market categories as stratification levels. Length samples were always 5 to 10 times more numerous than age samples. Length samples were taken at the auction, samples for age determination had to be bought. The fish were otolithed at the institute and sold again at the auction the next day. Length was measured to the centimetre below. From specimens used for age determination also total weight, sex, maturity, and weight of female gonads (sub-sample only) were determined.

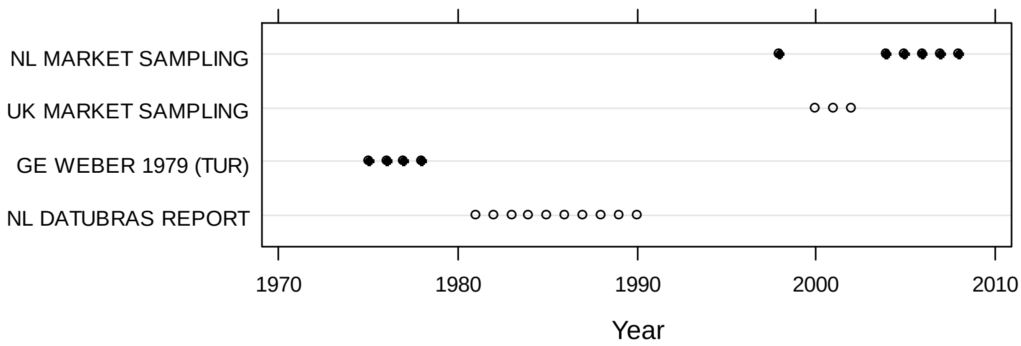

Figure 8.1.1 – Availability of market sampling data. Note that the Weber (1979) data are available for turbot only. Closed circles indicate availability of sex segregated data, open circles indicate sex aggregated data.

Research vessel survey data

Data from several research vessel surveys are available: The BTS-Isis survey, the BTS-Tridens survey, and the SNS survey. These surveys use different beam trawls, and the results of these surveys are also used for the analytical stock assessments for sole and plaice. The different surveys cover different parts of the North Sea.

The Dutch BTS survey started in 1985 and has been conducted in late summer/autumn by R.V. 'Isis'. Since 1996, RV 'Tridens 2' also takes part in the BTS survey, covering the central and western North Sea. The gear used is an 8m beam trawl (BT8) with a cod end fitted with a 40 mm cod-end liner. Eight tickler chains are used. Fishing speed is 4 knots with a haul duration of 30 minutes. Since its onset in 1996, R.V. 'Tridens 2' uses a flip-up rope in the gear. In the southeastern part of the survey area at least three hauls are made in each ICES rectangle, while in the northern area only one or two hauls are taken. The sampling stations are allocated over the fishable area of the rectangles on a 'pseudo-random' basis. Fish is measured to the cm below. The catches of the surveys are used to derive an abundance index for each age and year, taking the same approach as is used for sole and plaice in the North Sea

The Sole Net Survey (SNS) started in 1969 and was initially conducted in both spring and autumn, but since 1991 the survey is carried out in autumn only (Van Beek, 1997). The survey area is the south-eastern North Sea along the coast of the Netherlands, Germany and Denmark. The standard sampling grid of the SNS exists of 10 transects parallel or perpendicular to the continental North Sea coast between the Dutch-Belgian border and Esbjerg. On each transect a number of fixed stations is sampled. About 55 hauls are done each year, with at least 4 hauls in a transect. In some years an additional grid has been fished along the Danish coast between Esbjerg and the Skagerrak. The survey was carried out by RV 'Tridens 1' until 1989, between 1990 and 1995 by RV 'Tridens 2' and from 1996 onwards the SNS is conducted by RV 'Isis'. Fishing is done with 6m beam trawls (BT61, rigged with 4 tickler chains and a mesh size of 40 mm stretched mesh in the cod-end. Fishing speed is 3.5 knots and haul duration is 15 minutes. The gear used for sampling the additional grid between Esbjerg and the Skagerrak (heavy trawl; HT) was similar in layout and dimensions (beam width, number of tickler chains, cod end mesh size, etc.), but heavier in construction (shoes, net) compared to the 6m beam trawl to allow fishing on the rocky grounds of this area. Length frequency distributions of all fish species are recorded. Fish is measured to the cm below.

<u>Results</u>

Landings data are shown in Figure 8.1.2. Between 1950 and 1995 the total international landings of turbot from the North Sea fluctuated without clear trend between 4000 and 6000 t (fresh weight). Since 1995 a decrease can be seen to around 3000 t in 2008.

For brill, landings were between 500 and 700 t in the years 1950 to 1970, and suddenly increased to over 1000 t in 1971. After varying but on average increasing landings until 1985 (over 1700 t), a short fallback in landings occurred for 4 years. In 1990, however, landings were up again to the level before this period, and increased up to appoximately 2400 t in 1993. The variation in landings from 1983 until 1989 is mainly caused by variations in the Dutch landings. This period is marked by a decreased reliability of the Dutch landings data. The landings in these years should therefore be viewed with some caution.

Since the end of the 1990s total North Sea landings have decreased for both turbot and brill. This decrease in landings can also been seen in North Sea sole and plaice, although for those species, the decrease happened a few years earlier. The reason for the decline cannot be given without further analysis of the data. Potential causes could be reduced individual growth, reduction in fishing effort, or reduction in fish abundance.

The Dutch contribution to the international landings of both turbot and brill increased substantially in the 1960s, and is likely to be the result of the increase in beam trawling in the Netherlands during that period. The result is that since the late 1960s the dominance in landings has shifted to the Netherlands. The Danish contribution has been decreasing until the 1970s, but increased again during the 1980s and has been fairly constant since. The recent increases in English, Belgian, and Danish landings could well be related to an increasing number of Dutch vessels registered under foreign flag.

Discard data are only available from the Dutch sampling programme of the 80 mm beam trawl fleet since 2002. Both turbot and brill are discarded only in small amounts in this fleet, on average < 1 specimen per hour trawling (Table 8.1.1, see also Section 3.1.1). This low discarding can be explained by the fact that the species have high growth rates, Also, the landings quota seem not to have restricted the landings, which could have lead to overquota discarding and high-grading for these species that are only moderately targetted. Discarding of turbot and brill might, however, take place in other fisheries for which no observations are available.

Table 8.1.1 – Avalaible discards data for turbot and brill from the Dutch 80 mm beam trawl fishery

year	Brill (N per hour)	Turbot (N per hour)	Source
2002	<1	NA	CVO report Number: 04.010
2003	<1	<1	CVO report Number: 04.024
2004	0.42	0.3	CVO report Number: 05.006
2005	0.2	NA	IMARES Report C061/06
2006	0.3	NA	CVO report Number: 07.011
2007	<0.1	<0.1	CVO report Number: 08.008

The market sampling data for turbot indicate that because of the sexual dimorphism, male specimens in the landings are younger than females. This can be concluded from the years in which sex-segregated landings-at-age data are available, such as the Weber and the most recent Dutch dataset (Tables 8.1.2-8.1.5). This results in the dominant female cohort being on average one year older than the dominant male cohort.

The dominant age group in the turbot landings-at-age matrix for the two sexes combined is approximately 3 years old (Figure 8.1.3). However, there appears to be a sudden decrease in this average age in 2004, when the most recent Dutch market sampling programme started. A higher abundance of age 4 in the first half of the 1980s suggests that there has been a a relatively good year class.

The dominant age group in the brill landings-at-age matrix for the two sexes combined is 2 or 3-year old (Tables 8.1.6-8.1.7 and Figure 8.1.3). There is little difference between the age distribution of males and females.

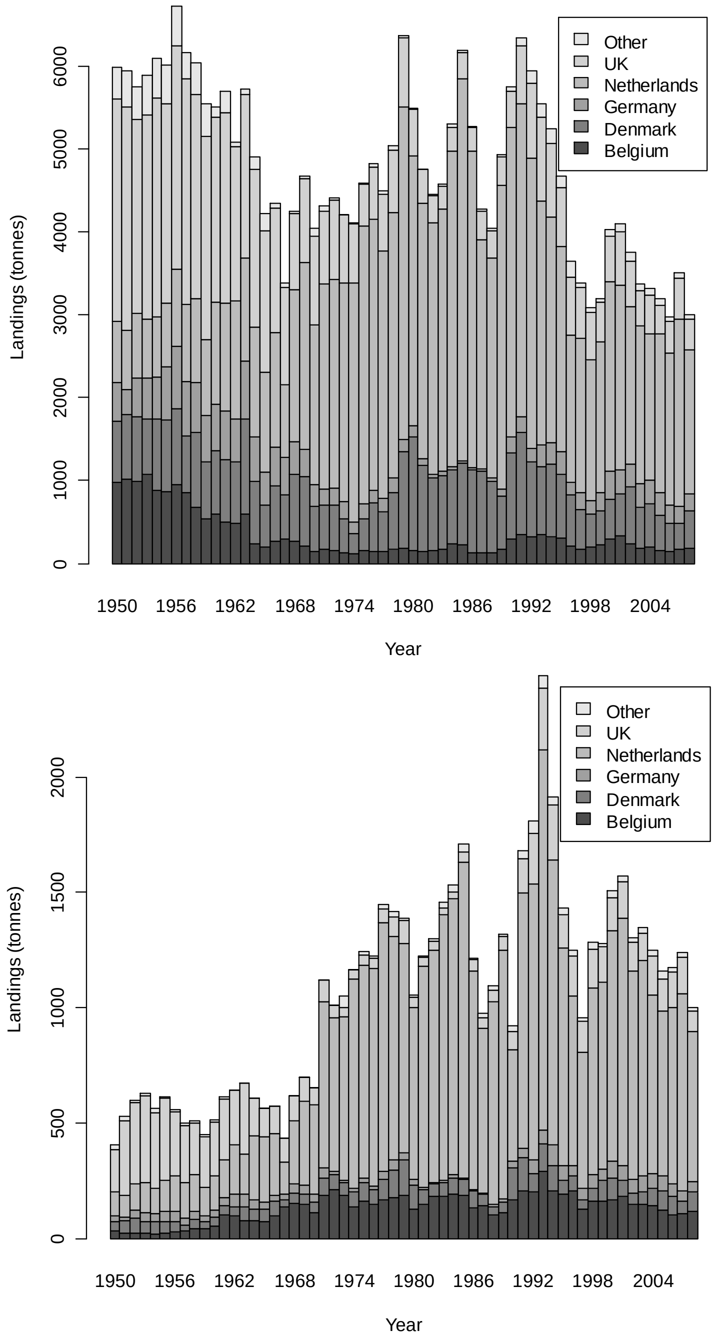

Figure 8.1.2 – International landings (in t) of turbot (upper panel) and brill (lower panel) from the North Sea.

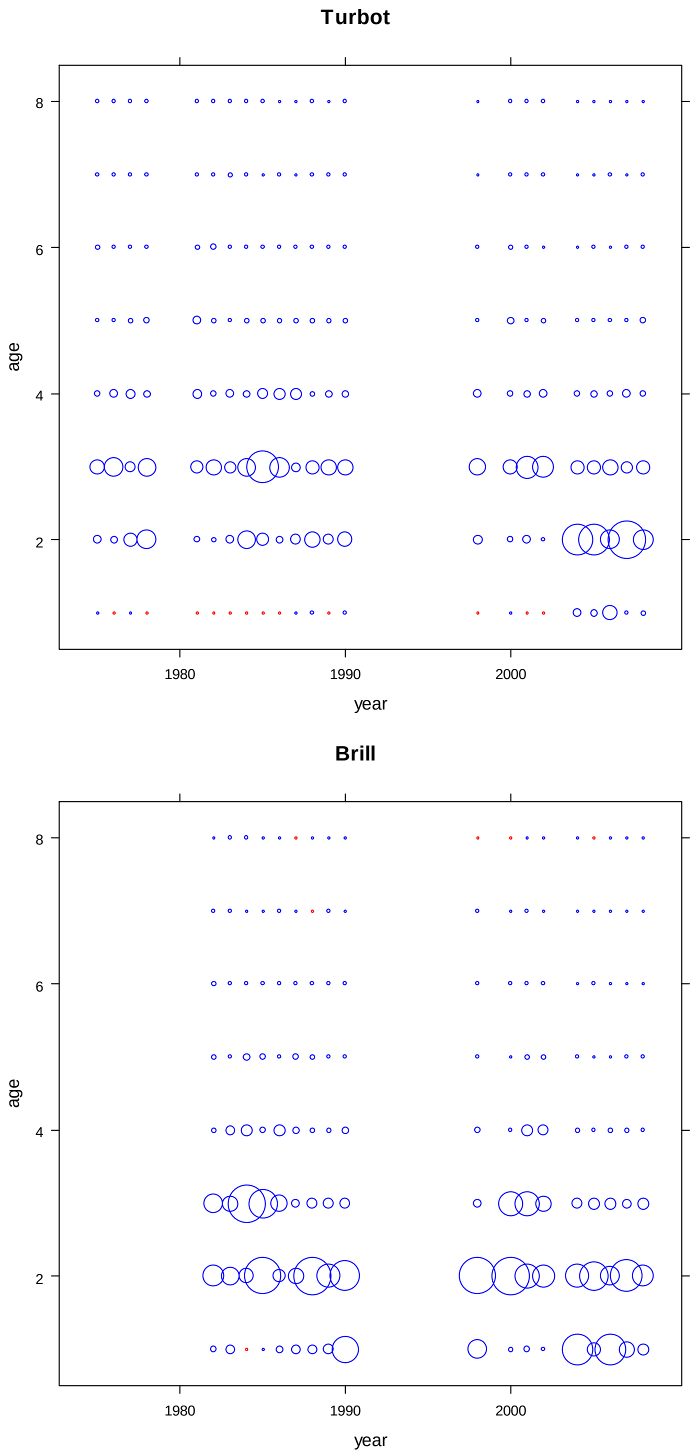

Figure 8.1.3 – Sexes combined landings-at-age matrices for turbot (upper panel) and brill.

In the light of doing an analytical assessment, it should be noticed that there is no full landings-at-age matrix and thus no full catch-at-age matrix. For turbot, there is a longer time series available because of the availability of the Weber (1979) data. The lack of a full catch-at-age matrix hinders doing a full analytical assessment. The last assessment was done in a study by Boon and Delbare (2000), using the 9 years of data spanning 1982-1990.

The most recent landings at age data span only 5 years, so does not cover a full cohort. Log catch curves for turbot nd brill are shown in Figures 8.1.4 and 8.1.5.

Catch rates for juvenile turbot and brill in the three surveys (SNS, BTS Isis and BTS Tridens) are low. These low catch rates are probably the cause for the fact that the data for the three surveys (Tables 8.1.8 and 8.1.9) do not show strong cohort signals, and the internal consistency is low for allmost all surveys and all ages (Figure 8.1.6).

The mean lengths-at-age and mean weights-at-age for the two species coming from the survey catches clearly show the sexual dimorphism, with females growing faster, and becoming bigger at older ages (Figure 8.1.7 to 8.1.10). However, especially for female turbot there is a strong temporal pattern with decreasing size of older animals since the early 1990s. In brill there seems to be no such signal. Especially the weights-at-age for females are very variable.

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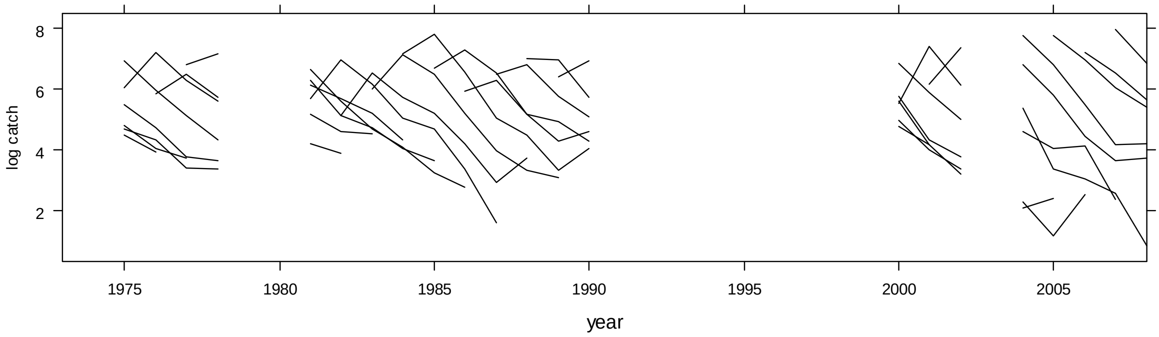

Figure 8.1.4 – Log catch curves for turbot in the North Sea

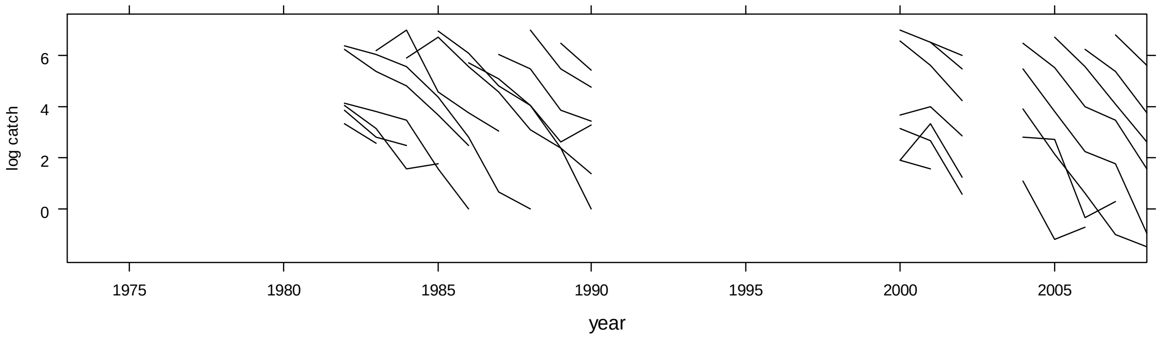

Figure 8.1.5 – Log catch curves for brill in the North Sea

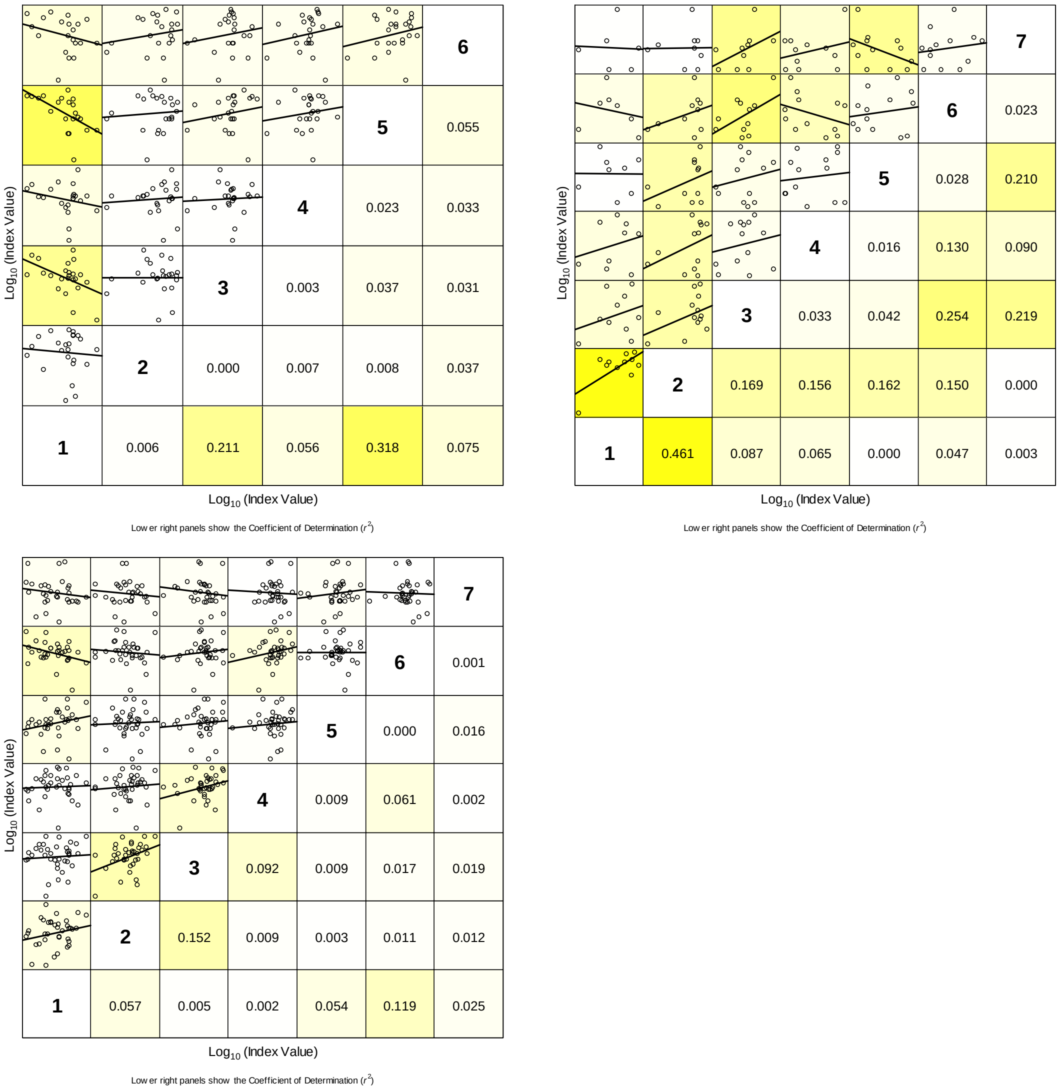

Figure 8.1.6 – Internal consistency plot for the survey indices for turbot from BTS-Isis, BTS-Tridens and SNS.

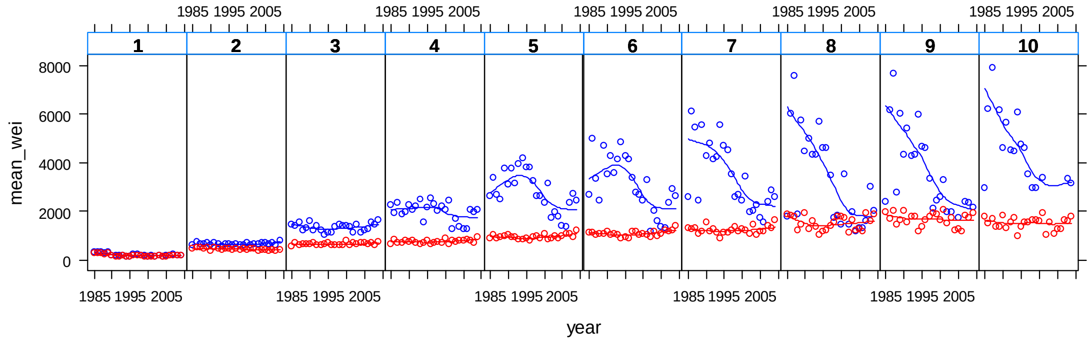

Figure 8.1.7 – Turbot in the North Sea: mean weight-at-age in the BTS survey. Red is males, blue is females[27].

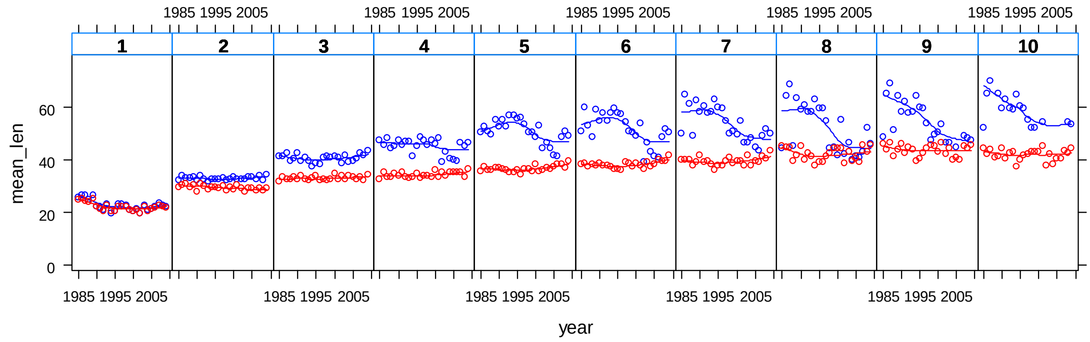

Figure 8.1.8 – Turbot in the North Sea: mean length-at-age in the BTS survey. Red is males, blue is females.

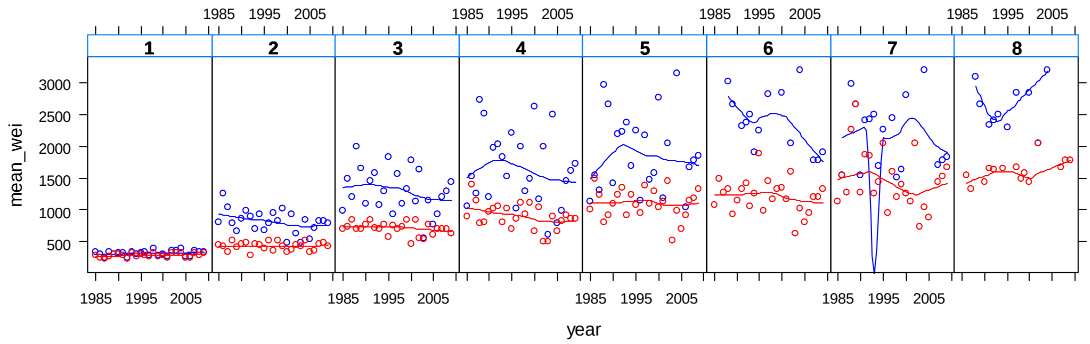

Figure 8.1.9 – Brill in the North Sea: mean weight-at-age in the BTS survey. Red is males, blue is females.

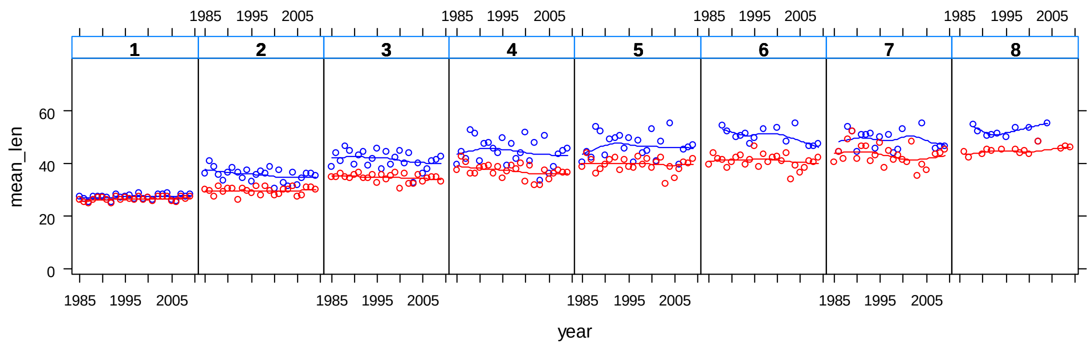

Figure 8.1.10 – Brill in North Sea: mean length-at-age in the BTS survey. Red is males, blue is females.

[27] Further analysis of the data is required to check if the trends shown in these plots are caused by the methods used or present a real biological phenomenon.

Table 8.1.2 – Female turbot landings-at-age table for total landings derived from Weber (1979).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1975	0.0	232.6	551.8	160.0	71.7	86.1	65.2	36.3	29.7	8.7	12.0	14.3	10.2	7.9	13.9	6.5
1976	0.0	177.2	724.3	223.8	86.5	64.7	46.9	45.7	28.5	39.6	20.5	5.8	16.1	7.6	7.6	8.2
1977	4.9	550.3	364.5	313.2	107.9	37.4	26.3	31.7	32.2	37.2	9.9	6.7	6.9	6.1	9.0	8.3
1978	0.0	817.1	646.1	156.3	158.0	57.9	31.4	17.0	18.3	13.0	8.6	6.6	4.2	8.0	4.3	0.6

Table 8.1.3 – Male turbot landings-at-age table for total landings derived from Weber (1979).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1975	0.8	194.7	460.2	78.6	36.5	38.1	24.8	10.6	12.0	5.2	3.1	5.1	2.1	0.7	3.9	12.3
1976	0.0	172.4	621.5	168.1	27.7	11.2	10.5	4.5	9.7	13.6	5.5	1.6	4.6	1.6	2.5	13.9
1977	13.3	344.5	280.0	217.6	57.9	6.4	4.2	10.3	4.4	9.5	13.8	2.7	3.8	2.9	0.1	3.0
1978	0.0	506.7	627.1	153.0	109.5	18.1	6.2	12.0	2.1	3.1	1.1	0.1	0.1	0.8	2.3	2.6

Table 8.1.4 – Sexes combined landings-at-age data for turbot for total international landings from Boon & Delbare (2000).

	1	2	3	4	5	6	7	8	9	10
1981	0	299	755	532	458	175	67	35	40	32
1982	0	169	1046	267	167	292	98	49	41	65
1983	0	402	673	479	110	113	180	91	31	81
1984	0	1296	1223	311	157	60	57	74	51	70
1985	0	795	2415	654	179	109	26	38	48	74
1986	0	371	1470	697	183	67	29	16	18	90
1987	13	648	546	676	158	52	19	5	5	60
1988	36	1084	897	178	176	90	28	42	10	25
1989	0	594	1037	315	139	73	28	22	10	29
1990	43	957	1032	305	160	73	98	58	13	39

Table 8.1.5 – Sexes combined turbot landings-at-age data for the UK.

	1	2	3	4	5	6	7	8	9	10	11	12
2000	4.52	254.8	937.7	269.8	315.1	144.7	116.08	51.25	58.79	27.13	15.07	30.15
2001	0.00	478.3	1642.4	357.3	63.5	75.5	55.15	64.74	21.57	20.38	15.58	25.18
2002	0.00	66.5	1564.5	462.5	147.7	24.3	43.82	29.21	11.36	4.87	16.23	12.98

Table 8.1.6 – Sexes combined brill landings-at-age table from Boon and Delbare (2000).

	1	2	3	4	5	6	7	8	9	10
1982	98	592	504	65	57	49	29	3	2	19
1983	219	492	421	215	45	23	17	13	3	9
1984	0	366	1098	265	126	33	5	12	7	6
1985	7	1068	838	98	82	39	5	6	5	8
1986	140	311	440	263	43	17	12	1	2	12
1987	186	428	164	125	98	21	2	0	0	1
1988	188	1119	237	59	57	22	0	1	0	0
1989	222	657	238	47	14	11	11	2	19	4
1990	754	872	234	118	31	27	1	4	0	13

Table 8.1.7 Sexes combined brill landings-at-age table from Boon and Delbare (2000).

	1	2	3	4	5	6	7	8	9	10	11	12
2000	78.8	1100.8	705.4	38.5	6.7	23.5	6.70	0.00	0.00	1.67	0.00	10.05
2001	81.1	697.1	678.9	274.9	54.6	28.1	14.90	4.97	1.65	3.31	0.00	19.87
2002	10.7	618.9	397.7	244.3	71.3	17.8	3.57	1.78	0.00	0.00	1.78	0.00

Table 8.1.8a – SNS survey: indices for male turbot.

	1	2	3	4	5	6	7
1970	33.39	52.97	18.66	4.76	1.23	0.52	0.17
1971	11.48	36.68	16.48	3.6	0.92	0.44	0.12
1972	10.1	38.03	17.58	4.76	0.99	0.44	0.1
1973	30.79	39.92	11.62	3.07	0.5	0.21	0.06
1974	58.89	43.28	11.41	2.69	0.53	0.26	0.07
1975	63.69	58.03	15.33	3.3	0.6	0.31	0.09
1976	30.74	40.18	9.81	2.25	0.38	0.13	0.07
1977	254.96	151.86	35.46	7.31	1.57	0.7	0.24
1978	21.12	84.66	32.54	8.63	2.04	0.92	0.33
1979	10.01	70.29	34.1	8.12	1.75	0.83	0.27
1980	75.25	45.6	16.63	4.41	0.99	0.43	0.14
1981	16.68	45.26	17.12	4.08	0.67	0.36	0.15
1982	57.96	30.47	5.72	1.44	0.32	0.13	0.02
1983	106.14	112.36	21.04	5.01	0.8	0.23	0.09
1984	60.76	51.31	18.39	4.42	1.01	0.59	0.23
1985	30.75	65.68	18.66	3.88	0.72	0.39	0.14
1986	15.94	10.78	4.21	0.74	0.22	0.11	0.04
1987	42.54	12.54	2.22	0.45	0.06	0.05	0.02
1988	107.48	78.23	15.54	3.52	0.57	0.23	0.1
1989	43.54	31.48	9.8	2.62	0.57	0.26	0.12
1990	158.21	78.25	13.02	3.67	0.96	0.25	0
1991	26.23	53.86	15.79	3.43	0.72	0.38	0.1
1992	171.01	75.73	22.93	5.87	1.02	0.56	0.26
1993	102.61	114.3	24.89	6.26	1.05	0.41	0.15
1994	65.93	33.04	9.76	3.01	0.83	0.56	0.22
1995	126.11	47.94	4.6	1.11	0.1	0	0
1996	55.85	57.07	13.25	2.86	0.55	0.22	0.06
1997	22.64	20.28	5.11	1.51	0.39	0.15	0.09
1998	37.74	29.31	7.67	1.72	0.3	0.18	0.06
1999	106.8	63.33	22	5.29	1.43	0.61	0.2
2000	102.08	30.91	3.95	1.08	0.11	0.01	0.01
2001	31.85	17.16	11.96	3.63	0.78	0.39	0.06
2002	85.82	37.21	7.14	1.66	0.69	0.42	0.07
2003							
2004	94.59	28.83	6.97	2	0.73	0.39	0.17
2005	93.06	67.65	12.37	3.17	0.56	0.17	0.06
2006	117.01	78.61	17.41	4.02	0.83	0.32	0.07
2007	50.46	53.26	17.58	5.02	1.18	0.42	0.06
2008	49.46	63.73	18.06	4.88	1.24	0.9	0.42
2009	16.64	16.36	4.63	1.25	0.54	0.48	0.26

Table 8.1.8b – BTS Isis survey: indices for male turbot.

	1	2	3	4	5	6
1985	0.313	0.766	0.232	0.062	0.014	0.006
1986	0.169	0.502	0.205	0.059	0.016	0.008
1987	0.213	0.608	0.229	0.057	0.013	0.007
1988	0.442	0.695	0.237	0.069	0.015	0.007
1989	0.267	0.772	0.297	0.078	0.022	0.012
1990	1.385	0.824	0.215	0.058	0.013	0.006
1991	0.888	0.676	0.294	0.08	0.02	0.01
1992	0.883	0.656	0.227	0.059	0.014	0.007
1993	1.034	0.871	0.238	0.058	0.014	0.007
1994	1.003	0.779	0.268	0.07	0.015	0.007
1995	1.06	0.376	0.141	0.036	0.009	0.004
1996	0.668	0.807	0.247	0.064	0.013	0.006
1997	0.587	0.66	0.227	0.062	0.015	0.008
1998	1.07	0.764	0.207	0.053	0.014	0.007
1999	0.888	0.601	0.194	0.049	0.012	0.006
2000	2.603	0.638	0.257	0.069	0.02	0.009
2001	0.759	0.652	0.233	0.057	0.013	0.007
2002	1.765	0.365	0.127	0.031	0.007	0.004
2003	0.89	0.604	0.163	0.042	0.01	0.005
2004	1.261	0.599	0.213	0.062	0.014	0.006
2005	1.013	0.771	0.259	0.074	0.019	0.01
2006	1.041	0.592	0.166	0.052	0.015	0.008
2007	0.796	0.795	0.281	0.081	0.022	0.011
2008	1.005	0.747	0.202	0.052	0.012	0.007
2009	0.632	0.428	0.161	0.053	0.016	0.01

Table 8.1.8c – BTS Tridens survey: indices for male turbot.

	1	2	3	4	5	6	7
1996	0.0131	0.0561	0.0379	0.0123	0.0037	0.0016	0.0005
1997	0.0001	0.0027	0.0121	0.005	0.0023	0.0015	0.0009
1998	0	0	0.0001	0.0003	0.0005	0.0004	0.0006
1999	0	0	0.0002	0.0006	0.0006	0.0005	0.0005
2000	0.0008	0.0288	0.0351	0.0116	0.0036	0.0016	0.0004
2001	0.0297	0.0325	0.0256	0.013	0.0046	0.0024	0.0008
2002	0.0029	0.0294	0.018	0.0072	0.0023	0.0016	0.0003
2003	0.0007	0.0199	0.0162	0.0065	0.0028	0.0019	0.001
2004	0.0002	0.0186	0.0218	0.0112	0.0051	0.0022	0.0012
2005	0.0074	0.0325	0.0458	0.022	0.008	0.0041	0.0016
2006	0.0084	0.0405	0.0313	0.011	0.0028	0.0011	0.0004
2007	0.0114	0.1081	0.0585	0.0169	0.0052	0.0024	0.0009
2008	0.0161	0.0772	0.0225	0.0057	0.0011	0.0005	0.0005
2009	0.0071	0.0972	0.078	0.0255	0.0076	0.0045	0.0016

Table 8.1.9a – SNS survey: indices for female turbot.

	1	2	3	4	5	6	7
1970	20.53	28.21	5.89	0.68	0.07	0.03	0
1971	8.14	24.38	3.67	0.28	0.03	0.02	0
1972	7.84	25.69	5.45	0.67	0.06	0.05	0
1973	18.22	16.8	3.02	0.64	0.04	0.01	0
1974	32.56	18.29	2.62	0.65	0.03	0.03	0
1975	37.27	24.55	2.22	0.37	0.01	0.01	0
1976	19.14	14.57	1.54	0.25	0	0.01	0
1977	160.36	56.32	6.48	3.5	3.14	2.03	1.49
1978	17.21	49.59	11.24	1.38	0.13	0.06	0
1979	10.47	51.9	9.58	1.01	0.08	0.02	0
1980	41.88	26.23	5.52	0.71	0.07	0.02	0
1981	12.76	26.77	3.14	1.99	3.02	2.26	1.61
1982	30.98	9.58	2.05	0.68	0.03	0.01	0
1983	62.16	30.36	2.7	0.72	0.01	0.02	0
1984	33.86	28.75	7.91	1.82	0.2	0.04	0.02
1985	20.62	28.8	2.63	0.3	0	0	0
1986	8.03	6.48	1.33	2.86	1.61	1.06	0.33
1987	21.58	4.84	0.28	0.11	0	0	0
1988	59.48	25.24	2.09	0.61	0	0	0
1989	22.45	14.66	4.55	1.26	0.18	0.03	0.01
1990	83.56	21.14	5.92	1.49	0.07	0	0
1991	17.35	23.62	3.55	0.53	0.04	0	0
1992	95.41	36.17	7.42	1.51	0.1	0.03	0.02
1993	59.79	36.09	5.05	1.15	0.05	0.03	0
1994	34.25	16.88	9.29	2.21	0.19	0.03	0.03
1995	68.43	9.07	0.31	0.56	0	0	0
1996	34.02	19.71	1.58	0.15	0	0	0
1997	12.82	7.33	5.63	2.95	0.57	0.25	0.03
1998	20.01	12.25	1.7	0.34	0.02	0.01	0
1999	58.26	34.96	7.28	0.91	0.05	0.04	0
2000	53.54	7.49	0.38	0.25	0	0	0
2001	17.04	19	5.54	0.83	0.08	0.03	0
2002	47.52	12.11	5.94	1.19	0.05	0.02	0.02
2003							
2004	55.62	13.55	6.43	5.33	1.75	0.66	0.07
2005	55.4	18.56	2.57	0.66	0.02	0.01	0
2006	63.32	26.68	3.49	0.84	0.04	0.02	0
2007	29.82	24.73	7.72	1.32	0.12	0	0
2008	29.33	27.57	15.12	5.8	3.43	2.31	1.67
2009	9.15	8	9.62	3.43	0.51	0.15	0.04

Table 8.1.9b – BTS Isis survey: indices for female turbot.

	1	2	3	4	5	6
1985	0.234	0.338	0.112	0.043	0.011	0.005
1986	0.128	0.315	0.129	0.037	0.009	0.007
1987	0.148	0.347	0.121	0.057	0.017	0.009
1988	0.273	0.358	0.107	0.029	0.006	0.002
1989	0.194	0.468	0.163	0.04	0.014	0.011
1990	0.753	0.338	0.123	0.071	0.023	0.013
1991	0.499	0.464	0.145	0.037	0.016	0.011
1992	0.541	0.354	0.113	0.04	0.012	0.007
1993	0.599	0.377	0.089	0.035	0.021	0.015
1994	0.812	0.405	0.086	0.014	0.006	0.005
1995	0.607	0.239	0.054	0.015	0.006	0.005
1996	0.42	0.365	0.074	0.032	0.018	0.014
1997	0.349	0.346	0.121	0.04	0.014	0.008
1998	0.601	0.326	0.113	0.044	0.01	0.004
1999	0.543	0.299	0.084	0.038	0.01	0.004
2000	1.406	0.44	0.172	0.067	0.013	0.005
2001	0.487	0.364	0.107	0.048	0.018	0.01
2002	0.968	0.222	0.047	0.01	0.001	0
2003	0.497	0.257	0.097	0.032	0.005	0.002
2004	0.719	0.334	0.094	0.018	0.002	0.001
2005	0.634	0.408	0.145	0.028	0.002	0.001
2006	0.593	0.28	0.118	0.02	0.001	0
2007	0.466	0.439	0.213	0.094	0.019	0.007
2008	0.569	0.32	0.117	0.048	0.01	0.005
2009	0.348	0.258	0.203	0.08	0.017	0.007

Table 8.1.9c – BTS Tridens survey: indices for female turbot.

	1	2	3	4	5	6	7
1996	0.0106	0.0568	0.0254	0.0033	0.0004	0.0001	0
1997	0.0001	0.02	0.0424	0.0344	0.0143	0.0082	0.0026
1998	0	0.0005	0.0246	0.0369	0.0141	0.0074	0.0015
1999	0	0.0015	0.0228	0.0114	0.0024	0.0009	0.0001
2000	0.0023	0.0553	0.0259	0.0037	0.0004	0.0001	0
2001	0.0173	0.0491	0.0396	0.0065	0.0004	0.0002	0
2002	0.0038	0.0305	0.0261	0.0045	0.0002	0.0001	0.0001
2003	0.002	0.0282	0.0359	0.0101	0.0012	0.0002	0.0001
2004	0.0012	0.0404	0.054	0.0194	0.0034	0.0015	0.0002
2005	0.006	0.078	0.0887	0.0246	0.0038	0.0015	0.0001
2006	0.0064	0.0465	0.0183	0.0024	0.0003	0.0002	0
2007	0.0142	0.0912	0.0423	0.0229	0.0054	0.002	0.0003
2008	0.0149	0.0332	0.014	0.0253	0.0166	0.0129	0.0081
2009	0.0094	0.1238	0.0689	0.0127	0.0013	0.0003	0.0001

8.2 CEFAS: Assessment of sea bass[28]

The aim of this WP was to update international landings information, any survey data and recent catch at age or effort data. In 2007, Cefas ran assessment models for UK bass fisheries and the aim of the WP was to compile all international data into a format where an analytical assessment for the international data set could be made.

8.2.1 International landings data

Data on bass landings by country were updated using information submitted to ICES (from the FishStat database) (Tables 8.2.1-8.2.8).

8.2.2 UK data

Catch at age, effort and landings data

In 2007, Cefas undertook an assessment of bass in four stock areas in which the UK has an interest, namely the North Sea (ICES Divisions IVb+c), the eastern Channel (ICES Division VIId), the western Channel (VIIe+h) and the Irish Sea/Bristol Channel (ICES Divisions VIIa+f+g). Assessments were run for three gear groups, namely trawl, nets and lines. These assessments were presented as a working document to WGNEW in 2009.

The effort, catch numbers at age and landings data used for these assessments were updated to include data for 2007 and 2008, and are presented in Tables 8.2.9-8.2.12. In addition, the effort data for all gear groups were updated and are given in Table 8.2.13.

Survey data

The UK carries out three bass pre-recruit surveys, details of which can be found in reports of the ICES Study Group on Bass (SGBASS). Briefly, trawl surveys are undertaken in the vicinity of Thames estuary and the Solent, and a seine net survey is carried out in the River Tamar. In the Solent, fishing is undertaken using a high headline bass trawl of local design, and the survey has been carried out since the early 1980s. The survey takes place twice a year, in May and September and the fishing gear catches several year classes. A relative index of abundance for a given year class is calculated using the mean number of fish caught when the year class is at Age 2, Age 3 and Age 4. Thus each year class is sampled during 6 separate surveys. A year class is not considered fully sampled until it has been sampled at ages 2, 3 and 4, but the index is considered as provisional. In the Thames survey, which is a shorter time series, fishing is carried out using two bass trawls of the same design. In this survey, which takes place in November, the gear predominantly catches fish at Age 0, 1 and 2. In the Tamar survey, the seine gear sweeps two creeks on 5-6 occasions during the year. Surveys in May-July catch fish at age-1, and in August-September the survey also catches the age-0 fish that have newly recruited to the creeks and estuaries. Separate indices are produced for the 0-group and 1-group fish.

Updated survey indices are given in Table 8.2.14 and Figure 8.2.1. For the trawl surveys, the indices are given as the relative mean number of fish per 10 minute tow and for the seine net survey indices are given as the relative mean number per m^2 swept. For the Solent survey, the index shows the two extremely large year classes of 1989 and 1997 and the very poor 1985 year class. In recent years, the index has been more consistent. Provisional data for the 2006 and 2007 year classes suggest that these are above the series average. For the Thames survey, results also suggest that 2007 is a strong year class. In the Tamar survey, the 2007 year class did not show strongly as 0-groups, but as 1-groups, the index was above the series average. The 2008 year class showed strongly as 0-groups and as 1-groups.

8.2.3 French data

New estimates of landings by individual vessels in the French fleet were available for 2000-2008, based on logbooks, sales records and information on the vessel's activity. Data were available as landings by year, quarter and gear for each vessel, but have been summarised in Table 8.2.15.

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[28] Author: Sarah Walmsley

The French fleet lands approximately 5 000 t of bass annually, with the majority being taken by bottom trawl and pelagic trawl gears, although bass are also taken in nets, longlines and handlines. The majority of French landings come from ICES Divisions VIId, e, h and VIIIa,b,d.

8.2.4 Assessment

With regard to an assessment, it was considered that there are currently insufficient data to carry out an international assessment. For the UK, there is a paucity of data on landings made by the recreational sector. This sector is estimated to land significant quantities of bass, but these estimates were made some years ago. There is also a lack of information on the catch composition, age composition and fishing effort for other countries that catch bass, such as France, though work is currently underway to rectify this.

If these data were to be made available by the beginning of August, work could be carried out to combine the data into an international dataset and for preliminary assessments (for the areas IV and VII) to be undertaken. The results could then be presented to the meeting of the ICES Assessment Working Group on New Species (WGNEW) which is scheduled to meet in October 2010, and would help inform any recommendations by the WGNEW on the way forward for bass stock assessment.

Table 8.2.1 - Nominal landings (t) of bass by country in Divisions IVb, c, and VIId, and additional UK catch1 according to the CEFAS logbook scheme, 1985 – 2006..

Year	Belgium	Denmark	France	Netherlands	Scotland	UK (Engl. & Wales)	Unallocated[1]	Total
1984			21			77	577	675
1985			175			76	170	421
1986			151			92	149	392
1987			85			86	194	365
1988			104	8		102	211	425
1989		1	147	2		91	150	391
1990		<0.5	131			70	185	386
1991		<0.5	161			168	212	541
1992		<0.5	180			83	253	516
1993			262			143	346	751
1994		1	260			357	915	1533
1995		1	298		<0.5	413	367	1079
1996		1	417	4	<0.5	318	267	1007
1997		1	290	1	<0.5	321	688	1301
1998		2	369	32	<0.5	281	323	1007
1999		1	628	32	<0.5	335	598	1594
2000			695	61	<0.5	217	378	1351
2001			772	76	<0.5	205	160	1213
2002			914	105	5	244	457	1725
2003	133		1100	169	2	269	277	1950
2004	119		937	197	<0.5	307	657	2217
2005	149	1	1126	319	1	276	596	2568
2006	150	2	1086	299	6	250	459	2252
2007	128	1	1340	373	24	252	-	2118
2008	118		1020	375	41	352	-	1906

Source: ICES Bulletin Statistique

1) Landings estimated by the Study Group.

Table 8.2.2 - Nominal landings (t) of bass by country in Divisions VIIe, h, and additional UK catch1 according to the CEFAS logbook scheme 1985 – 2006.

Year	Belgium	Denmark	France	Guernsey	Jersey	Channel Islands	Netherlands	Spain	Scotland	UK (Engl. & Wales)	Unallocated[1]	Total
1984			171	18	7					39	283	518
1985			98	10	8					19	213	348
1986			128	8	7					22	99	264
1987			744	8	6					16	209	983
1988			228	7	5					30	103	373
1989		1	131	40	8					39	55	274
1990			157	20	5					91	59	332
1991			202	13	3					45	80	343
1992			337	26	10					40	54	467
1993			252	29	16					51	88	436
1994			163			49				67	422	701
1995			269	59	10					101	112	551
1996			959			56	4		<0.5	162	49	1230
1997			774	57	17					150	439	1437
1998			580	60	19		16			162	88	925
1999			756	92	16				<0.5	310	94	1268
2000			684	111	19		<0.5	1		137	172	1124
2001			786	65	15		4			167	138	1175
2002			624	52	21		2		<0.5	234	99	1032
2003	2		1050	59	25		5			234	310	1685
2004	4		1225	140	19					231	275	1894
2005	3		714	198	22		8	<0.5†		162	156	1263
2006	6		986	162	31		9		1	199	303	1697
2007	6		691	142	18		3		28	243	-	1131
2008	7		454	123	20		5			217	-	826

Source: ICES Bulletin Statistique
1) Landings estimated by the Study Group.

Table 8.2.3 - Nominal landings (t) of bass by country in Divisions VIIa, f, g, and additional UK catch1 according to the CEFAS logbook scheme, 1985-2006.

Year	Belgium	France	Ireland	Scotland	UK (Engl. & Wales)	Unallocated[1]	Total
1984		1			8	203	212
1985		13			11	90	114
1986		2			11	245	258
1987		24	3		23	257	307
1988		7			43	80	130
1989		14			62	127	203
1990		14			27	120	161
1991		75			27	184	286
1992		43			24	147	214
1993		14			32	480	526
1994		9			110	735	854
1995		40		<0.5	141	264	445
1996		41		<0.5	82	234	357
1997		31		<0.5	88	443	562
1998		195		<0.5	42	439	676
1999		28		<0.5	32	391	451
2000		70		<0.5	50	424	544
2001		53			81	410	544
2002		80			131	213	424
2003	17	40		<0.5	73	382	512
2004	34	53		2	74	676	839
2005	54	99		1	72	364	590
2006	55	45			118	216	434
2007	44	43			168		256
2008	63	32			180		276

Source: ICES Bulletin Statistique
1) Landings estimated by the Study Group.

Table 8.2.4 - Nominal landings (t) of bass by country in Divisions IVa, VIa, VIIb,c,j&k and XII.

Year	Belgium	Denmark	France	Ireland[1]	Netherlands	Norway	Portugal	Scotland	Spain	Spain (BC)[1]	UK (Engl. & Wales)	Total
1984			1									1
1985			<0.5								<0.5	<0.5
1986			<0.5									<0.5
1987			<0.5	1							<0.5	1
1988			<0.5		3							3
1989			0.5	1								1
1990		<0.5	<0.5	1								1
1991		<0.5	1								<0.5	1
1992			2								1	3
1993			1								1	2
1994		<0.5	<0.5								1	1
1995		<0.5	<0.5					<0.5			8	8
1996			0.5				3	<0.5			5	8
1997		<0.5	<0.5								<0.5	<0.5
1998		<0.5	0.5					<0.5	40		10	50
1999		<0.5	0					<0.5	1		1	2
2000			3					<0.5		<0.5	1	4
2001			1							<0.5	<0.5	1
2002									1	<0.5	12	13
2003						<0.5		<0.5		<0.5		1
2004	<0.5					<0.5		<0.5		<0.5		1
2005		<0.5	2			<0.5						2
2006			3			<0.5						3
2007		<0.5	6			<0.5						6
2008			5									5

Source: ICES Bulletin Statistique
1) Estimates for Spain (Basque Country).

Table 8.2.5 - Nominal landings (t) of bass by country in Division VIIIa,b&d

Year	Belgium	France	Spain	Spain (BC)[1]	UK (Engl. Wales)	& Unallocated[2]	Total
1984		381	0		0		381
1985		805	0		1		806
1986		1478	0		4		1482
1987		1547	0		5		1552
1988		1512	0		16		1528
1989		1673	0				1673
1990		1407	0				1407
1991		1611	17		20		1648
1992		1601	14		9		1624
1993		1404	14		19		1437
1994		1393	17	60	14	130	1554
1995		1283	0	29	7	130	1420
1996		1344	0	51	14	130	1488
1997		1345	0	42	13	130	1488
1998		1142	27	50	3	130	1302
1999		1602	11	57	2		1672
2000		1824	50	58			1932
2001		1855	2	42			1899
2002		1618	15	50	<0.5		1683
2003		2300	39	38	2		2379
2004	<0.5	2072	212	65	7		2144
2005	<0.5	3202	31	43	4		3280
2006		3326	168		2		3496
2007	1	2985	79		1		3066
2008		1508	146				1654

Source: ICES Bulletin Statistique
1) Estimates for Spain (Basque Country).
2) Landings estimated by the Study Group.

Table 8.2.6 - Nominal landings (t) of bass by country in Division VIIIc.

Year	France	Portugal	Spain	Spain (BC)[1]	UK (Engl. & Wales)	Total
1984	0		180			180
1985	0		200			200
1986	5		206			211
1987	3		208			211
1988	12	<0.5	358			370
1989	1	1	325			327
1990	1		395			396
1991	9	1	300			310
1992	0		254			254
1993	0	<0.5	247			247
1994	0	1	306			307
1995	1	<0.5	334		<0.5	335
1996	1	<0.5	376			377
1997	0	<0.5	290			290
1998	0	<0.5	258			258
1999	9	<0.5	221			222
2000	20			5		25
2001	1		122	8		131
2002	1		107	14		122
2003	0		152	8		160
2004	39	1	173	8		221
2005	57	1	130	9	<0.5	197
2006	2	2	151			155
2007	1	1	114			116
2008		1	141			142

Source: ICES Bulletin Statistique
1) Estimates for Spain (Basque Country).

Table 8.2.7 – Nominal landings (t) of bass by country in Division IXa.

Year	Portugal*	Spain	Total
1984		250	250
1985		164	164
1986	181	182	363
1987	127	194	321
1988	351	93	444
1989	507	92	599
1990	412	146	558
1991	378	111	489
1992	345	94	439
1993	289	104	393
1994	372	134	506
1995	316	112	428
1996	378	158	536
1997	229	184	413
1998	273	115	388
1999	308	134	442
2000	361	83	444
2001	332	102	434
2002	326	49	475
2003	279	83	362
2004	66	75	141
2005	176	80	256
2006	459	117	576
2007	544	228	772
2008	405	111	516

* revised data set 2004

Table 8.2.8 – Nominal landings (t) of bass by stock area.

Year	IVb,c and VIId	VIIe, h	VIIa, f, g	IVb, VIa, VIIb, c & j, XII	VIIIa, b, d	VIIIc	IXa	Total
1984	675	518	212	1	381	180	250	2217
1985	421	348	114	<0.5	806	200	164	2053
1986	392	264	258	<0.5	1482	211	363	2970
1987	365	983	307	1	1552	211	321	3740
1988	425	373	130	3	1528	370	444	3273
1989	391	274	203	1	1673	327	599	3468
1990	386	332	161	1	1407	396	558	3241
1991	541	343	286	1	1648	310	489	3618
1992	516	467	214	3	1624	254	439	3517
1993	751	436	526	2	1437	247	393	3792
1994	1533	701	854	1	1554	307	506	5456
1995	1079	551	445	8	1420	335	428	4266
1996	1007	1230	357	8	1488	377	536	5003
1997	1301	1437	562	<0.5	1488	290	413	5491
1998	1007	925	676	50	1302	258	388	4606
1999	1594	1268	451	2	1672	222	442	5651
2000	1351	1124	544	4	1932	25	444	5424
2001	1213	1175	544	1	1899	131	434	5397
2002	1725	1032	424	13	1683	122	475	5474
2003	1950	1685	512	1	2379	160	362	7049
2004	2217	1894	839	1	2144	221	141	7457
2005	2568	1263	590	2	3280	197	256	8156
2006	2252	1697	434	3	3496	155	576	8613
2007	2118	1131	256	6	3066	116	772	7465
2008	1906	826	276	5	1654	142	516	5325

Table 8.2.9 - Effort (days fished), catch numbers at age and landings (kg) data for bass in ICES Divisions IVb+c areas and three gear groups (trawl, nets, lines), used in the UK assessment (1985-2006), with additional data for 2007 and 2008.

Effort

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Trawl	1169	1967	1720	1722	1712	749	1016	1232	1115	1797	2125	2556
Nets	1254	1780	2121	2904	3041	2205	2517	3617	3407	5624	7022	6364
Lines	749	782	626	1502	718	873	661	947	1209	1082	947	1685

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Trawl	1966	2010	1997	2447	2203	1829	2503	2624	1877	1388	1604	1697
Nets	6571	5319	4467	3779	3226	4053	4003	2818	3090	2074	1642	2262
Lines	1943	1971	1722	1358	1183	1079	1815	1332	482	318	432	247

Catch numbers at age

Trawl

Age	3	4	5	6	7	8	9	10	11	12+
1985	61	19	47	134	11	22	422	166	78	132
1986	41	742	0	0	73	0	0	997	0	286
1987	0	738	2560	235	40	0	28	0	302	1020
1988	0	0	0	213	240	0	107	0	0	1041
1989	0	0	20	324	365	82	7	31	11	676
1990	0	0	3	5	150	126	37	62	26	421
1991	218	1747	0	0	0	981	273	0	0	654
1992	531	1142	1115	186	0	0	0	0	0	0
1993	212	14052	0	0	0	0	0	0	0	0
1994	115	4823	27763	1459	1190	74	0	93	575	562
1995	1051	3932	4648	13630	3001	922	0	0	0	0
1996	909	4278	758	2628	11680	1915	1006	0	0	0
1997	519	739	2243	1634	1824	5486	748	567	0	536
1998	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1999	0	1979	6159	2956	828	904	528	2038	215	168
2000	2728	291	4271	5909	931	724	1109	546	1010	0
2001	3606	8944	315	990	1272	218	715	281	21	478
2002	1064	3877	10646	419	1550	1728	507	276	128	526
2003	3939	19137	4340	2812	187	464	767	60	118	474
2004	125	2081	10962	5834	4535	0	0	0	691	0
2005	1669	11627	10743	9306	781	43	0	18	58	0
2006	4370	11069	7288	2285	1680	669	91	0	0	1630
2007	356	1271	11835	4909	1061	502	448	125	0	119
2008	145	2372	9563	7092	3169	372	1211	572	191	0

Nets

Age	3	4	5	6	7	8	9	10	11	12+
1985	300	202	153	277	57	180	1813	552	706	1424
1986	13	181	1406	0	0	0	0	1670	800	3364
1987	0	1679	5824	2212	534	588	174	90	2514	1683
1988	0	636	6072	12355	2349	423	489	74	31	977
1989	666	152	472	7779	6476	1296	23	163	143	1415
1990	298	72	263	689	3581	2469	357	299	280	731

1991	12476	4870	326	0	0	439	192	0	0	982
1992	4523	10135	5617	229	0	605	286	443	56	200
1993	163	16958	5030	2811	506	64	24	402	363	1233
1994	383	19675	100954	5301	2238	24	0	46	315	343
1995	3883	19269	32920	57259	2834	1165	0	92	92	917
1996	10223	26970	4300	8033	11141	27	27	0	0	1808
1997	3205	2154	3656	3862	4969	15073	702	866	0	1654
1998	578	9555	2922	4053	2772	2197	3891	173	49	164
1999	0	7530	21487	11714	2110	2481	1195	3598	157	314
2000	2863	429	8226	9025	1023	809	757	346	1209	218
2001	4993	13685	362	1243	1811	275	717	226	171	238
2002	5258	13749	24085	805	1626	1588	233	284	78	262
2003	6004	38686	13797	8451	294	556	545	202	28	241
2004	1523	12939	31116	5813	3104	16	195	125	119	441
2005	2633	16183	14813	13842	4020	909	0	235	312	129
2006	5726	17561	15153	3929	3930	665	1713	16	65	1076
2007	648	3282	28985	13597	2414	1503	668	66	0	255
2008	821	8873	56065	22637	6194	995	839	581	58	0

Lines

Age	3	4	5	6	7	8	9	10	11	12+
1985	700	445	249	101	223	12	406	209	134	234
1986	196	3483	825	255	726	0	0	1978	246	0
1987	0	36	110	37	18	21	6	10	129	296
1988	0	5	40	279	136	14	87	10	11	976
1989	0	0	0	88	76	107	21	48	61	1196
1990	150	13	6	79	252	316	145	122	94	1082
1991	30	54	48	40	40	644	436	137	0	2731
1992	82	191	322	86	0	78	106	267	160	693
1993	28	318	103	87	22	10	6	70	74	268
1994	2	78	843	182	115	7	0	25	66	566
1995	8	70	108	297	71	92	0	20	20	336
1996	28	59	85	270	1109	26	9	0	33	297
1997	32	26	71	93	113	487	57	76	17	285
1998	33	629	173	181	111	130	367	52	6	97
1999	0	263	1518	750	567	811	603	2270	246	749
2000	4	4	102	254	65	88	165	144	819	112
2001	575	1551	41	491	810	204	1184	160	222	535
2002	493	1119	1395	187	714	1484	432	984	406	1782
2003	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
2004	56	216	714	771	294	19	66	6	79	671
2005	22	104	107	178	43	85	0	67	67	135
2006	1	46	116	70	85	28	37	17	0	255
2007	17	59	1172	949	219	203	155	53	0	138
2008	0	0	0	1325	3533	883	883	0	0	0

Landings (kg)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Trawl	1266	2837	7593	3296	2897	2369	2658	2700	6412	26723	29737	33087
Nets	9640	16599	20052	21459	19467	13256	9602	12138	24973	87150	103363	52791
Lines	2511	6790	1644	4126	3858	5984	7913	4902	1778	3291	2234	2874

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Trawl	18049	17476	16211	22234	15178	19869	24082	27161	22963	22957	18054	25471
Nets	47577	28793	48225	26353	20192	39010	54134	51962	43046	45992	39638	71055
Lines	2714	2546	13075	3875	9897	18225	8239	4654	1784	1551	3751	10732

Table 8.2.10 - Effort (days fished), catch numbers at age and landings (kg) data for bass in ICES Division VIId and three gear groups (trawl, nets, lines), used in the UK assessment (1985-2006), with additional data for 2007 and 2008.

Effort

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Trawl	3889	3227	3155	4116	4810	3833	6973	3645	4842	4651	3832	3909
Nets	9500	9073	10038	8263	6270	15557	17024	16068	10535	11017	15000	13633
Lines	1126	1139	515	556	1250	259	4057	464	1882	1758	2977	2813

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Trawl	3931	4481	4420	5165	5507	4237	4861	4369	3316	3503	3929	2862
Nets	16461	16351	14116	10160	11051	8900	11910	12442	10250	14848	14033	6975
Lines	2486	3491	2382	1120	876	1320	1544	1795	1477	2456	2717	808

Catch numbers at age

Trawl

	2	3	4	5	6	7	8	9	10	11	12+
1985	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1986	0	107	346	245	101	357	106	173	853	200	641
1987	0	166	13311	17414	4492	270	530	0	179	917	2218
1988	0	166	10555	32067	7671	2321	74	258	346	0	1936
1989	31571	4227	253	2500	8142	2525	943	472	483	144	4660
1990	0	86	147	207	400	3182	1993	595	182	110	788
1991	0	22	4995	211	37	160	1021	1673	786	0	3268
1992	0	3045	15040	7230	230	0	350	1160	178	0	1042
1993	0	128	26660	35848	10173	177	114	229	1159	565	755
1994	0	681	3174	104074	7011	1845	113	15	59	444	1134
1995	0	60	1738	7273	68607	2552	1417	131	68	0	1362
1996	0	160	2703	7322	9832	33535	1495	737	46	59	817
1997	0	95	1867	14380	11902	5322	30344	927	339	55	567
1998	0	190	10361	14699	26963	11289	3941	12082	469	140	139
1999	87	0	39939	64483	12941	9821	2388	905	3868	99	0
2000	0	2062	1147	55484	19123	1659	1046	298	74	157	385
2001	223	1325	42460	8778	41547	6513	995	1532	300	382	1186
2002	0	920	9805	62835	1399	5793	1665	410	413	239	284
2003	0	207	18864	14624	27649	2213	9497	4095	2118	798	1831
2004	0	991	6722	61321	15618	12795	409	1458	953	470	1133
2005	0	3297	35226	11504	2309	994	21	0	0	0	0
2006	0	9795	46538	32078	8515	1306	153	0	0	0	0
2007	0	0	14186	33363	11666	2060	1062	0	0	0	0
2008	0	1385	34169	51369	10347	3680	1877	728	80	0	0

Nets

Age	2	3	4	5	6	7	8	9	10	11	12+
1985	0	5217	13315	1470	109	39	163	342	0	466	0
1986	0	11401	12160	14107	2561	4473	53	828	2210	121	3042
1987	0	80	4886	19009	2131	478	228	228	98	293	3024
1988	0	0	23	3417	610	771	387	490	370	26	3695
1989	776	265	316	3307	20552	3013	1035	164	35	0	0
1990	0	188	244	273	231	1806	1195	201	230	73	182
1991	0	98	17852	1016	0	1968	8469	7801	3768	211	9893

1992	0	6759	25548	19772	286	44	69	71	47	18	94
1993	0	67	10957	10592	2956	79	17	102	383	262	482
1994	2	91	3244	91351	8857	3467	280	31	264	1126	4610
1995	0	484	7270	19948	88207	1213	550	18	4	66	651
1996	0	94	7162	16793	14011	44994	2297	1144	70	51	858
1997	0	195	1838	14645	12847	4994	50786	2856	876	592	1126
1998	0	221	15078	20693	13217	5352	2089	7317	610	181	256
1999	22	0	18930	41202	10205	6696	1328	529	1957	88	457
2000	0	885	440	42392	14705	1293	888	236	67	488	282
2001	119	693	24311	2737	24775	7317	1243	1194	884	286	948
2002	0	1572	8507	125382	3612	9601	1456	221	118	18	140
2003	0	148	14163	12787	23309	886	1937	580	315	157	293
2004	0	1014	5899	71297	23602	26500	1733	4191	1218	407	1182
2005	0	3808	21767	27456	57048	9627	4276	0	699	0	0
2006	0	5210	42273	41874	16074	7852	1356	1377	128	384	386
2007	0	0	3344	19759	9992	13623	6455	1316	3286	8887	733
2008	0	1386	45971	99042	21883	6294	3797	2714	819	988	1290

Lines

Age	2	3	4	5	6	7	8	9	10	11	12+
1985	0	710	906	299	474	48	186	719	172	101	311
1986	0	353	2032	1549	360	1011	236	407	2247	526	3810
1987	0	8	778	1858	855	260	223	301	204	561	1473
1988	0	0	1252	10869	1859	1155	249	432	151	132	1928
1989	0	0	0	0	0	90	202	67	135	0	583
1990	0	8	28	48	134	852	578	198	88	67	343
1991	0	116	8793	408	36	574	4113	3989	1767	48	11778
1992	0	1328	5424	3117	78	29	87	366	265	75	329
1993	0	25	4699	6536	6018	349	80	532	2699	2094	5200
1994	0	38	2809	55467	8927	6046	345	34	274	1685	3610
1995	0	104	5531	14745	52409	2268	2520	111	462	243	10871
1996	0	198	9046	12773	8297	37894	3919	4050	100	347	7062
1997	0	349	3014	16365	11637	5213	46585	2119	1159	610	2239
1998	0	193	6797	9848	15664	7021	4696	20431	1915	778	3449
1999	17	0	11558	26152	8525	7711	3146	2111	9009	944	2401
2000	0	343	242	15082	9349	1701	1952	828	331	2174	787
2001	42	180	5392	897	9730	3761	811	1123	685	519	2216
2002	0	194	1333	9649	1670	9981	4119	1033	2329	485	1603
2003	0	65	5524	5205	12852	1205	4823	1775	872	535	1721
2004	0	240	1273	10497	4466	9681	1567	4836	2003	616	3169
2005	0	141	1113	3024	9074	2895	3027	0	3916	1400	1255
2006	0	31	1580	2230	2764	3452	990	2709	678	843	1219
2007	0	0	4048	7769	4979	3879	5929	1746	2650	2767	812
2008	0	102	1815	6257	7293	4265	2030	2165	798	499	1995

Landings

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Trawl	16754	5398	23108	37363	36128	9845	22914	22518	49027	72031	66340	47233
Nets	13014	35919	24612	15211	20874	6116	74070	30438	19036	96094	78627	76818
Lines	3337	19522	9150	13507	2648	3145	49644	9277	41345	67989	97235	94285

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Trawl	56570	75649	91631	54867	69333	51268	73311	70644	30935	55011	44296	70136
Nets	96555	52554	63956	43586	48785	90269	60361	106646	101681	86089	93404	137362
Lines	88449	92575	80561	31416	27767	36110	36628	46067	37052	24361	49729	34778

Table 8.2.11 – Effort (days fished), catch numbers at age and landings (kg) data for bass in ICES Divisions VIIe+h and three gear groups (trawl, nets, lines), used in the UK assessment (1985-2006), with additional data for 2007 and 2008.

Effort

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Trawl	2072	2462	2694	3552	7187	7363	4481	4378	4906	5654	6299	6602
Nets	1128	1642	1692	2926	2576	2782	1881	1324	1736	1793	2142	2514
Lines	1653	1595	1541	1014	1314	580	385	943	950	985	1166	887

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Trawl	7312	6914	5987	7997	7572	7426	7759	8145	7014	15571	9353	8650
Nets	3624	2393	2749	1940	1616	1080	1359	1296	923	2376	1972	2524
Lines	2896	791	1101	836	457	149	351	467	309	616	1331	1162

Catch numbers at age

Trawl

Age	3	4	5	6	7	8	9	10	11	12+
1985	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1986	107	346	245	101	357	106	173	853	200	641
1987	166	13311	17414	4492	270	530	0	179	917	2218
1988	166	10555	32067	7671	2321	74	258	346	0	1936
1989	4227	253	2500	8142	2525	943	472	483	144	4660
1990	86	147	207	400	3182	1993	595	182	110	788
1991	22	4995	211	37	160	1021	1673	786	0	3268
1992	3045	15040	7230	230	0	350	1160	178	0	1042
1993	128	26660	35848	10173	177	114	229	1159	565	755
1994	681	3174	104074	7011	1845	113	15	59	444	1134
1995	60	1738	7273	68607	2552	1417	131	68	0	1362
1996	160	2703	7322	9832	33535	1495	737	46	59	817
1997	95	1867	14380	11902	5322	30344	927	339	55	567
1998	190	10361	14699	26963	11289	3941	12082	469	140	139
1999	0	39939	64483	12941	9821	2388	905	3868	99	0
2000	2062	1147	55484	19123	1659	1046	298	74	157	385
2001	1325	42460	8778	41547	6513	995	1532	300	382	1186
2002	920	9805	62835	1399	5793	1665	410	413	239	284
2003	207	18864	14624	27649	2213	9497	4095	2118	798	1831
2004	991	6722	61321	15618	12795	409	1458	953	470	1133
2005	3297	35226	11504	2309	994	21	0	0	0	0
2006	9795	46538	32078	8515	1306	153	0	0	0	0
2007	0	4451	39390	24241	11809	10880	3760	1921	704	864
2008	2225	11674	23181	24117	9227	4203	2729	705	728	868

Nets

Age	3	4	5	6	7	8	9	10	11	12+
1985	5217	13315	1470	109	39	163	342	0	466	0
1986	11401	12160	14107	2561	4473	53	828	2210	121	3042
1987	80	4886	19009	2131	478	228	228	98	293	3024
1988	0	23	3417	610	771	387	490	370	26	3695
1989	265	316	3307	20552	3013	1035	164	35	0	0
1990	188	244	273	231	1806	1195	201	230	73	182
1991	98	17852	1016	0	1968	8469	7801	3768	211	9893

1992	6759	25548	19772	286	44	69	71	47	18	94
1993	67	10957	10592	2956	79	17	102	383	262	482
1994	91	3244	91351	8857	3467	280	31	264	1126	4610
1995	484	7270	19948	88207	1213	550	18	4	66	651
1996	94	7162	16793	14011	44994	2297	1144	70	51	858
1997	195	1838	14645	12847	4994	50786	2856	876	592	1126
1998	221	15078	20693	13217	5352	2089	7317	610	181	256
1999	0	18930	41202	10205	6696	1328	529	1957	88	457
2000	885	440	42392	14705	1293	888	236	67	488	282
2001	693	24311	2737	24775	7317	1243	1194	884	286	948
2002	1572	8507	125382	3612	9601	1456	221	118	18	140
2003	148	14163	12787	23309	886	1937	580	315	157	293
2004	1014	5899	71297	23602	26500	1733	4191	1218	407	1182
2005	3808	21767	27456	57048	9627	4276	0	699	0	0
2006	5210	42273	41874	16074	7852	1356	1377	128	384	386
2007	0	2362	16221	9360	4734	5196	1676	1342	578	927
2008	4264	14007	19389	18011	5280	2268	1693	769	911	994

Lines

Age	3	4	5	6	7	8	9	10	11	12+
1985	710	906	299	474	48	186	719	172	101	311
1986	353	2032	1549	360	1011	236	407	2247	526	3810
1987	8	778	1858	855	260	223	301	204	561	1473
1988	0	1252	10869	1859	1155	249	432	151	132	1928
1989	0	0	0	0	90	202	67	135	0	583
1990	8	28	48	134	852	578	198	88	67	343
1991	116	8793	408	36	574	4113	3989	1767	48	11778
1992	1328	5424	3117	78	29	87	366	265	75	329
1993	25	4699	6536	6018	349	80	532	2699	2094	5200
1994	38	2809	55467	8927	6046	345	34	274	1685	3610
1995	104	5531	14745	52409	2268	2520	111	462	243	10871
1996	198	9046	12773	8297	37894	3919	4050	100	347	7062
1997	349	3014	16365	11637	5213	46585	2119	1159	610	2239
1998	193	6797	9848	15664	7021	4696	20431	1915	778	3449
1999	0	11558	26152	8525	7711	3146	2111	9009	944	2401
2000	343	242	15082	9349	1701	1952	828	331	2174	787
2001	180	5392	897	9730	3761	811	1123	685	519	2216
2002	194	1333	9649	1670	9981	4119	1033	2329	485	1603
2003	65	5524	5205	12852	1205	4823	1775	872	535	1721
2004	240	1273	10497	4466	9681	1567	4836	2003	616	3169
2005	141	1113	3024	9074	2895	3027	0	3916	1400	1255
2006	31	1580	2230	2764	3452	990	2709	678	843	1219
2007	0	964	7563	8295	5078	6558	3971	4574	1467	7333
2008	95	1675	5065	11186	5458	5047	5783	2577	3392	3747

Landings (kg)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Trawl	16994	5398	23108	37363	36128	9845	22914	22518	49027	72031	66340	47233
Nets	13014	35919	24612	15211	20874	6116	74070	30438	19036	96094	78627	76818
Lines	3337	19522	9150	13507	2648	3145	49644	9277	41345	67989	97235	94285

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Trawl	56570	75649	91631	54867	69333	51268	73311	70644	30935	55011	82065	68239
Nets	96555	52554	63956	43586	48785	90269	60361	106646	101681	86089	41781	19712
Lines	88449	92575	80561	31416	27767	36110	36628	46067	37052	24361	67755	56289

Table 8.2.12 – Effort (days fished), catch numbers at age and landings (kg) data for bass in ICES Divisions VIIa+f+g and three gear groups (trawl, nets, lines), used in the UK assessment (1985-2006), with additional data for 2007 and 2008.

Effort

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Trawl	788	1029	1677	2546	3342	2648	1613	1876	2587	2293	2919	2405
Nets	1704	2899	3196	8096	4278	851	891	563	561	799	1226	1044
Lines	67	359	826	3173	2826	649	852	640	238	844	1382	368

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Trawl	2960	2226	1478	1835	2510	2387	3015	2063	1902	4573	2469	1845
Nets	1176	367	270	552	529	554	743	394	495	923	1724	1820
Lines	498	274	150	99	268	326	422	318	254	586	1451	824

Catch numbers at age

Trawl

Age	3	4	5	6	7	8	9	10	11	12+
1985	226	1096	654	1874	245	843	1197	382	52	332
1986	0	510	687	188	511	198	507	605	131	57
1987	144	450	2758	1479	311	158	89	99	463	232
1988	1955	10518	8273	3872	641	113	194	6	86	425
1989	0	0	343	4168	6532	2866	1364	1041	883	8302
1990	1082	1435	0	1717	4077	1398	520	56	155	1407
1991	0	10981	859	516	3286	2204	898	445	102	147
1992	646	1486	2032	63	149	732	1886	1145	294	604
1993	48	8325	7861	3309	166	140	983	1722	890	481
1994	0	231	10039	2962	1210	84	13	139	519	697
1995	0	3223	12672	40610	1579	602	0	0	48	353
1996	0	205	180	5263	7290	102	6	0	0	0
1997	0	766	9002	5478	7724	16909	453	137	0	1072
1998	59	6382	4360	10107	1325	2444	4386	180	11	370
1999	88	1916	3281	2991	5101	1285	911	2065	85	193
2000	0	0	2665	2142	2492	3645	1528	2095	3348	160
2001	145	4099	2407	16256	2965	1167	1807	894	1095	1483
2002	1660	4527	30315	2975	10107	1532	896	894	288	1199
2003	0	2164	6654	37076	1738	6797	759	505	317	1192
2004	0	2136	26306	13849	21001	313	1089	314	34	130
2005	215	4569	7946	25633	7317	9965	1361	802	117	176
2006	0	3794	10710	5821	18050	6566	10056	852	507	446
2007	0	2286	21508	16393	6423	4431	1962	2048	476	1188
2008	0	4592	55059	67818	25192	14452	13518	8873	3895	2861

Nets

Age										
1985	4210	480	483	1609	76	752	608	270	92	26
1986	0	1548	1301	264	423	172	326	430	16	154
1987	0	1315	3573	1070	134	149	53	85	330	5
1988	0	304	2720	13786	5452	482	423	42	188	625
1989	0	0	31	859	4298	2283	982	660	387	1684
1990	0	0	0	42	155	404	275	85	156	1341
1991	0	2089	150	500	1695	4002	3022	1220	142	1336

1992	390	719	466	34	117	449	1654	2297	595	1799
1993	19	3923	5950	2428	99	43	170	150	244	427
1994	0	60	15881	5560	3255	200	70	619	1482	1652
1995	0	212	2216	38747	1499	498	0	3	6	4743
1996	24	721	1369	11187	29376	361	59	0	27	316
1997	0	400	4343	3759	5850	18946	305	731	0	263
1998	2	825	882	2958	480	822	1647	118	18	105
1999	0	1874	1619	1187	1575	231	165	360	8	4
2000	201	127	11148	4424	2178	2536	711	681	763	103
2001	90	2680	1514	14187	3199	1225	1686	1203	1536	2986
2002	389	1826	19746	3169	15616	3451	2583	3523	1415	6832
2003	0	773	2667	16132	519	1288	149	91	52	466
2004	0	200	1746	1611	6707	254	631	185	102	153
2005	0	69	321	4361	2035	6071	495	841	130	238
2006	0	296	1093	561	1844	471	765	46	167	155
2007	0	1527	13844	13236	6183	7833	4109	6229	1070	3149
2008	0	1407	14130	19924	7896	5037	4922	3773	1414	687

Lines

Age										
1985	9	9	1	17	3	31	112	34	15	92
1986	29	856	529	123	251	97	155	502	124	158
1987	106	274	1510	778	189	107	89	231	663	343
1988	23	434	1653	1449	387	114	202	33	189	1977
1989	0	0	503	3065	123	0	0	0	0	0
1990	0	0	0	288	766	557	220	38	83	550
1991	43	780	57	227	490	1177	965	287	21	275
1992	438	481	435	12	41	160	497	634	195	367
1993	4	555	426	208	11	17	75	234	248	422
1994	0	1330	70318	8437	2597	195	72	755	1972	1901
1995	0	2154	10912	39045	1065	572	0	20	72	745
1996	9	327	502	5197	14836	157	77	0	0	86
1997	0	218	1259	1370	3070	10435	265	44	0	870
1998	2006	1848	899	2440	400	870	1949	85	4	34
1999	0	1024	608	420	761	150	227	923	90	159
2000	44	33	2422	769	323	423	149	223	478	86
2001	21	685	391	6145	2058	680	1056	565	536	893
2002	64	307	3593	887	5571	1856	916	1528	401	1918
2003	0	213	734	5691	352	1661	231	201	76	677
2004	0	195	2609	2647	6475	417	946	1169	324	1352
2005	0	113	1116	4613	1626	3577	447	450	114	208
2006	0	1813	7136	4280	13325	4030	6744	410	921	730
2007	0	1473	15056	14110	5424	5269	2675	3673	961	851
2008	0	1490	15905	22076	8209	4220	3637	2039	1013	1218

Landings (kg)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Trawl	5910	3410	4896	12853	29343	11595	7709	5388	17757	12846	40425	8192
Nets	4145	3960	4189	21967	12294	5144	16292	14903	10436	27193	54149	37905
Lines	628	2622	4602	8237	1661	3752	3156	4051	3184	64810	42687	18043

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Trawl	38016	23826	17452	23034	30105	41268	45166	45367	46163	49257	57335	67000
Nets	33124	7988	5676	20405	34767	63800	18265	10601	14984	5103	63839	56976
Lines	18621	8339	4776	5236	14394	19827	9510	18006	10998	37324	45681	54466

Table 8.2.13 – Nominal fishing effort (days fished, by gear group) by UK vessels landing into England and Wales (E&W) and by E&W vessels landing outside the UK, 1985–2008. Source FAD database.

	IVb+c					VIId					VIIe+h					VIIa+f+g				
	Trawls	Pair trawls	Nets	Lines	Other	Trawls	Pair trawls	Nets	Lines	Other	Trawls	Pair trawls	Nets	Lines	Other	Trawls	Pair trawls	Nets	Lines	Other
1985	1169	2	1254	749	81	3889	1	9500	1126	28	2072	62	1128	1653	159	788	0	1704	67	30
1986	1967	26	1780	782	122	3227	2	9073	1139	168	2462	36	1642	1595	172	1029	0	2899	359	45
1987	1720	0	2121	626	0	3155	0	10038	515	193	2694	12	1692	1541	20	1677	5	3196	826	38
1988	1722	0	2904	1502	72	4116	0	8263	556	148	3552	64	2926	1014	44	2546	0	8096	3173	58
1989	1712	0	3041	718	110	4810	140	6270	1250	9	7187	47	2576	1314	45	3342	8	4278	2826	750
1990	749	0	2205	873	268	3833	0	15557	259	1	7363	139	2782	580	19	2648	2	851	649	12
1991	1016	0	2517	661	98	6973	6	17024	4057	38	4481	95	1881	385	107	1613	1	891	852	3
1992	1232	0	3617	947	42	3645	1	16068	464	73	4378	77	1324	943	117	1876	0	563	640	104
1993	1115	0	3407	1209	45	4842	1	10535	1882	282	4906	33	1736	950	190	2587	0	561	238	328
1994	1797	6	5624	1082	155	4651	0	11017	1758	662	5654	15	1793	985	150	2293	4	799	844	370
1995	2125	56	7022	947	79	3832	24	15000	2977	2423	6299	34	2142	1166	352	2919	5	1226	1382	173
1996	2556	0	6364	1685	160	3909	10	13633	2813	1701	6602	102	2514	887	669	2405	0	1044	368	70
1997	1966	0	6571	1943	91	3931	0	16461	2486	2639	7312	170	3624	2896	1621	2960	0	1176	498	88
1998	2010	0	5319	1971	208	4481	23	16351	3491	2072	6914	90	2393	791	1597	2226	3	367	274	113
1999	1997	0	4467	1722	126	4420	42	14116	2382	1258	5987	179	2749	1101	1196	1478	1	270	150	136
2000	2447	0	3779	1358	227	5165	8	10160	1120	2231	7997	168	1940	836	993	1835	0	552	99	66
2001	2203	2	3226	1183	216	5507	19	11051	876	1514	7572	165	1616	457	649	2510	0	529	268	69
2002	1829	0	4053	1079	163	4237	19	8900	1320	1014	7426	170	1080	149	828	2387	0	554	326	128
2003	2503	0	4003	1815	420	4861	81	11910	1544	1564	7759	333	1359	351	477	3015	0	743	422	149
2004	2624	1	2818	1332	252	4369	5	12442	1795	511	8145	474	1296	467	311	2063	0	397	318	19
2005	1877	4	3090	482	93	3316	12	10250	1477	490	7014	171	923	309	189	1902	0	495	254	26
2006	1388	2	2074	318	223	3503	5	14848	2456	617	15571	74	2376	616	126	4573	19	923	586	45
2007	1604	2	1642	432	95	3929	20	14033	2717	1997	9353	164	1972	1331	145	2469	0	1724	1451	31
2008	1697	1	2262	247	140	2862	1	6975	808	835	8650	77	2524	1162	228	1845	0	1820	824	57

Table 8.2.14 - Indices of relative abundance of bass caught in UK bass pre-recruit surveys. For the Solent and Thames surveys, abundance is given as mean number of fish per 10 minute tow and for the Tamar survey, abundance is given as number of fish per m2 swept by the seine net.

	Thames	Solent	Tamar (Age 0)	Tamar (Age 1)
1977		0.119		
1978		0.219		
1979		1.724		
1980		0.319		
1981		0.785		
1982		1.450		
1983		1.813		
1984		0.104		0.126
1985		0.005	0.663	0.385
1986		0.052	0.005	0.014
1987		0.340	0.032	0.062
1988		0.808	1.484	1.284
1989		4.431	2.348	2.389
1990		0.629	1.038	1.516
1991		0.507	0.076	0.058
1992		0.593	2.216	2.431
1993		0.310	1.013	0.913
1994	0.784	1.271	1.126	0.346
1995	0.011	2.342	2.356	1.294
1996		0.207	0.102	0.047
1997	0.134	3.261	1.119	1.299
1998	0.275	0.800	2.082	3.170
1999	1.042	1.413	1.215	0.937
2000	0.387	0.569	0.340	1.185
2001	1.226	0.477	0.351	0.129
2002	2.059	0.774	2.098	3.179
2003	1.813	0.793	0.965	1.067
2004	1.071	0.529	1.453	0.261
2005	0.403	0.549	0.522	0.169
2006	1.298	1.221	0.186	0.203
2007	2.870	1.253	0.475	1.308
2008	0.573	0.000	1.275	1.229
2009	0.668		0.460	

Table 8.2.15 – Estimated French bass landings (t), by stock area and gear group, 2000-2008.

	Bottom trawl	Handlines	Longlines	Nets	Other gears	Pelagic trawl	Seine	Danish seine	All gears
IVb,c & VIId									
2000	436	9	7	62	9	89	0	0	612
2001	439	70	10	75	11	77	0	0	681
2002	579	71	8	94	6	109	0	0	868
2003	809	108	17	111	12	140	0	0	1197
2004	830	80	15	114	6	272	0	0	1318
2005	773	89	19	99	4	393	0	0	1377
2006	668	106	19	99	9	243	0	0	1145
2007	887	150	26	104	15	246	0	0	1429
2008	841	96	11	67	13	263	0	7	1297
VIIe,h									
2000	204	192	97	45	10	588	1	0	1138
2001	226	141	154	35	8	577	8	0	1149
2002	280	133	137	34	9	303	6	0	902
2003	262	169	144	40	7	632	3	0	1258
2004	358	128	158	35	7	548	4	0	1237
2005	434	149	182	48	8	959	5	0	1784
2006	403	189	239	41	5	1177	21	0	2075
2007	273	173	211	53	4	602	4	0	1320
2008	246	168	151	61	6	771	22	0	1423
VIIa,f,g									
2000	51	0	0	0	0	4	0	0	56
2001	48	0	0	0	0	6	0	0	54
2002	52	0	0	0	0	4	0	0	55
2003	49	0	0	0	0	0	0	0	50
2004	49	0	0	0	0	0	0	0	49
2005	33	0	0	0	0	0	0	0	34
2006	39	0	0	0	0	0	0	0	39
2007	27	0	0	1	0	0	0	0	28
2008	58	0	0	0	0	0	0	0	58
IVa, VIa, VIIb,c,j,k									
2000	1	0	1	1	0	0	0	0	3
2001	0	0	0	0	0	0	0	0	1
2002	0	0	0	0	0	0	0	0	1
2003	1	0	0	1	0	1	0	0	3
2004	6	0	0	0	0	0	0	0	6
2005	1	0	0	0	0	3	0	0	4
2006	4	0	0	0	0	0	0	0	5
2007	6	0	0	0	0	4	0	0	10
2008	3	0	0	0	0	13	0	0	15

Table 8.2.15 - Continued.

	Bottom trawl	Handlines	Longlines	Nets	Other gears	Pelagic trawl	Seine	Danish seine	All gears
VIIIa,b,d									
2000	441	104	530	742	22	465	10	0	2314
2001	335	102	549	581	17	636	35	0	2255
2002	335	103	544	562	18	616	57	0	2234
2003	286	127	686	542	24	819	21	0	2506
2004	414	132	751	526	26	411	36	0	2295
2005	498	88	722	536	29	806	55	0	2734
2006	458	111	764	582	27	760	16	0	2719
2007	524	139	781	690	19	510	19	0	2682
2008	547	105	684	557	9	662	42	0	2606
8c									
2000	3	0	0	2	0	9	0	0	14
2001	0	0	0	3	0	17	0	0	20
2002	0	0	0	2	0	1	0	0	3
2003	0	0	0	0	0	9	0	0	10
2004	0	0	0	0	0	1	0	0	1
2005	0	0	0	0	0	13	2	0	16
2006	0	0	0	0	0	3	0	0	4
2007	0	0	0	1	0	3	0	0	4
2008	1	0	0	0	0	7	0	0	8
8e									
2000	1	0	0	0	0	0	0	0	1
2001	0	0	0	0	0	0	0	0	1
2002	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0
9a									
2000	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0

Table 8.2.15 - Continued.

	Bottom trawl	Handlines	Longlines	Nets	Other gears	Pelagic trawl	Seine	Danish seine	All gears
10									
2000	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	2	0	2
All landings									
2000	1137	305	635	852	41	1156	10	0	4137
2001	1048	313	713	694	36	1312	44	0	4160
2002	1247	307	689	692	33	1033	63	0	4063
2003	1408	404	848	695	44	1602	24	0	5024
2004	1656	340	925	675	39	1232	40	0	4906
2005	1740	326	923	684	41	2174	63	0	5950
2006	1572	407	1022	722	42	2183	37	0	5986
2007	1717	462	1018	849	39	1364	23	0	5472
2008	1696	369	846	685	27	1715	65	7	5409

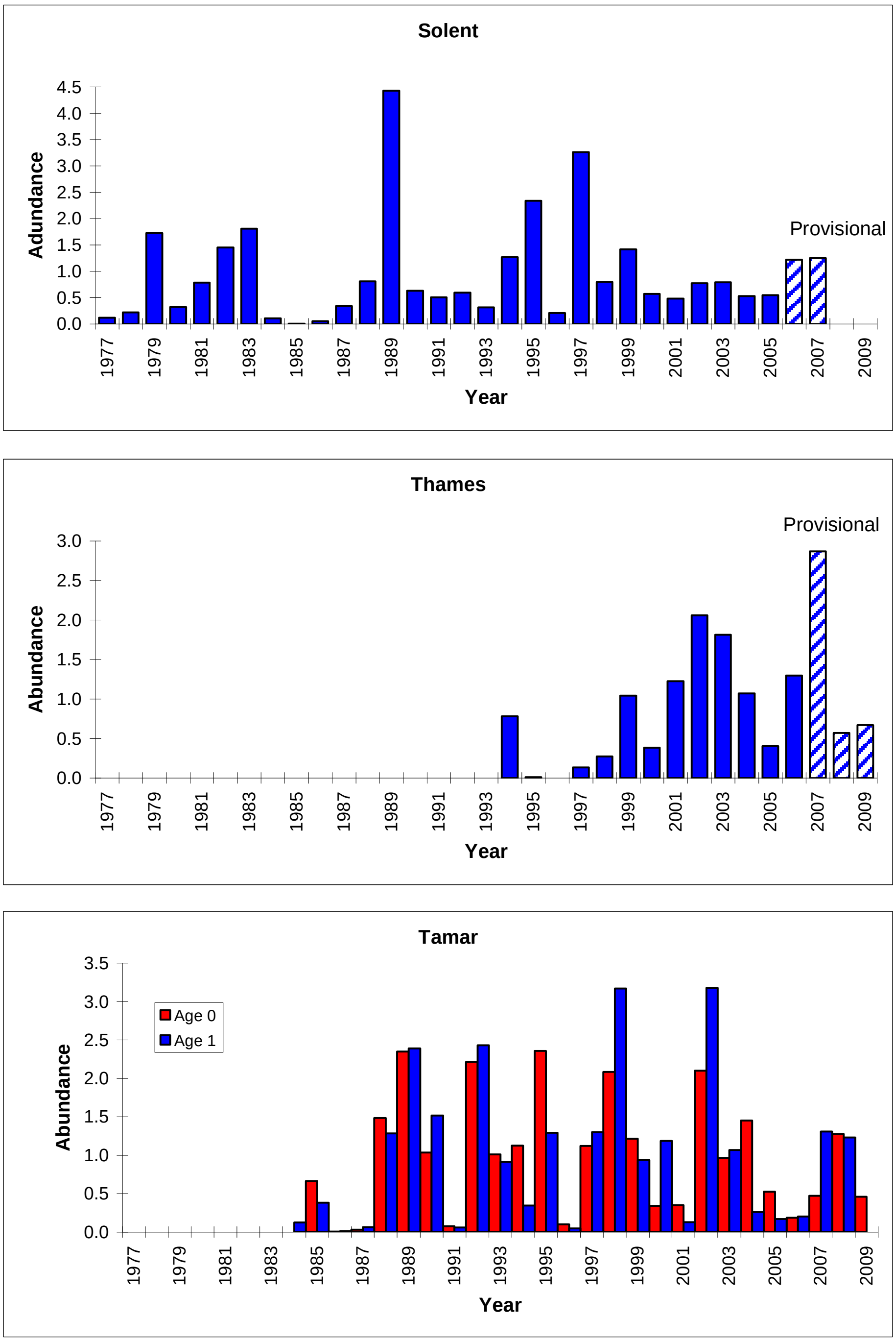

Figure 8.2.1 - Relative abundance indices for 3 UK bass pre-recruit surveys. For the Solent and Thames surveys, the indices are relative mean abundance of fish per 10 minute tow. For the Tamar survey, the indices are relative mean abundance of fish per m2 water swept by seine net gear.

8.3 ILVO: Assessment of turbot and brill in Skagerrak, Channel, Irish and Celtic Seas

Given the highly fragmented and incomplete time series of age data, the poor quality of survey abundance series and indices (low catch numbers quickly result in underrepresentation of certain year-classes – mainly for the older ones), the poor agreement among these survey series, and the conclusions on the development of assessments for turbot and brill in the North Sea elsewhere in this report, no progress could be made in the development of assessments for these species in the Skagerrak, the Channel and the Celtic and Irish Seas (as compared to Delbare & De Clerck, 1999, en Boon & Delbare, 2000).

Regarding stock delineation and the identification of possible assessment areas, ILVO and KUL (Katholieke Universiteit Leuven) picked up the genetic research on these species in 2009 (PhD Sara Vandamme). Since management units were historically only rarely defined taking biological information (genetics, otolith shape, microchemistry, …) into account, this allowed for mismatches between management and biological units. In many cases this has lead to severe declines of marine fish stocks over the last decades. Brill and turbot are no subjects of analytical fishery management yet, while advice on these species is highly requested by policy makers. In this way they represent ideal species to define biologically relevant management units from the start. Delbare & De Clerck (1999) carried out genetic research on brill from the North Sea, English Channel, Bay of Biscay and the Celtic and Irish Seas in the EU funded study 'Stock discrimination in relation to the assessment of the brill fishery'. High variation in the sequenced part of the D-loop, with only a weak geographical differentiation, was in agreement with the results obtained from biological parameters, as the composition of commercial brill landings, growth rate and reproduction characteristics. This favours the hypothesis that brill from the NE Atlantic might be considered to be only one population. And indeed, a separation into two groups was only weakly supported. The first group comprised the Bay of Biscay, the English Channel and the Irish and Celtic Seas (and could be subdivided in English Channel-Celtic Sea and Irish Sea-Bay of Biscay), with the second group occupying the North Sea and Skagerrak/Kattegat. Further research including the Mediterranean and Black Seas was suggested. For turbot, different studies suggest that there is a more distinct division of turbot into geographically delineated populations. Turbot from the Bay of Biscay may be part of a southern stock (that extends further south), while North Sea and Celtic Sea turbot allegedly belong to the northern Atlantic stock and Irish Sea turbot represent a distinct population. In this view, the English Channel is a transition zone between the northern and southern stocks. With the new study, ILVO and KUL builds further on this knowledge, refines it and extends it to other regions. The main objectives are: 1) The characterization of the spatial connectivity and temporal stability of turbot and brill populations on a large (European) and small (North Sea and adjacent seas) geographical scale, based on neutral and adaptive (linked to life-history traits) genetic markers. The extent of genetic discreteness of European populations will be examined, to define which population model can best be used for fisheries management of both species. 2) The comparative analysis and environmental correlation of connectivity patterns in both turbot and brill, providing novel insights into the evolutionary processes influencing population (adaptive) differentiation in flatfish. 3) The development of appropriate assessment methods for turbot and brill stocks incorporating these molecular results, leading to sustainable flatfish stock management in the future.

8.4 DTU-Aqua: Growth and mortality parameters in witch flounder[29]

The preliminary age data have been used to estimate parameters for the von Bertalanffy growth equation. For this estimation all the different length at age data sets (for each quarter for each country) have been used. These estimated mean lengths by age groups are shown in Table 8.4.1. Notice that also the data from 1981 have been included in the data, even though they are considered uncertain.

Table 8.4.1 – Danish and Swedish mean lengths by quarter.

	age group										
	2	3	4	5	6	7	8	9	10	11	12
DK-1981			27.0	30.8	32.7	36.2	37.7	39.9			
DK-2009-4			31.7	35.7	37.7	39.4	43.1	43.0	43.0		
DK-2010-1			33.5	37.2	40.6	43.0					
SW-2009-1			29.1	32.5	34.1	36.8	35.1	40.0	35.0		45.0
SW-2009-2	20.0	26.5	29.0	32.2	34.1	34.7	36.4	35.9	39.9	41.0	37.5
SW-2009-4			30.6	32.9	36.0	36.3	37.6	38.1	40.8		47.0

The growth parameters were estimated by a least square method, in this case using the FAO/ICLARM software package "FiSAT". Figure 8.4.1 shows the data input as well as the estimated growth curve.

The parameters are shown in Table 8.4.2. Notice that t0 has been set to 0.

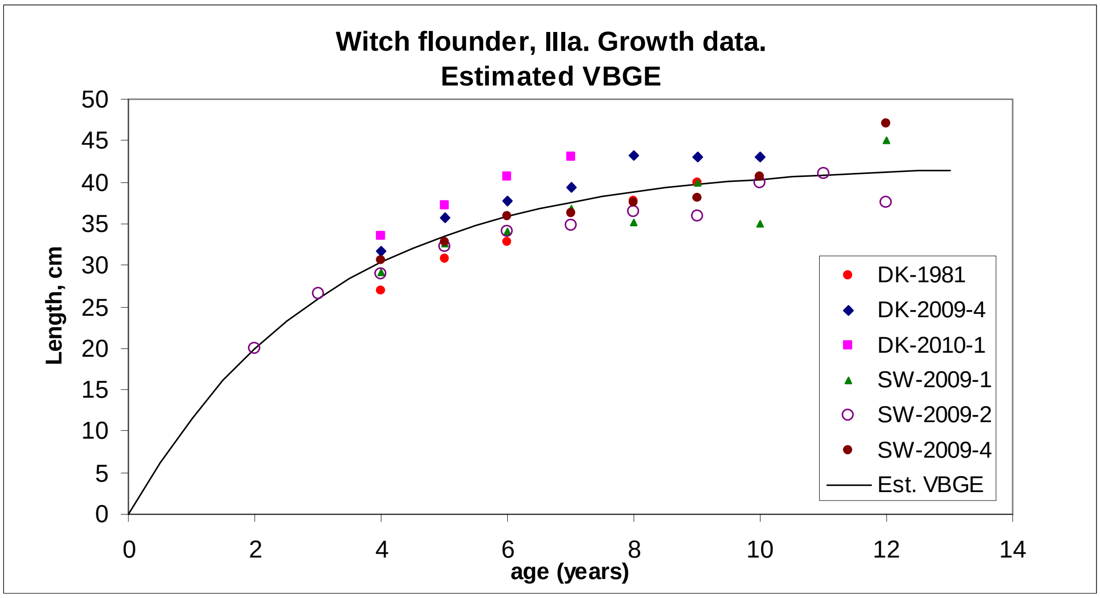

Figure 8.4.1 – Estimated growth curve for witch flounder.

[29] Author: Sten Munch-Petersen

Table 8.4.2 – Estimated growth parameters for witch flounder for the Von Bertalanffy growth equation.

L_{∞}, cm	42.1
W_{∞}, kg	0.56
K	0.32
to	0

9 WP8 and WP9 – Project meetings and co-ordination

During the contract period two meetings have been held. On 28 May 2009 a kick-off meeting was held at DG MARE in Bruxelles. The Commission was represented by Antonio Cervantes, Patrick Daniel (responsible for the MoU with ICES), Maria Jesus Fidalgo (for administrative issues) and Apostolos Peltekis (for financial issues). The participating institutes were represented by Henk Heessen (IMARES, coördinator), and Kelle Moreau (ILVO, Ostend).

In the course of November 2009 the coordinator prepared an interim technical report.

A second meeting for the NESPMAN project was held at IMARES (IJmuiden, The Netherlands) towards the end of the contract period from 29 to 31 March 2010. In this meeting all participating institutes were represented. The results achieved so far were presented and discussed. Also final agreements were reached on how and when to send all contributions to the coordinator. All contributions should be sent to the coordinator ultimately on Friday 16 April, but preferably at an earlier date.

10 Quality Assurance

IMARES utilises an ISO 9001:2000 certified quality management system (certificate number: 08602-2004-AQ-ROT-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.

Justification

Rapport C089/10
Project Number: 4302501401

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

Approved: Dr. T.P.A. Brunel
Scientist

Signature:

Date: 29 July 2010

Approved: Drs. J. Asjes
Head Department Fish

Signature:

Date: 29 July 2010

Number of copies:	5
Number of pages	439
Number of tables:	116
Number of graphs:	239
Number of appendix attachments:	4

Appendix 2.4

Table App2.4.1 – IBTS Q1 Dab abundance indices (n*1 Mill.) by stratum and total for North Sea, 1965-2009. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Year	S1	S2	S3	S4	S5	S6	S7	S8	Sum	CI
1965	.	.	.	0.0	.	.	.	.	0.0	
1966	.	0.0	0.0	56.5	55.4	123.2	.	.	235.0	56
1967	.	6.7	22.4	65.4	46.9	175.8	0.1	0.0	317.3	44
1968	.	71.6	255.1	191.6	54.8	32.9	0.0	.	606.1	34
1969	.	228.9	159.5	160.7	19.8	77.6	0.0	.	646.5	42
1970	.	192.9	58.2	254.6	346.5	663.8	30.8	.	1546.9	42
1971	.	6.8	23.7	398.4	21.5	186.7	6.1	.	643.0	51
1972	.	37.1	43.3	304.2	15.7	11.7	1.5	4.7	418.2	70
1973	.	123.1	56.3	544.3	27.0	623.1	0.6	33.8	1408.2	67
1974	0.0	130.6	228.5	516.7	181.3	2488.4	5.5	5.7	3556.8	77
1975	34.2	90.4	120.1	267.1	12.4	550.0	3.8	3.8	1081.7	32
1976	12.0	228.6	274.5	1118.8	137.8	863.1	21.5	0.8	2657.2	34
1977	9.4	57.1	90.4	371.2	45.6	594.7	21.1	6.8	1196.3	21
1978	5.5	370.8	260.7	626.6	60.7	350.5	12.7	17.0	1704.6	50
1979	607.8	16.6	169.1	305.3	60.0	66.2	2.2	61.2	1288.3	55
1980	3.1	37.9	19.5	303.8	35.5	591.6	1.4	155.4	1148.1	55
1981	0.5	14.2	71.7	365.0	20.1	729.8	1.9	48.1	1251.3	32
1982	4.7	16.6	60.7	282.3	67.6	234.3	3.5	68.0	737.5	39
1983	2.2	42.9	132.2	351.4	100.5	996.2	62.2	65.7	1753.4	23
1984	25.1	195.9	422.6	464.5	109.9	671.7	5.5	50.4	1945.7	23
1985	10.1	106.6	226.4	566.4	41.5	389.2	11.7	97.1	1449.0	27
1986	11.6	508.5	658.3	753.0	78.9	608.8	11.1	77.7	2707.9	48
1987	7.8	189.9	248.9	921.6	123.8	1518.5	12.4	460.3	3483.1	23
1988	15.6	185.1	449.6	873.5	127.8	2013.1	73.5	281.8	4020.0	18
1989	63.1	365.2	509.7	1437.6	130.8	1800.6	39.6	200.2	4546.9	16
1990	19.3	316.5	426.8	1141.8	508.9	1895.4	167.8	361.0	4837.4	20
1991	33.5	456.0	259.1	984.0	269.3	1496.0	102.5	508.4	4108.8	24
1992	45.7	188.2	421.2	535.2	65.2	1262.2	58.1	120.6	2696.4	19
1993	132.2	485.2	493.0	1475.3	81.5	1596.0	95.8	258.2	4617.2	20
1994	92.9	219.4	290.8	916.9	73.5	846.7	124.6	220.7	2785.6	17
1995	63.8	369.1	313.3	1115.1	108.0	1952.8	129.9	255.0	4307.2	32
1996	34.5	476.2	462.8	1215.2	124.3	477.3	118.1	323.3	3231.7	32
1997	161.0	555.0	350.2	892.6	397.6	744.7	167.5	276.3	3544.8	27
1998	713.9	439.4	433.9	1328.4	175.3	1098.8	190.1	320.3	4700.1	23
1999	236.4	466.5	380.8	1155.0	184.0	796.7	195.8	309.1	3724.2	16
2000	109.5	580.1	517.2	1182.1	97.4	782.5	118.2	418.7	3805.7	17
2001	74.9	309.1	408.0	1549.4	149.2	813.5	84.7	228.4	3617.3	20
2002	67.5	642.7	510.1	2007.3	246.7	1211.8	227.6	436.7	5350.4	26
2003	95.2	599.4	449.7	2234.9	102.2	802.9	455.3	761.9	5501.5	17
2004	11.7	412.1	290.4	1771.7	43.1	1393.9	408.9	614.4	4946.3	29
2005	68.6	318.9	289.9	1529.3	95.3	726.5	231.5	1645.4	4905.3	24
2006	37.7	316.7	418.0	1990.8	102.0	356.8	113.6	800.5	4136.1	20
2007	52.3	959.5	557.2	2363.2	118.9	939.7	432.8	897.2	6320.9	30
2008	71.1	458.7	462.4	2710.6	117.4	938.5	129.7	437.1	5325.6	22
2009	36.4	348.3	225.0	2354.6	254.4	258.2	145.4	438.5	4061.0	25

Table App2.4.2 – IBTS Q1 Dab biomass indices (kg*1 Mill.) by stratum and total for North Sea, 1965-2009

Year	S1	S2	S3	S4	S5	S6	S7	S8	Sum
1965	.	.	.	0.00	.	.	.	.	0.00
1966	.	0.00	0.00	7.90	2.30	12.82	.	.	23.02
1967	.	1.75	1.97	5.73	3.40	13.22	0.01	0.00	26.09
1968	.	6.14	18.07	15.43	3.38	10.29	0.00	.	53.31
1969	.	10.76	9.36	15.07	2.94	9.28	0.00	.	47.40
1970	.	9.48	5.18	30.01	38.55	29.61	10.63	.	123.46
1971	.	1.56	4.36	50.17	2.46	30.50	2.01	.	91.06
1972	.	2.63	3.25	27.59	2.95	2.63	0.13	0.56	39.73
1973	.	8.73	4.19	46.15	7.03	43.42	0.01	3.57	113.08
1974	0.00	10.85	17.39	58.45	21.81	140.67	0.68	0.58	250.43
1975	1.55	7.42	15.14	35.96	1.84	52.60	0.37	0.31	115.20
1976	0.90	15.08	18.34	106.81	19.86	74.72	0.83	0.13	236.66
1977	1.20	2.94	7.43	24.47	5.30	43.68	0.84	0.59	86.45
1978	0.20	20.82	22.45	55.34	9.97	36.87	0.96	1.60	148.21
1979	19.07	1.53	18.95	22.60	10.10	6.54	0.39	5.36	84.55
1980	0.21	1.94	3.44	37.20	5.49	51.61	0.10	15.86	115.86
1981	0.13	1.21	7.20	28.02	3.14	61.19	0.16	2.86	103.90
1982	0.40	1.25	6.76	27.55	6.18	21.43	0.32	4.39	68.28
1983	0.40	3.35	11.63	21.76	8.11	80.99	5.78	4.67	136.70
1984	2.47	14.32	36.61	30.96	6.98	39.49	0.55	3.51	134.90
1985	1.03	6.55	16.54	33.24	4.90	28.15	0.49	8.44	99.32
1986	1.04	40.12	48.63	49.35	8.25	39.63	0.89	6.96	194.86
1987	0.86	11.29	20.69	51.48	12.48	81.53	0.80	40.27	219.40
1988	1.48	10.63	34.08	45.07	10.00	93.43	2.92	26.47	224.07
1989	3.70	18.11	34.99	66.64	11.99	79.07	2.42	14.15	231.06
1990	1.68	16.81	24.53	52.03	24.97	93.04	7.32	22.99	243.36
1991	2.00	20.69	17.17	48.71	14.40	64.85	4.86	25.99	198.68
1992	3.90	18.56	37.68	51.97	6.55	80.08	5.92	12.62	217.28
1993	9.88	28.44	36.26	81.76	6.00	80.80	5.69	16.47	265.29
1994	5.11	12.26	20.81	53.55	5.40	41.73	6.90	12.53	158.28
1995	3.01	20.72	17.99	65.63	7.02	80.88	8.27	13.25	216.77
1996	1.52	20.04	28.42	69.69	7.37	24.20	7.03	15.46	173.73
1997	7.93	25.99	20.06	50.47	19.59	29.76	6.70	14.27	174.76
1998	38.42	21.33	22.96	73.64	11.23	61.05	11.56	15.18	255.37
1999	14.27	25.51	18.77	65.49	8.99	38.03	6.12	14.71	191.91
2000	6.61	28.30	24.88	60.48	5.10	27.68	6.64	30.84	190.53
2001	4.35	17.80	20.51	80.89	7.19	35.58	6.14	13.30	185.77
2002	5.56	38.27	27.82	116.59	17.22	57.44	13.07	20.73	296.70
2003	8.10	37.75	26.19	126.64	5.79	39.74	32.82	32.71	309.75
2004	1.30	25.99	19.95	142.79	4.17	115.42	18.13	29.59	357.34
2005	4.98	20.06	19.71	112.66	9.38	56.15	16.35	65.14	304.43
2006	2.77	23.50	29.07	138.48	6.97	22.76	10.57	32.55	266.66
2007	4.78	51.79	30.99	135.79	5.47	51.89	34.28	41.37	356.37
2008	5.29	21.95	27.66	161.84	5.97	45.61	10.45	24.69	303.47
2009	2.52	20.12	13.07	131.69	13.85	14.54	9.97	20.27	226.03

Table App2.4.3 – IBTS Q1 Dab length frequency (n*1 Mill.) for North Sea, 1966-2009

Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Length												
1.5	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.02
3.5	0.00	0.00	0.00	0.00	3.54	0.21	0.00	0.00	0.04	0.00	0.28	0.07
4.5	0.00	0.07	0.00	0.08	12.73	0.95	0.00	12.84	0.00	0.00	0.22	8.72
5.5	0.00	1.00	0.44	0.24	62.05	2.23	0.00	22.12	0.00	0.15	8.80	17.26
6.5	0.10	0.70	0.70	1.23	31.61	1.72	0.00	21.60	0.25	0.46	12.58	17.50
7.5	0.10	0.56	1.65	1.96	15.01	3.29	0.00	15.34	1.37	1.94	10.88	9.29
8.5	0.08	1.85	0.87	2.50	8.19	4.55	0.28	19.67	11.28	6.11	22.25	8.90
9.5	1.09	3.26	2.67	2.50	11.51	9.60	0.96	33.43	37.75	9.20	20.71	20.75
10.5	4.18	15.28	7.11	2.80	45.17	17.85	2.41	48.54	89.82	26.42	56.04	36.95
11.5	18.27	24.39	11.36	27.60	130.58	21.93	3.90	50.32	179.68	47.51	94.14	52.83
12.5	14.99	29.59	22.87	30.32	139.50	28.96	11.14	57.43	303.94	76.25	202.36	47.60
13.5	16.88	30.74	42.31	52.22	157.65	24.37	28.81	46.78	351.65	106.51	277.30	67.04
14.5	28.76	37.61	66.41	99.68	187.04	39.84	42.83	106.88	374.85	137.68	446.90	100.48
15.5	35.65	33.12	102.50	102.41	147.37	66.76	59.83	138.24	463.10	152.79	434.78	140.96
16.5	24.23	32.41	103.40	116.01	163.75	66.12	49.36	151.44	501.54	138.76	369.37	142.93
17.5	25.83	30.11	76.18	71.67	122.33	69.77	59.16	145.25	338.71	115.42	256.66	133.71
18.5	21.93	28.05	61.28	47.19	94.86	73.77	49.94	145.18	268.66	85.28	146.53	94.48
19.5	10.57	15.39	25.25	35.73	64.72	66.93	32.33	89.31	227.70	62.50	120.71	80.56
20.5	11.39	11.24	22.04	17.64	39.55	48.01	24.02	57.22	89.63	31.61	77.78	58.70
21.5	7.45	9.64	17.52	10.41	22.83	30.66	15.44	65.41	109.65	25.71	42.34	43.43
22.5	6.49	3.74	11.12	6.68	24.30	18.47	11.12	46.88	48.48	20.75	19.67	37.71
23.5	2.47	3.96	7.64	4.19	18.05	17.09	8.35	35.01	36.17	13.79	12.20	21.90
24.5	1.90	1.58	5.90	2.26	24.34	5.21	6.58	42.79	37.73	7.64	9.55	20.72
25.5	1.40	1.41	5.21	1.20	6.18	9.80	4.69	19.98	26.45	5.64	5.26	11.11
26.5	0.53	0.47	4.32	2.85	5.73	2.54	2.69	19.64	22.73	2.09	1.32	8.73
27.5	0.38	0.02	2.74	0.86	1.82	4.55	1.41	4.77	7.01	3.39	1.40	5.21
28.5	0.28	0.11	1.09	2.41	2.10	3.57	1.79	5.02	9.01	1.03	1.55	3.50
29.5	0.04	0.39	1.12	1.06	0.80	0.62	0.61	3.10	7.79	1.77	1.17	1.60
30.5	0.00	0.34	0.40	0.26	1.00	0.52	0.07	1.98	3.59	0.43	3.28	0.83
31.5	0.04	0.17	0.83	0.73	0.14	0.22	0.26	0.67	5.46	0.24	0.12	1.59
32.5	0.00	0.11	0.64	0.11	0.47	0.39	0.19	0.71	1.13	0.12	0.64	0.70
33.5	0.00	0.00	0.23	0.00	0.07	0.49	0.02	0.37	1.13	0.41	0.03	0.31
34.5	0.00	0.00	0.24	1.00	0.00	0.78	0.02	0.00	0.33	0.00	0.03	0.11
35.5	0.00	0.00	0.00	0.02	0.76	0.12	0.02	0.09	0.08	0.00	0.09	0.00
36.5	0.00	0.00	0.06	0.00	0.25	0.49	0.00	0.00	0.04	0.00	0.03	0.06
37.5	0.00	0.00	0.00	0.00	0.21	0.37	0.00	0.16	0.04	0.00	0.03	0.00
38.5	0.00	0.00	0.00	0.00	0.21	0.12	0.00	0.00	0.00	0.07	0.00	0.00
39.5	0.00	0.00	0.00	0.00	0.43	0.12	0.00	0.00	0.00	0.00	0.00	0.00
40.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
41.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	235.04	317.35	606.10	646.52	1546.85	643.03	418.23	1408.16	3556.79	1081.69	2657.21	1196.27

Table App2.4.3 – IBTS Q1 Dab length frequency (n*1 Mill.) for North Sea, 1966-2009 (continued)

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Length												
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
2.5	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00
3.5	0.00	0.01	0.00	0.00	0.00	0.05	0.00	0.00	0.38	0.45	0.00	0.11
4.5	0.02	0.26	0.03	0.00	0.21	0.05	0.00	0.21	2.26	5.15	0.78	1.89
5.5	0.00	1.07	0.50	0.79	0.72	0.89	1.09	1.03	9.51	29.01	4.21	19.96
6.5	1.08	1.63	1.90	6.03	2.47	3.20	3.53	0.95	11.93	22.00	9.11	34.55
7.5	2.43	2.09	4.03	1.85	4.47	5.78	12.60	0.87	13.68	10.83	12.46	35.54
8.5	3.72	8.84	2.75	4.03	3.18	3.46	18.28	1.19	12.33	13.09	28.81	42.07
9.5	9.18	46.79	2.88	18.51	4.11	10.38	19.62	2.15	19.25	19.09	40.04	43.08
10.5	31.16	144.29	10.39	43.66	9.04	29.15	36.15	8.57	36.65	66.89	108.07	93.13
11.5	63.06	161.99	23.81	56.32	14.53	58.35	63.79	20.29	65.54	142.68	187.46	184.39
12.5	84.06	186.90	23.27	89.69	22.14	94.98	104.34	45.08	102.72	210.14	230.16	245.44
13.5	151.77	98.01	38.43	90.98	27.51	117.80	110.71	85.71	114.60	292.32	276.53	372.50
14.5	200.28	100.86	60.70	123.80	36.78	132.59	133.79	124.81	155.40	305.31	327.80	508.43
15.5	252.72	102.77	80.33	141.83	54.12	173.81	185.87	181.79	248.26	373.14	424.67	567.93
16.5	232.00	107.47	98.41	133.76	69.01	173.66	222.79	194.35	326.54	346.58	441.37	557.57
17.5	215.72	92.20	123.18	123.99	78.42	195.41	249.24	189.50	361.59	327.93	430.38	488.45
18.5	166.47	68.36	141.39	100.71	77.72	186.81	204.56	172.82	320.00	292.70	361.95	357.04
19.5	102.04	43.88	125.52	75.97	73.53	161.63	178.88	121.48	270.14	262.29	298.23	291.04
20.5	51.99	29.37	111.51	63.36	66.62	111.58	124.84	85.56	198.33	213.53	249.60	191.16
21.5	42.58	29.88	99.84	51.40	52.18	89.79	78.26	62.77	134.81	170.93	181.70	154.70
22.5	24.41	18.33	60.22	37.14	41.06	58.65	64.96	43.95	87.12	132.71	125.88	91.81
23.5	19.27	11.54	43.09	28.26	29.73	48.62	37.35	30.22	61.40	77.58	86.93	70.34
24.5	13.10	9.41	32.96	18.72	23.84	30.25	27.55	26.87	48.20	57.93	66.12	55.81
25.5	11.37	6.52	28.29	12.27	14.82	21.97	21.05	15.01	32.21	50.83	40.16	42.44
26.5	5.65	3.97	13.83	8.55	12.63	17.63	13.57	10.68	26.40	19.14	30.95	37.39
27.5	7.01	3.50	5.75	7.01	7.50	10.25	9.06	8.40	21.83	18.09	20.30	19.37
28.5	7.51	1.34	6.94	5.21	3.90	7.35	8.04	4.44	7.72	10.49	12.54	12.60
29.5	1.94	2.21	3.65	4.26	2.80	3.83	6.41	3.54	8.24	4.92	7.64	10.81
30.5	1.51	1.92	1.17	1.36	1.73	2.09	2.66	3.19	5.07	2.69	7.50	7.53
31.5	2.05	1.11	1.44	0.79	0.82	1.15	2.32	1.55	1.72	2.27	2.85	3.45
32.5	0.28	0.48	1.65	0.57	0.77	0.71	1.83	0.79	1.37	0.94	3.86	2.56
33.5	0.12	0.36	0.05	0.23	0.67	0.75	0.84	0.29	0.94	0.66	0.92	1.80
34.5	0.03	0.26	0.00	0.26	0.29	0.35	0.27	0.15	0.46	0.52	0.46	1.13
35.5	0.00	0.20	0.20	0.00	0.16	0.34	0.28	0.22	0.22	0.08	0.25	0.16
36.5	0.00	0.08	0.00	0.00	0.00	0.00	0.06	0.10	0.11	0.18	0.11	0.56
37.5	0.10	0.40	0.00	0.00	0.05	0.00	0.42	0.32	0.06	0.03	0.09	0.05
38.5	0.00	0.00	0.00	0.00	0.00	0.02	0.27	0.03	0.04	0.03	0.05	0.07
39.5	0.00	0.00	0.02	0.00	0.00	0.00	0.09	0.06	0.03	0.00	0.06	0.02
40.5	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
41.5	0.00	0.00	0.00	0.00	0.00	0.03	0.20	0.00	0.00	0.00	0.00	0.00
42.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43.5	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
44.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45.5	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
Sum	1704.64	1288.33	1148.12	1251.32	737.53	1753.37	1945.72	1448.97	2707.90	3483.15	4019.99	4546.87

Table App2.4.3 – IBTS Q1 Dab length frequency (n*1 Mill.) for North Sea, 1966-2009 (continued)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Length												
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
3.5	0.03	0.00	0.48	0.00	2.74	0.15	0.00	2.91	2.95	1.45	0.62	0.32
4.5	1.78	0.68	8.99	2.53	12.25	7.05	0.39	33.66	10.21	7.28	6.86	0.37
5.5	33.65	2.66	18.90	10.93	22.18	26.30	4.53	39.05	13.17	22.20	34.37	8.00
6.5	57.99	13.65	19.95	18.63	22.65	34.40	8.12	27.65	17.66	44.06	49.41	20.75
7.5	64.47	25.55	17.76	18.29	22.37	31.94	14.35	25.04	14.69	53.12	50.76	48.52
8.5	56.07	20.82	12.10	17.13	23.06	43.33	17.53	25.71	9.80	46.94	41.29	59.68
9.5	59.02	25.05	7.70	29.66	31.39	58.18	21.37	42.96	24.32	67.48	41.81	42.87
10.5	117.35	54.90	13.56	56.24	45.18	109.79	37.98	84.12	70.18	106.16	69.18	35.53
11.5	156.02	162.14	35.77	118.80	75.03	180.68	72.02	105.40	139.68	139.96	142.66	83.06
12.5	221.65	164.01	92.74	128.80	125.33	297.64	148.72	175.12	220.65	186.29	204.42	172.79
13.5	342.72	292.27	151.17	167.66	148.01	346.42	218.72	246.96	289.79	240.48	258.05	266.13
14.5	441.00	454.28	235.84	251.96	157.58	349.39	276.88	335.24	336.29	317.05	343.45	380.75
15.5	587.80	616.17	341.14	453.29	192.88	415.38	380.72	434.33	494.56	382.01	422.39	476.51
16.5	606.48	590.04	435.90	660.69	307.64	404.39	425.68	429.07	643.34	403.67	446.58	485.16
17.5	595.13	555.89	428.21	757.12	390.77	455.36	412.95	414.95	647.03	420.13	419.57	432.06
18.5	422.09	394.51	321.16	586.36	352.75	445.75	330.08	318.49	552.47	343.25	359.22	360.28
19.5	315.99	238.82	174.08	465.40	275.33	331.00	263.72	236.97	370.75	271.39	261.88	238.36
20.5	236.65	162.41	128.65	273.15	181.81	253.07	204.17	173.41	281.81	200.60	203.26	171.81
21.5	166.54	103.15	81.24	193.05	125.78	174.45	125.75	122.85	183.59	127.16	142.71	89.67
22.5	100.33	79.80	59.32	131.08	90.08	113.33	86.39	88.12	127.46	107.70	95.20	70.48
23.5	94.25	52.31	35.16	95.11	64.74	76.23	54.15	55.16	88.75	66.01	74.93	54.83
24.5	56.63	33.26	29.82	61.56	42.62	49.41	43.89	42.47	59.31	54.11	45.42	40.29
25.5	37.95	27.48	16.82	42.77	25.48	35.75	28.46	29.02	31.82	37.09	28.62	24.91
26.5	20.11	12.92	8.26	27.27	19.99	24.60	15.69	19.43	23.64	24.33	23.22	19.20
27.5	14.55	9.67	8.74	17.72	10.50	16.52	17.11	17.15	16.77	16.44	17.29	12.02
28.5	10.47	5.40	4.28	11.82	7.60	11.76	9.41	6.94	11.20	13.98	8.90	6.60
29.5	8.62	5.71	3.41	8.62	4.38	6.00	5.29	5.77	7.74	10.26	6.56	6.67
30.5	3.77	1.99	2.70	4.28	2.54	4.79	4.37	2.33	4.88	4.91	3.96	2.67
31.5	4.42	1.28	0.76	2.44	1.22	2.39	1.22	1.65	2.87	4.46	1.43	2.70
32.5	1.79	1.26	1.36	1.31	0.78	1.20	0.59	0.45	1.04	2.49	0.74	1.63
33.5	1.09	0.11	0.17	2.85	0.25	0.26	0.61	0.90	1.05	1.08	0.52	0.44
34.5	0.51	0.08	0.07	0.34	0.44	0.12	0.13	0.27	0.53	0.46	0.30	0.82
35.5	0.13	0.20	0.15	0.11	0.16	0.14	0.41	1.26	0.07	0.00	0.07	0.84
36.5	0.12	0.02	0.06	0.12	0.03	0.00	0.04	0.00	0.00	0.05	0.00	0.61
37.5	0.04	0.20	0.00	0.00	0.03	0.00	0.04	0.05	0.04	0.14	0.00	0.00
38.5	0.11	0.07	0.00	0.09	0.00	0.00	0.20	0.00	0.02	0.00	0.03	0.00
39.5	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	4837.37	4108.75	2696.41	4617.18	2785.57	4307.20	3231.68	3544.83	4700.09	3724.21	3805.69	3617.34

Table App 2.4.3 – IBTS Q1 Dab length frequency (n*1 Mill.) for North Sea, 1966-2009 (continued)

Year	2002	2003	2004	2005	2006	2007	2008	2009
Length								
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00
3.5	0.00	1.72	0.00	0.14	0.00	0.17	0.00	0.06
4.5	0.12	3.61	1.10	2.98	0.92	1.56	1.00	0.45
5.5	9.27	13.78	5.65	15.13	7.18	10.16	13.35	2.26
6.5	30.00	21.49	9.26	23.54	14.62	18.20	54.79	8.09
7.5	74.30	33.19	23.56	20.70	19.38	19.15	83.96	13.86
8.5	53.06	30.37	19.99	19.53	12.88	20.26	69.34	7.78
9.5	28.42	36.31	48.77	12.89	15.10	21.85	58.99	10.38
10.5	37.43	71.33	69.92	33.41	37.13	47.17	77.71	23.16
11.5	74.70	125.46	126.16	91.37	86.70	100.63	87.14	58.48
12.5	173.01	193.95	198.50	260.24	240.32	190.92	118.38	123.52
13.5	325.32	315.00	295.01	405.22	269.27	311.18	172.60	207.22
14.5	534.47	469.01	372.37	504.44	344.41	539.59	280.61	310.42
15.5	736.09	614.90	411.94	534.72	391.39	696.66	423.93	348.62
16.5	821.45	715.28	574.09	543.13	476.22	829.31	634.73	521.35
17.5	725.84	765.45	685.14	588.72	592.59	865.09	798.57	645.60
18.5	535.47	652.15	705.56	561.87	522.18	786.89	784.90	621.77
19.5	394.03	504.81	557.74	439.37	411.89	625.18	601.99	458.00
20.5	260.34	300.84	306.72	294.37	258.81	464.38	387.80	252.98
21.5	169.61	211.76	167.73	172.89	157.70	272.69	232.04	171.18
22.5	124.34	137.58	127.17	121.89	100.07	177.60	149.74	92.89
23.5	81.37	107.60	79.06	85.72	62.93	103.70	111.43	65.03
24.5	49.54	65.11	60.53	61.71	40.29	72.67	62.80	35.48
25.5	38.33	40.47	34.28	41.20	28.76	48.26	38.14	28.67
26.5	24.22	25.11	24.88	28.27	17.89	32.94	31.66	19.85
27.5	18.01	18.75	14.86	18.10	11.47	17.23	16.35	14.61
28.5	13.13	10.74	9.24	9.96	7.33	17.13	13.87	6.38
29.5	8.07	5.36	8.31	6.44	3.75	11.37	8.64	5.57
30.5	4.70	6.86	3.21	4.69	2.73	6.46	3.77	2.54
31.5	1.23	1.43	3.93	1.36	1.32	6.45	4.76	2.99
32.5	2.92	0.71	0.88	0.59	0.38	2.61	1.35	0.64
33.5	0.89	0.23	0.46	0.15	0.21	2.66	0.29	0.30
34.5	0.69	0.52	0.17	0.14	0.12	0.54	0.57	0.57
35.5	0.03	0.00	0.08	0.00	0.15	0.24	0.06	0.09
36.5	0.00	0.08	0.09	0.18	0.07	0.00	0.31	0.09
37.5	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.04
38.5	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.04
39.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	5350.40	5501.48	4946.34	4905.33	4136.14	6320.91	5325.55	4060.95

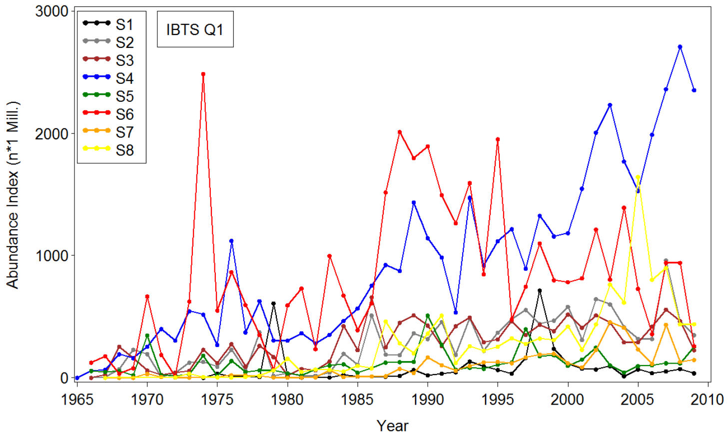

Figure App2.4.1 – IBTS Q1 Dab abundance index (n*1Mill.) by stratum for North Sea, 1965-2009

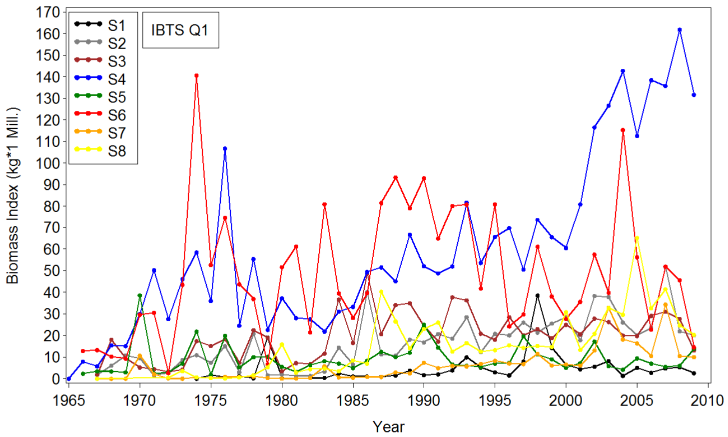

Figure App2.4.2 – IBTS Q1 Dab biomass index (kg*1Mill.) by stratum for North Sea, 1965-2009

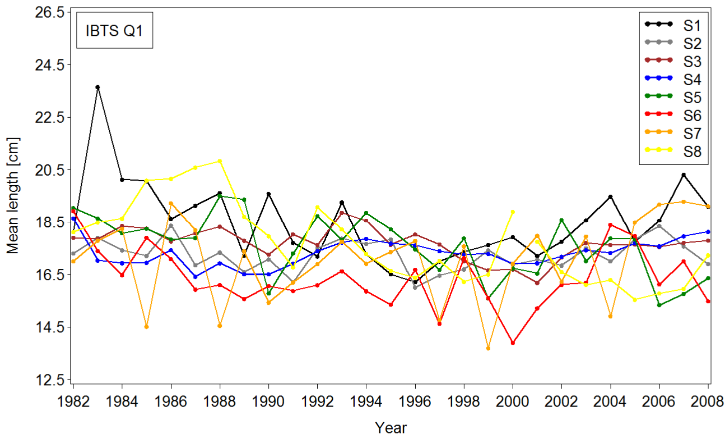

Figure App2.4.3 – IBTS Q1 Dab mean length [cm] by stratum for North Sea, 1965-2009

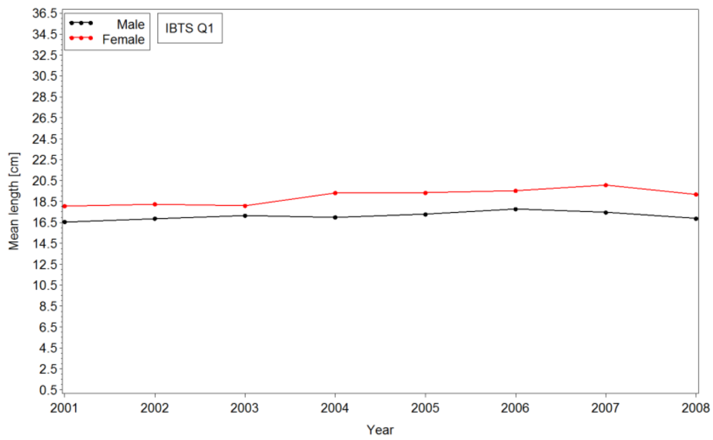

Figure App 2.4.4 – IBTS Q1 Dab mean length [cm] by sex for North Sea, 1965-2009

Table App2.4.4 – IBTS Q3 Dab abundance indices (n*1 Mill.) by stratum and total for North Sea, 1991-2009. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Year	S1	S2	S3	S4	S5	S6	S7	S8	Sum	CI
1991	171.1	332.6	721.6	1789.5	291.4	2180.7	217.7	1224.9	6929.4	19
1992	72.2	498.1	712.6	1614.5	282.3	1861.4	514.4	479.4	6034.8	18
1993	94.2	216.2	490.9	954.1	113.0	1210.5	234.0	371.5	3684.5	16
1994	49.4	288.4	650.4	1396.2	136.3	1247.3	359.4	432.5	4559.8	19
1995	33.2	280.4	375.8	1131.6	187.4	667.3	292.4	851.7	3819.8	25
1996	74.1	370.2	447.5	910.2	151.2	1572.3	396.2	799.9	4721.5	21
1997	85.4	219.7	365.8	1614.3	251.4	3248.4	472.6	3189.2	9446.8	42
1998	57.5	201.1	557.8	1377.7	157.4	2398.7	268.8	741.4	5760.6	18
1999	118.0	554.6	806.7	1573.5	239.0	2742.9	733.8	1430.8	8199.1	18
2000	212.6	373.0	529.9	2029.2	135.5	1608.5	647.0	.	5535.8	18
2001	48.2	268.7	425.1	2445.7	1080.9	3889.2	408.0	529.0	9095.0	18
2002	26.7	499.0	626.8	2734.5	316.5	3311.3	483.7	793.1	8791.7	18
2003	33.6	335.9	461.1	2534.0	154.4	2689.9	274.1	888.9	7371.9	18
2004	32.6	330.1	668.9	2165.4	78.9	2169.6	955.3	1246.0	7647.0	16
2005	55.4	350.4	487.7	2602.6	183.0	2405.3	618.3	1452.9	8155.7	15
2006	74.8	422.4	913.1	2374.5	548.1	1175.2	437.5	1075.1	7020.8	21
2007	153.9	517.0	655.3	2840.9	939.9	2394.2	992.1	926.3	9419.5	18
2008	85.0	284.2	663.8	3460.4	963.7	3132.5	1048.2	880.5	10518.4	16
2009	107.0	231.3	575.7	3451.3	787.5	1873.6	1306.0	1639.6	9972.1	27

Table App2.4.5 – IBTS Q3 Dab biomass indices (kg*1 Mill.) by stratum and total for North Sea, 1991-2009

Year	S1	S2	S3	S4	S5	S6	S7	S8	Sum
1991	8.64	15.12	48.55	88.94	16.17	117.58	14.80	76.58	386.38
1992	4.30	24.64	48.79	92.69	15.71	97.06	39.08	27.42	349.69
1993	5.41	11.86	32.25	58.51	8.55	74.99	20.70	21.24	233.49
1994	3.19	14.78	38.08	83.31	6.64	66.85	18.35	23.23	254.42
1995	2.39	14.65	24.49	66.33	7.73	35.31	14.04	41.60	206.55
1996	4.65	19.47	27.20	59.67	6.61	68.14	16.21	34.88	236.84
1997	5.18	12.50	18.52	83.70	10.73	142.88	28.77	123.09	425.37
1998	3.29	10.34	38.10	82.37	9.27	119.60	18.73	34.88	316.57
1999	5.44	26.46	46.46	81.81	11.55	121.74	29.18	72.20	394.84
2000	9.54	18.59	29.59	104.66	6.08	69.05	26.06	.	263.58
2001	2.87	15.85	23.53	145.04	55.92	176.38	23.89	25.59	469.07
2002	2.17	26.91	36.31	161.35	15.53	174.67	24.86	39.50	481.30
2003	2.53	17.78	26.43	142.71	6.97	130.22	18.99	38.17	383.80
2004	2.09	17.15	37.88	132.82	4.52	128.55	64.71	62.77	450.50
2005	2.89	17.46	29.52	149.13	10.05	149.37	34.65	80.95	474.01
2006	5.74	23.87	55.12	166.53	24.55	67.11	34.29	58.78	435.99
2007	10.02	26.19	35.52	178.43	37.36	129.84	52.19	49.33	518.87
2008	5.48	13.98	37.34	199.11	42.00	144.65	47.13	45.45	535.14
2009	6.35	12.38	35.70	207.19	38.03	85.16	59.42	90.31	534.54

Table App2.4.6 – IBTS Q3 Dab length frequency (n*1Mill.) for North Sea, 1991-2009

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Length										
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
3.5	0.03	2.01	0.00	0.00	0.00	0.04	0.05	0.00	0.21	0.21
4.5	2.39	9.74	0.19	2.37	1.26	0.04	2.70	2.48	6.24	0.00
5.5	8.22	15.81	0.37	5.92	8.36	2.13	8.72	6.56	24.33	1.03
6.5	6.19	14.51	0.42	2.28	2.54	1.91	6.47	17.99	18.39	4.34
7.5	2.34	15.83	0.43	8.25	6.77	1.33	4.80	5.73	10.55	12.37
8.5	3.62	16.64	1.35	14.28	5.75	6.07	12.54	16.71	21.74	10.53
9.5	14.62	33.43	9.84	26.38	25.01	31.30	98.76	43.85	116.09	54.85
10.5	67.54	84.87	33.29	94.51	75.05	120.31	341.42	113.78	280.51	118.22
11.5	159.18	150.04	66.80	175.42	144.17	210.75	527.82	197.63	484.76	190.15
12.5	226.62	176.39	105.75	221.45	176.32	301.04	631.90	290.58	490.59	269.49
13.5	382.40	231.34	143.37	277.46	221.71	329.81	684.09	378.90	603.03	415.81
14.5	559.17	349.95	162.95	342.08	326.41	452.71	939.52	497.54	778.50	681.19
15.5	863.05	576.54	268.37	419.41	429.57	515.48	1285.70	632.92	952.85	823.20
16.5	1003.55	783.96	396.58	483.84	481.28	623.63	1329.82	667.49	1003.75	762.88
17.5	1046.97	920.22	518.71	530.67	483.34	545.98	1146.91	686.38	961.07	634.58
18.5	772.96	787.64	567.66	571.60	458.52	459.76	853.28	648.73	736.12	508.72
19.5	587.00	631.20	430.86	485.79	339.09	375.03	559.79	461.33	558.74	351.70
20.5	423.67	418.74	323.67	338.94	214.97	261.06	396.57	324.88	382.59	236.64
21.5	265.80	273.60	234.42	183.95	148.53	165.61	228.15	239.22	239.40	156.38
22.5	164.59	209.36	151.51	132.85	95.61	121.17	120.88	171.67	183.02	103.88
23.5	153.57	133.51	105.18	91.12	65.00	65.12	90.13	121.50	131.37	71.75
24.5	88.61	83.59	63.44	56.25	47.15	43.03	54.51	87.72	88.91	39.21
25.5	48.87	50.76	41.19	33.84	24.57	35.95	38.34	60.89	43.83	28.43
26.5	26.39	25.16	25.91	25.83	16.03	15.19	30.21	34.66	30.95	20.94
27.5	19.79	16.77	11.50	16.24	11.49	12.52	18.73	21.22	24.38	17.81
28.5	12.18	9.66	8.77	6.44	4.37	11.62	16.92	13.72	9.82	6.46
29.5	6.58	5.53	6.04	7.50	3.70	6.38	7.77	6.61	7.01	3.98
30.5	6.37	4.43	3.90	2.18	1.19	2.24	4.38	4.87	3.18	5.79
31.5	2.81	2.03	1.03	1.60	1.13	1.95	2.51	2.77	3.24	1.24
32.5	1.57	0.49	0.66	0.75	0.63	1.74	0.89	0.90	1.04	2.22
33.5	1.45	0.41	0.31	0.44	0.09	0.44	1.48	0.61	1.46	1.41
34.5	0.61	0.27	0.03	0.15	0.06	0.04	0.81	0.78	1.22	0.09
35.5	0.25	0.10	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.20
36.5	0.23	0.00	0.00	0.00	0.00	0.11	0.11	0.00	0.11	0.00
37.5	0.00	0.13	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
38.5	0.20	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.09	0.00
39.5	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
40.5	0.03	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
41.5	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	6929.44	6034.85	3684.52	4559.78	3819.84	4721.55	9446.84	5760.59	8199.12	5535.81

Table App2.4.7 – IBTS Q3 Dab length frequency (n*1Mill.) for North Sea, 1991-2009 (continued)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Length									
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.5	0.00	0.00	0.19	3.70	0.00	0.21	0.00	0.18	0.00
4.5	2.44	6.87	3.34	14.60	0.90	3.58	6.55	3.36	0.98
5.5	7.93	24.25	8.99	10.59	2.07	1.81	17.49	2.33	35.08
6.5	16.49	29.09	11.31	8.91	1.35	0.42	21.24	21.18	69.57
7.5	7.82	34.65	3.24	20.83	1.69	2.08	66.02	15.58	65.88
8.5	3.91	15.52	4.52	8.89	17.12	4.66	47.00	15.17	22.07
9.5	11.67	29.70	40.43	30.26	112.18	16.25	112.15	96.31	48.07
10.5	62.28	82.35	128.86	118.19	246.78	77.20	216.02	361.58	188.13
11.5	202.30	230.44	305.76	326.32	296.45	170.36	347.56	556.48	343.82
12.5	528.97	536.95	444.56	315.43	311.45	251.23	369.48	727.39	492.29
13.5	668.41	497.88	567.91	359.31	373.74	381.34	481.35	712.65	582.51
14.5	1021.33	659.60	646.89	506.34	549.94	493.12	611.41	874.68	857.69
15.5	1212.57	949.86	764.74	716.66	695.11	634.05	881.76	1013.66	1123.78
16.5	1431.13	1221.24	950.53	966.40	924.09	852.40	1174.33	1183.90	1133.14
17.5	1256.00	1348.55	1029.17	1095.44	1023.74	967.12	1159.78	1273.68	1319.78
18.5	892.32	1062.81	827.99	992.16	982.26	935.46	1122.42	1133.00	1122.93
19.5	681.16	708.59	574.60	719.80	849.46	756.97	934.35	827.91	857.15
20.5	405.00	490.06	413.40	512.36	606.17	528.27	682.59	593.74	588.09
21.5	224.51	255.79	239.65	328.59	384.34	365.57	420.34	390.42	384.58
22.5	161.16	199.82	166.55	209.01	257.74	210.00	259.88	244.55	238.65
23.5	95.42	123.80	91.87	135.53	151.00	125.84	144.68	162.51	167.43
24.5	81.59	67.97	53.32	93.50	127.17	85.39	107.19	90.73	105.32
25.5	40.31	63.03	40.28	59.26	81.86	54.87	93.40	63.83	67.93
26.5	29.41	49.66	21.00	32.48	59.04	33.41	58.26	54.70	59.62
27.5	19.76	48.54	13.14	26.25	42.82	28.98	35.49	32.44	32.14
28.5	10.01	21.25	12.07	11.43	15.53	17.22	22.28	24.66	27.62
29.5	11.74	11.84	3.17	10.64	14.20	16.20	14.29	17.05	15.92
30.5	4.31	7.64	2.15	7.09	7.71	2.83	6.05	11.24	7.89
31.5	2.41	9.54	1.42	1.49	9.08	0.76	1.80	7.76	4.57
32.5	1.77	2.69	0.31	3.15	5.68	1.68	1.65	2.27	4.98
33.5	0.72	0.66	0.36	2.09	1.67	1.24	1.91	1.79	1.12
34.5	0.04	0.92	0.17	0.20	3.30	0.13	0.60	1.15	1.41
35.5	0.13	0.05	0.00	0.00	0.00	0.15	0.17	0.44	0.23
36.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	1.69
37.5	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00
38.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39.5	0.00	0.05	0.00	0.04	0.00	0.00	0.00	0.00	0.00
40.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	9095.01	8791.65	7371.89	7646.95	8155.72	7020.82	9419.53	10518.45	9972.07

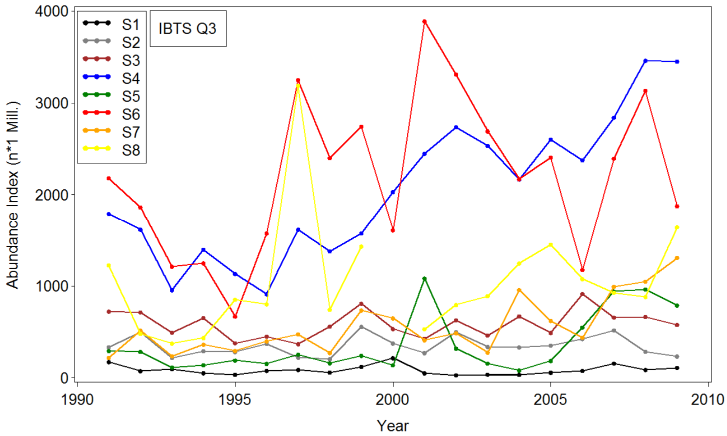

Figure App2.4.5 – IBTS Q3 Dab abundance indices (n*1 Mill.) by stratum for North Sea, 1991-2009

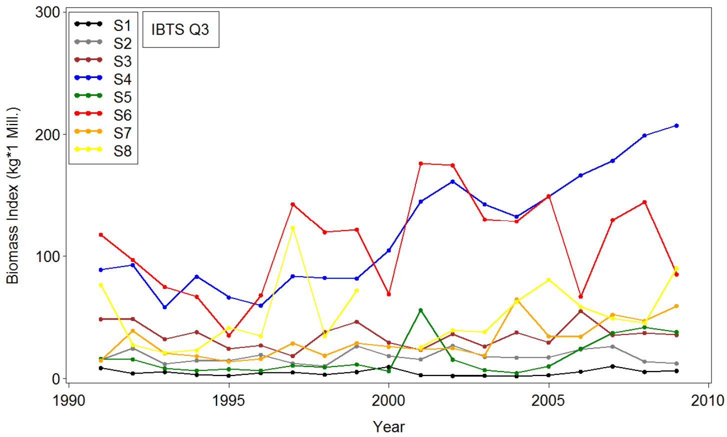

Figure App2.4.6 – IBTS Q3 Dab biomass indices (n*1 Mill.) by stratum for North Sea, 1991-2009

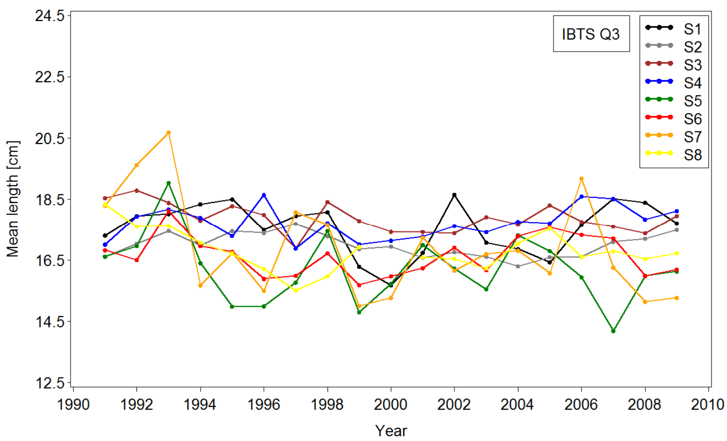

Figure App2.4.7 – IBTS Q3 Dab mean length [cm] by stratum for North Sea, 1991-2009

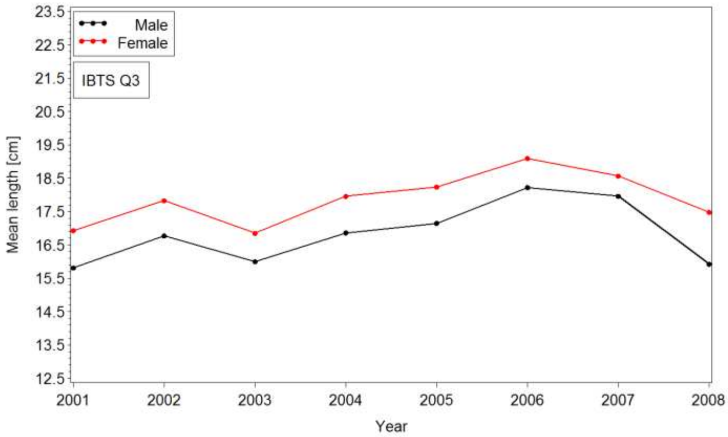

Figure App2.4.8 – IBTS Q3 Dab mean length [cm] by sex for North Sea, 1991-2009.

Table App2.4.8 – BTS NED Dab abundance indices (n*1 Mill.) by stratum and total for North Sea, 1987-2009. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Year	S2	S3	S4	S5	S6	S7	Sum	CI
1987	.	.	3325	898	3412	.	7636	39
1988	.	0	2696	619	4873	.	8188	34
1989	.	.	2774	1160	3869	.	7803	26
1990	.	.	2551	577	3321	.	6448	29
1991	.	.	1957	296	2010	.	4264	24
1992	.	.	2059	644	1857	.	4560	23
1993	.	.	1216	386	2533	.	4136	34
1994	.	.	1564	336	1948	.	3847	25
1995	.	.	1160	365	1408	.	2933	24
1996	89	85	1021	368	2665	.	4228	31
1997	159	127	818	398	2246	186	3934	25
1998	79	227	1016	506	2408	80	4316	26
1999	215	498	1292	339	2154	58	4557	21
2000	401	827	1376	363	1479	75	4522	19
2001	149	428	1203	501	1226	126	3632	19
2002	304	259	1140	413	1308	203	3629	15
2003	336	354	1320	270	1599	174	4053	21
2004	393	414	1330	334	851	319	3642	17
2005	240	417	1047	457	1009	159	3329	13
2006	202	821	1697	442	814	327	4304	27
2007	547	555	2418	392	1316	278	5506	24
2008	.	.	1989	763	2380	.	5133	34
2009	556	720	1600	548	1035	522	4980	21

Table App2.4.9 – BTS NED Dab biomass indices (kg*Mill.) by stratum and total for North Sea, 1987-2009.

Year	S2	S3	S4	S5	S6	S7	Sum
1987	.	.	106.66	22.35	121.72	.	250.72
1988	.	0.00	105.14	19.40	140.73	.	265.26
1989	.	.	98.48	23.14	125.53	.	247.15
1990	.	.	105.87	14.85	94.63	.	215.34
1991	.	.	84.46	12.52	74.22	.	171.19
1992	.	.	87.53	19.33	72.44	.	179.30
1993	.	.	53.42	14.96	89.07	.	157.45
1994	.	.	66.14	10.56	63.32	.	140.03
1995	.	.	40.14	10.34	46.27	.	96.75
1996	4.14	4.12	44.00	11.71	87.35	.	151.33
1997	6.84	5.98	33.65	13.46	55.46	5.07	120.47
1998	4.11	12.86	39.08	15.97	72.98	3.88	148.87
1999	9.93	27.00	41.53	9.92	54.66	1.65	144.69
2000	15.93	38.59	51.86	11.69	44.33	4.13	166.53
2001	5.80	18.24	45.81	18.05	43.45	6.85	138.19
2002	11.55	12.88	49.17	19.13	52.02	7.76	152.50
2003	12.33	18.27	57.57	12.53	71.85	6.21	178.78
2004	16.29	19.84	69.60	13.14	51.16	16.27	186.30
2005	11.20	21.57	48.29	18.60	54.18	6.95	160.79
2006	9.42	36.54	81.38	19.66	38.48	13.97	199.44
2007	23.20	29.06	133.93	15.49	58.14	17.94	277.76
2008	.	.	106.21	36.46	102.44	.	245.11
2009	24.86	33.01	92.27	20.03	51.36	31.27	252.81

Table App2.4.10 – BTS NED Dab length frequency (n*1Mill.) for North Sea, 1987-2009.

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26
3.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.5	0.00	0.00	0.00	0.00	0.00	1.12	0.00	0.00	0.80	0.00	0.10
5.5	0.00	0.00	0.00	1.92	0.27	10.93	2.13	0.00	2.08	0.00	0.26
6.5	14.74	3.28	40.55	16.41	0.40	30.14	8.04	9.02	10.97	3.70	14.69
7.5	58.16	6.11	100.09	49.21	21.11	46.69	31.08	23.76	39.61	12.85	72.84
8.5	41.35	0.98	178.33	67.73	39.23	49.54	33.21	45.86	80.24	8.63	62.83
9.5	138.24	34.97	119.80	143.60	3.55	77.54	28.66	37.40	42.94	30.25	207.71
10.5	259.17	388.10	182.67	216.74	8.17	97.16	63.91	134.39	76.05	79.72	357.86
11.5	521.55	703.32	433.00	586.42	55.21	90.71	249.40	352.35	238.83	277.08	384.87
12.5	890.09	918.71	698.73	530.59	235.74	273.32	411.87	507.47	383.58	519.26	356.71
13.5	733.48	932.21	877.82	663.55	395.30	398.07	382.53	406.18	288.05	560.31	405.42
14.5	854.08	848.70	812.59	674.66	417.88	389.44	446.49	300.21	287.59	415.13	290.62
15.5	956.98	1087.62	1048.72	645.46	535.19	399.13	464.87	268.06	288.34	476.04	253.54
16.5	845.13	908.29	964.09	674.47	635.61	531.75	390.49	306.58	313.61	368.24	316.36
17.5	870.36	607.73	870.93	557.56	536.24	645.80	329.30	327.44	247.79	373.59	367.21
18.5	492.26	642.70	596.28	619.76	507.66	582.19	372.77	270.35	178.85	333.63	279.12
19.5	335.65	488.44	436.10	445.80	380.80	362.60	342.20	270.06	150.16	254.42	206.58
20.5	240.61	250.14	199.83	198.11	212.63	285.58	239.09	235.30	99.01	179.49	117.75
21.5	124.91	123.42	114.68	190.84	119.42	120.42	142.28	142.07	58.12	149.65	92.14
22.5	78.11	119.48	63.15	61.73	88.23	76.68	68.23	96.92	57.89	79.48	60.71
23.5	72.39	24.47	19.61	51.85	25.89	31.94	54.53	41.48	45.82	31.31	31.97
24.5	48.83	55.39	17.06	28.67	12.98	22.55	30.51	36.85	15.96	32.94	20.39
25.5	21.13	24.66	9.18	9.59	13.84	17.70	15.40	13.46	13.20	11.05	17.10
26.5	11.43	5.30	5.97	4.90	6.47	6.92	18.05	11.93	6.44	13.52	9.53
27.5	6.58	6.53	4.72	3.48	4.66	3.85	4.96	4.08	3.34	9.09	3.33
28.5	13.32	4.18	2.61	2.77	4.51	3.80	3.02	2.11	1.38	4.08	2.62
29.5	2.66	1.43	2.06	1.67	1.17	2.10	0.77	1.91	1.01	1.92	0.69
30.5	1.29	0.85	0.94	0.42	0.92	1.05	0.71	1.15	0.58	0.95	0.32
31.5	0.00	0.58	0.49	0.37	0.28	0.70	0.71	0.91	0.18	0.53	0.04
32.5	3.01	0.08	1.98	0.06	0.00	0.62	0.39	0.05	0.29	0.44	0.58
33.5	0.14	0.33	0.37	0.00	0.10	0.00	0.38	0.05	0.05	0.30	0.05
34.5	0.00	0.24	0.12	0.06	0.07	0.05	0.11	0.00	0.05	0.08	0.04
35.5	0.00	0.08	0.06	0.00	0.07	0.20	0.00	0.00	0.00	0.00	0.00
36.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.16	0.00	0.13
37.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
38.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39.5	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
40.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	7635.68	8188.35	7802.51	6448.40	4263.58	4560.34	4136.10	3847.45	2932.98	4227.72	3934.38

Table App2.4.11 – BTS NED Dab length frequency (n*1Mill.) for North Sea, 1987-2009 (continued)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00
3.5	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.5	0.00	0.00	0.08	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.5	0.14	11.37	3.34	1.43	1.78	6.75	0.20	1.83	0.00	2.57	0.00	0.23
6.5	25.69	32.91	19.32	7.32	23.15	4.57	6.04	6.07	1.25	8.66	0.75	5.64
7.5	24.10	86.62	45.23	16.18	59.68	8.04	20.86	18.43	4.46	33.08	134.20	3.49
8.5	140.72	127.32	31.40	34.01	78.93	27.47	12.93	29.47	3.70	84.61	141.91	3.06
9.5	104.48	69.67	15.82	26.38	31.81	26.98	9.28	6.72	4.77	153.31	64.46	25.34
10.5	177.35	180.45	70.20	27.66	26.98	27.83	29.96	34.73	14.27	105.74	19.05	53.72
11.5	338.71	358.86	268.38	53.73	61.75	119.09	63.98	133.82	93.85	82.90	154.52	192.98
12.5	467.20	510.16	413.61	142.44	175.78	255.17	156.80	295.96	214.03	132.99	404.43	279.12
13.5	461.14	501.78	375.52	314.40	356.68	469.70	288.15	316.97	342.79	331.83	697.45	292.79
14.5	382.91	440.99	421.22	421.82	381.67	443.49	324.81	241.60	377.26	393.82	432.55	315.73
15.5	377.85	478.23	677.42	517.11	415.49	367.88	336.50	247.73	467.07	424.33	448.41	415.15
16.5	381.81	421.68	558.42	634.99	380.97	448.73	361.75	292.10	556.05	632.75	345.68	548.27
17.5	318.39	394.96	459.48	526.41	464.15	458.42	442.89	326.23	517.99	618.65	358.92	569.19
18.5	284.53	290.19	373.24	356.13	335.72	414.17	409.49	345.48	508.61	635.91	390.85	611.56
19.5	299.36	234.93	279.96	224.29	249.77	288.96	285.01	247.36	363.85	472.72	171.71	496.37
20.5	178.29	149.90	192.86	128.56	184.80	173.66	178.87	192.30	277.98	367.84	198.47	349.37
21.5	114.90	102.56	126.31	77.49	112.74	119.27	181.61	124.21	179.00	298.50	247.75	246.46
22.5	98.71	58.09	64.32	50.46	84.16	91.36	143.53	126.66	127.22	214.24	241.38	170.22
23.5	64.25	38.75	41.09	26.80	62.74	69.99	129.15	113.14	87.64	176.96	249.73	92.50
24.5	27.58	33.07	35.89	16.79	47.60	70.02	99.94	84.40	54.40	123.49	194.51	74.81
25.5	15.67	11.44	15.61	10.59	30.59	71.94	62.64	56.08	41.62	87.29	95.92	95.75
26.5	15.49	9.62	8.82	6.59	31.52	41.93	38.58	41.56	26.29	42.35	58.90	41.11
27.5	6.93	4.89	12.00	4.62	14.43	28.40	29.60	17.59	18.06	34.16	37.50	37.32
28.5	3.47	3.17	6.04	2.59	9.39	7.71	7.43	17.15	12.46	20.90	12.93	20.93
29.5	2.54	1.72	3.17	1.18	3.67	3.47	10.49	5.08	3.91	15.34	11.85	11.84
30.5	0.77	1.24	0.89	1.98	1.40	5.76	7.65	2.77	3.34	4.35	17.76	8.52
31.5	0.89	0.90	0.82	0.10	1.22	1.42	2.10	2.25	1.41	1.31	0.57	4.13
32.5	0.55	0.55	0.46	0.00	0.00	0.53	0.84	1.26	0.32	1.48	0.00	6.30
33.5	0.65	0.08	0.50	0.14	0.00	0.05	0.82	0.05	0.10	4.68	0.23	4.95
34.5	0.88	0.32	0.09	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.97
35.5	0.07	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.67
36.5	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.07	0.00	0.00
37.5	0.00	0.08	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	4316.11	4556.54	4522.26	3632.20	3628.64	4052.77	3641.90	3329.43	4304.05	5506.82	5132.66	4980.49

Table App2.4.12 – BTS NED Dab mean length [cm] by age and stratum for North Sea, 2005 and 2007

Age	S2	S3	S4	S5	S6	S7
0	.	.	10.5	.	.	.
1	12.5	14.0	14.0	14.9	13.6	.
2	16.0	17.3	16.8	20.4	18.2	14.2
3	17.3	18.4	20.3	23.5	21.1	17.5
4	18.1	20.2	21.0	26.3	23.7	.
5	18.8	23.6	23.4	26.8	25.0	29.5
6	18.9	22.2	23.9	27.3	25.1	27.8
7	20.8	24.1	23.8	27.2	25.4	.
8	21.1	24.7	24.1	28.5	26.7	.
9	18.8	24.0	24.9	.	24.9	23.5
10	21.5	26.8	26.3	.	25.5	.
11	19.5	20.5	25.9	.	25.5	.
12	.	.	.	.	.	.
13	.	.	.	.	.	.
14	.	.	.	.	25.5	.

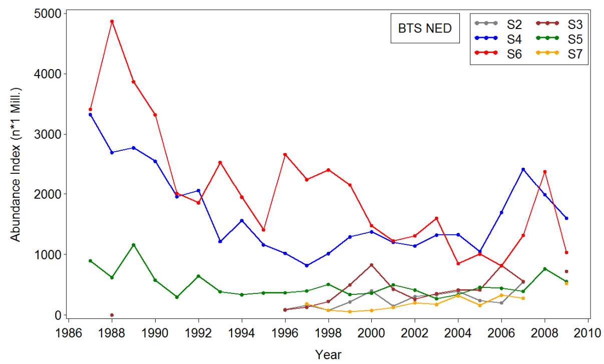

Figure App2.4.9 – BTS NED Dab abundance indices (n*1 Mill.) by stratum for North Sea, 1987-2009

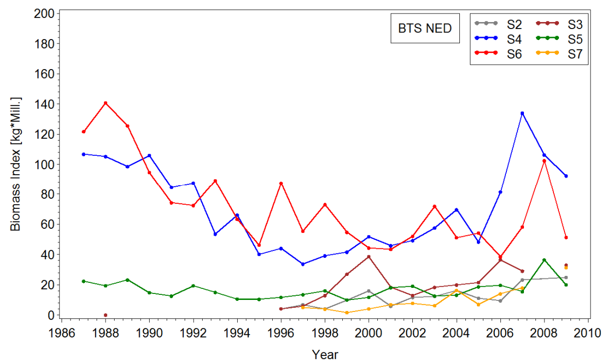

Figure App2.4.10 – BTS NED Dab biomass indices (kg*Mill.) by stratum for North Sea, 1987-2009

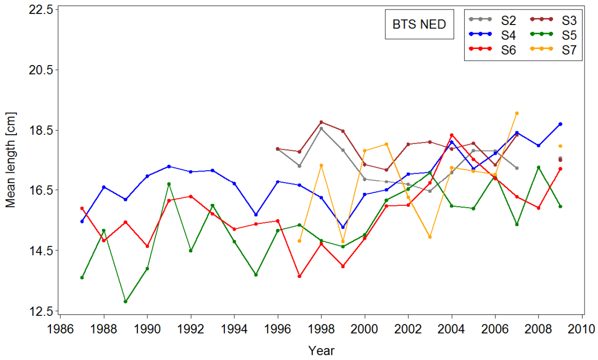

Figure App2.4.11 – BTS NED Dab mean length [cm] by stratum for North Sea, 1987-2009

Table App2.4.15 – BTS GER Dab abundance indices (n*1 Mill.) by stratum and total for east North Sea, 1997-2008. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance

Year	S4	S6	S7	Sum	CI
1997	148	146	35	329	41
1998	383	876	100	1359	34
1999	406	795	20	1221	33
2000	.	887	.	887	40
2001	414	743	55	1212	22
2002	470	467	160	1097	22
2003	467	568	159	1194	23
2004	465	512	156	1134	26
2005	255	665	119	1038	35
2006	.	.	.	.	.
2007	664	413	161	1239	22
2008	548	442	89	1080	24

Table App2.4.16 – BTS GER Dab biomass indices (n*Mill.) by stratum and total for east North Sea, 1997-2008

Year	S4	S6	S7	Sum
1997	10.22	10.33	2.22	22.77
1998	19.30	26.34	2.75	48.39
1999	18.03	28.81	0.73	47.57
2000	.	32.74	.	32.74
2001	20.17	35.88	2.31	58.36
2002	21.90	23.03	5.91	50.83
2003	23.67	20.87	3.76	48.31
2004	21.20	27.97	5.65	54.82
2005	13.82	28.56	4.75	47.13
2006	.	.	.	.
2007	40.99	24.73	9.00	74.73
2008	32.17	25.79	4.98	62.95

Table App2.4.17 – BTS GER Dab length frequency (n*1Mill.) for east North Sea, 1997-2008

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Length												
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.	0.00	0.00
2.5	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.	0.00	0.00
3.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	.	0.00	0.22
4.5	0.11	0.13	0.00	0.00	1.27	0.00	0.46	0.78	0.07	.	0.43	0.83
5.5	0.40	0.96	2.55	1.01	0.52	1.42	0.96	2.21	0.42	.	1.61	1.76
6.5	0.11	2.06	0.75	0.00	4.23	2.50	5.07	1.45	0.87	.	4.71	0.47
7.5	0.42	3.70	1.78	0.52	5.65	7.23	4.94	7.34	1.05	.	3.26	0.30
8.5	0.76	18.68	9.45	8.55	3.69	19.83	14.59	15.67	9.11	.	3.27	3.51
9.5	2.66	57.17	37.09	58.53	11.15	42.38	33.69	22.85	36.24	.	8.03	24.34
10.5	6.25	133.15	64.30	126.70	30.06	58.85	61.93	40.92	82.70	.	15.78	64.04
11.5	9.14	144.66	104.82	95.41	70.52	75.18	90.83	68.15	115.72	.	29.15	60.79
12.5	11.35	145.47	146.66	55.94	104.44	84.13	114.79	83.20	122.54	.	57.17	60.09
13.5	14.84	163.21	151.99	65.48	113.42	82.18	134.18	96.84	96.66	.	83.60	45.48
14.5	20.38	157.33	151.31	83.78	120.03	86.56	128.55	109.76	72.66	.	84.49	56.23
15.5	26.30	125.65	122.82	97.52	152.42	79.59	91.27	122.25	61.86	.	84.59	67.96
16.5	33.16	102.57	108.34	82.71	155.75	103.73	84.15	113.55	78.01	.	113.76	79.01
17.5	36.98	84.42	99.82	56.05	136.17	113.52	84.40	105.39	70.23	.	167.54	133.14
18.5	33.76	64.91	71.93	43.68	108.97	108.71	95.00	102.01	64.46	.	179.63	155.33
19.5	27.84	54.63	54.51	38.90	65.79	79.44	86.16	71.21	60.94	.	136.22	112.57
20.5	26.51	31.68	39.18	27.50	48.89	57.86	63.65	56.51	44.36	.	90.52	79.42
21.5	23.01	24.68	23.43	16.47	28.80	31.31	36.78	38.53	36.90	.	58.98	42.81
22.5	17.42	12.33	12.32	10.00	20.06	23.78	21.27	25.52	22.18	.	42.41	28.09
23.5	13.86	11.82	7.66	7.34	11.82	13.97	17.51	18.38	19.42	.	25.41	20.68
24.5	7.43	6.36	2.97	4.76	7.65	8.98	8.59	10.97	12.24	.	15.38	15.42
25.5	6.32	3.14	2.88	1.80	4.25	7.90	6.78	8.01	11.61	.	12.86	12.74
26.5	4.38	3.22	1.17	2.97	2.89	2.66	2.06	4.73	5.69	.	6.50	5.32
27.5	2.39	2.16	1.80	0.00	1.93	1.57	3.14	4.16	4.97	.	5.07	3.07
28.5	0.64	1.48	0.54	0.66	0.81	1.29	1.21	1.22	2.61	.	4.00	3.18
29.5	0.53	1.27	0.19	0.00	0.22	1.72	1.30	0.89	2.89	.	1.97	1.44
30.5	0.65	0.70	0.00	0.66	0.21	0.14	0.39	0.64	0.96	.	1.14	0.61
31.5	0.05	0.18	0.38	0.00	0.30	0.32	0.28	0.22	0.33	.	0.15	0.80
32.5	0.25	0.43	0.00	0.00	0.06	0.00	0.23	0.06	0.41	.	0.76	0.12
33.5	0.19	0.18	0.00	0.00	0.17	0.00	0.06	0.20	0.11	.	0.15	0.06
34.5	0.34	0.36	0.00	0.00	0.11	0.00	0.08	0.00	0.07	.	0.08	0.06
35.5	0.06	0.09	0.00	0.00	0.00	0.00	0.08	0.00	0.00	.	0.00	0.00
36.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.	0.00	0.00
37.5	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.	0.00	0.00
Sum	328.60	1358.83	1220.65	886.94	1212.25	1096.74	1194.38	1133.61	1038.38	.	1238.65	1079.91

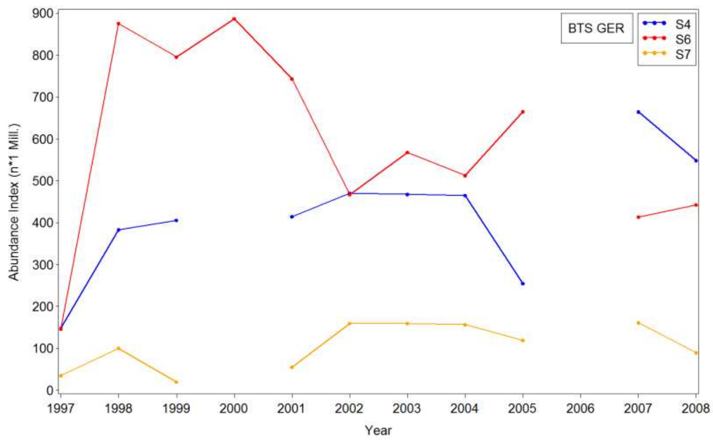

Figure App2.4.12 – BTS GER Dab abundance indices (n*1 Mill.) by stratum for North Sea, 1997-2008

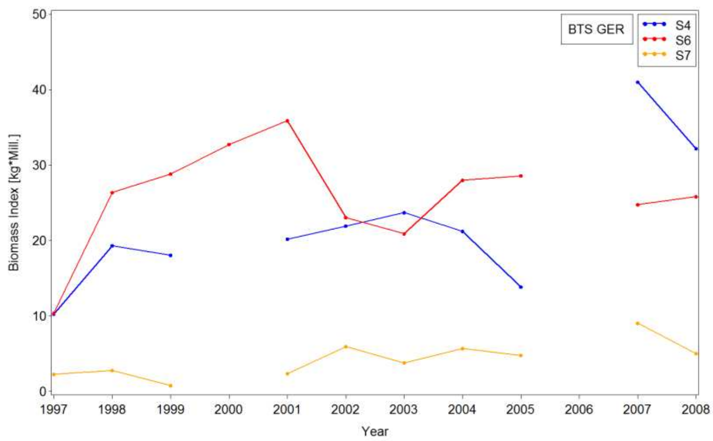

Figure App2.4.13 – BTS GER Dab biomass indices (kg*Mill.) by stratum for North Sea, 1997-2008

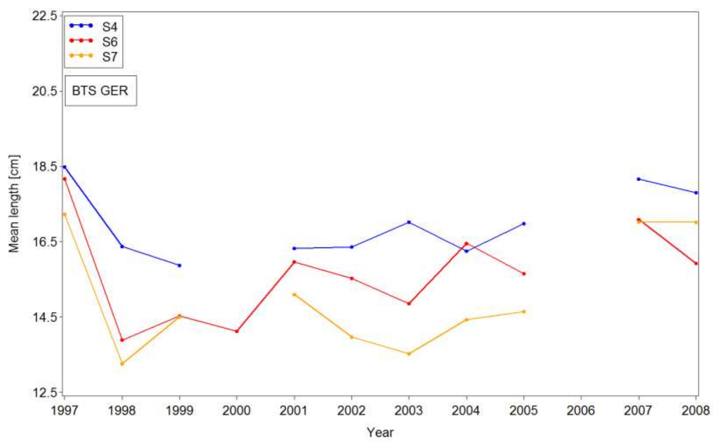

Figure App2.4.14 – BTS GER Dab mean length [cm] by stratum for North Sea, 1997-2008

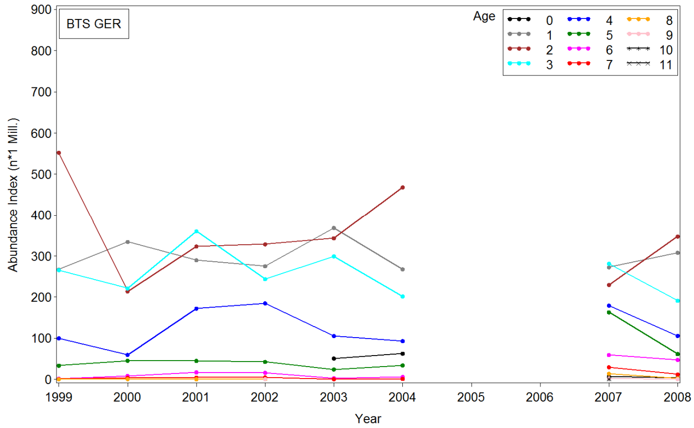

Figure App2.4.15 – BTS GER Dab age frequency [n*1 Mill.] for east North Sea, 1999-2008

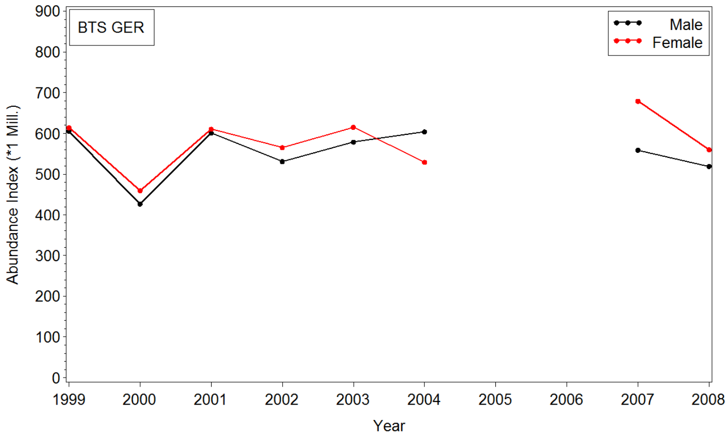

Figure App2.4.16 – BTS GER Dab sex frequency [n*1 Mill.] for east North Sea, 1999-2008

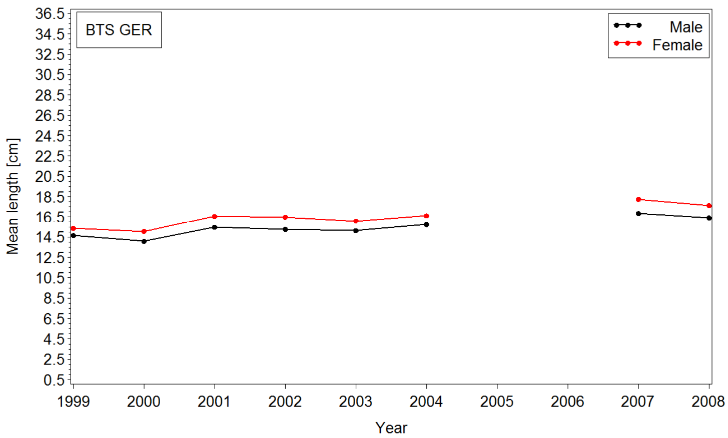

Figure App2.4.17 – BTS GER Dab mean length [cm] by sex for east North Sea, 1999-2008

Table App2.4.18 – BTS GBR Dab abundance indices (n*1 Mill.) by stratum and total for west North Sea, 1990-2007. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance

Year	S3	S5	S9	Sum	CI
1990	72.9	130.3	11.4	214.7	71
1991	.	12.8	18.9	31.7	57
1992	.	30.8	49.1	79.9	116
1993	.	1.6	18.2	19.8	119
1994	.	6.5	27.8	34.3	108
1995	12.3	6.5	14.9	33.7	80
1996	12.9	28.2	10.8	51.9	48
1997	.	5.0	16.0	20.9	51
1998	.	7.3	7.7	15.0	45
1999	.	7.8	12.2	19.9	70
2000	.	13.1	9.1	22.3	57
2001	.	41.5	14.3	55.8	65
2002	.	9.3	14.3	23.6	80
2003	.	12.8	20.4	33.3	81
2004	.	18.0	13.3	31.3	44
2005	.	7.5	7.1	14.7	39
2006	.	14.7	10.3	25.0	66
2007	.	12.2	3.6	15.9	34

Table App2.4.19 – BTS GBR Dab biomass indices (n*Mill.) by stratum and total for west North Sea, 1990-2007

Year	S3	S5	S9	Sum
1990	9.46	7.76	0.70	17.91
1991	.	0.76	1.10	1.86
1992	.	2.17	2.64	4.81
1993	.	0.19	1.06	1.25
1994	.	1.08	1.09	2.17
1995	2.05	0.41	0.66	3.12
1996	1.08	1.39	0.80	3.27
1997	.	0.33	0.94	1.27
1998	.	0.60	0.62	1.21
1999	.	0.32	0.45	0.77
2000	.	0.64	0.47	1.11
2001	.	1.14	1.28	2.41
2002	.	0.56	0.63	1.19
2003	.	1.09	0.78	1.87
2004	.	1.24	0.65	1.89
2005	.	1.13	0.60	1.73
2006	.	1.01	0.59	1.60
2007	.	1.30	0.39	1.69

Table App2.4.20 – BTS GBR Dab length frequency (n*1Mill.) for west North Sea, 1990-2007

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.5	2.844	0.612	1.235	0.473	5.181	1.347	1.127	1.281	0.144	0.698	0.479
7.5	2.312	1.584	1.744	0.691	7.680	1.342	0.447	1.664	0.409	3.045	0.907
8.5	3.906	0.317	2.188	0.338	4.592	0.415	0.054	0.182	0.089	1.254	0.552
9.5	1.321	0.210	0.059	0.000	1.207	0.000	0.031	0.000	0.030	0.354	0.086
10.5	0.716	0.000	0.427	0.016	0.532	0.243	0.590	0.296	0.092	0.803	0.281
11.5	3.453	0.506	0.486	0.045	0.035	0.429	1.276	0.091	0.092	1.093	0.663
12.5	11.279	0.366	0.259	0.091	0.438	1.212	2.700	0.239	0.219	0.879	1.806
13.5	7.395	0.877	1.405	0.332	0.966	2.384	4.772	0.476	0.517	1.030	2.165
14.5	7.680	1.133	4.201	1.766	1.805	3.411	4.773	1.358	0.295	1.143	2.097
15.5	7.160	1.269	5.692	3.113	1.446	3.035	3.711	1.583	0.347	1.586	1.017
16.5	9.764	2.886	6.742	2.465	1.164	1.778	3.138	1.915	0.589	1.361	1.322
17.5	14.386	4.032	9.069	1.296	0.864	1.036	4.010	2.076	1.076	1.139	1.664
18.5	18.818	3.688	9.586	0.895	1.412	1.169	4.494	2.457	1.162	1.344	1.880
19.5	18.943	3.653	12.611	1.053	1.049	2.121	4.279	1.885	1.435	0.764	2.053
20.5	15.524	2.374	7.344	1.246	0.605	0.986	2.656	1.341	1.532	0.808	1.193
21.5	6.645	2.527	4.778	1.343	0.489	0.483	3.078	0.804	1.141	0.533	0.918
22.5	12.493	1.509	4.492	0.924	0.648	0.733	1.692	0.546	1.510	0.481	0.652
23.5	9.966	1.764	2.949	0.816	0.335	1.602	2.139	0.476	1.231	0.209	0.796
24.5	15.308	0.804	0.684	0.638	0.297	1.563	1.395	0.522	1.023	0.423	0.266
25.5	10.196	0.675	1.020	0.712	0.194	1.141	1.434	0.353	0.619	0.138	0.358
26.5	6.977	0.345	0.796	0.278	0.132	1.308	1.327	0.198	0.335	0.394	0.338
27.5	7.309	0.135	0.364	0.695	0.215	1.330	0.555	0.339	0.347	0.070	0.180
28.5	8.819	0.115	0.760	0.088	0.065	0.750	0.719	0.179	0.284	0.087	0.295
29.5	4.601	0.066	0.127	0.154	0.051	0.617	0.776	0.076	0.150	0.102	0.051
30.5	3.631	0.092	0.068	0.093	0.082	0.592	0.007	0.125	0.142	0.008	0.053
31.5	0.023	0.032	0.095	0.009	0.596	0.967	0.089	0.064	0.019	0.000	0.058
32.5	0.013	0.000	0.064	0.042	0.030	0.595	0.014	0.000	0.051	0.049	0.000
33.5	2.276	0.000	0.043	0.025	0.032	0.022	0.062	0.005	0.016	0.026	0.026
34.5	0.020	0.000	0.000	0.014	0.000	0.000	0.000	0.016	0.041	0.036	0.012
35.5	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.033	0.026	0.018	0.000
36.5	0.000	0.017	0.000	0.000	0.000	0.011	0.071	0.000	0.000	0.000	0.000
37.5	0.029	0.000	0.000	0.011	0.000	0.000	0.014	0.020	0.000	0.023	0.000
38.5	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.020	0.000	0.000	0.000
39.5	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.038	0.000
40.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41.5	0.847	0.105	0.630	0.099	2.113	1.038	0.479	0.313	0.031	0.000	0.085
Sum	214.673	31.694	79.932	19.760	34.271	33.660	51.906	20.933	14.996	19.936	22.253

Table App2.4.20 – BTS GBR Dab length frequency (n*1Mill.) for west North Sea, 1990-2007 (continued)

Year	2001	2002	2003	2004	2005	2006	2007
1.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.5	3.615	0.499	4.103	0.695	0.768	1.015	1.477
7.5	8.768	0.573	6.325	0.625	0.347	0.460	0.951
8.5	14.872	0.469	4.186	0.053	0.114	0.016	0.166
9.5	4.652	0.051	0.844	0.170	0.000	0.015	0.037
10.5	0.040	0.172	0.371	0.561	0.000	0.381	0.000
11.5	0.271	0.409	0.796	1.185	0.277	0.602	0.022
12.5	0.629	2.175	0.890	1.142	0.505	2.169	0.125
13.5	0.542	3.145	0.420	1.846	0.867	3.109	0.290
14.5	1.368	3.904	0.975	2.331	0.592	1.719	0.326
15.5	1.283	2.932	0.939	2.762	0.283	1.196	0.381
16.5	1.924	1.227	0.842	2.630	0.576	1.437	0.327
17.5	1.942	1.068	1.101	2.647	1.450	2.233	0.556
18.5	2.423	0.699	1.723	2.043	1.270	1.336	1.538
19.5	1.977	0.628	1.631	2.366	1.115	1.901	1.159
20.5	3.092	0.602	1.786	1.801	1.240	1.394	1.462
21.5	1.761	0.899	1.243	1.754	0.787	1.556	1.136
22.5	1.114	1.006	0.997	1.601	0.981	0.963	1.208
23.5	1.218	0.502	0.752	1.434	0.607	0.814	0.818
24.5	0.865	0.651	0.807	1.097	0.212	0.650	0.717
25.5	0.544	0.427	0.296	0.700	0.220	0.511	0.528
26.5	0.590	0.356	0.393	0.436	0.130	0.328	0.487
27.5	0.558	0.325	0.157	0.402	0.336	0.049	0.315
28.5	0.122	0.269	0.095	0.291	0.162	0.222	0.183
29.5	0.041	0.155	0.082	0.099	0.150	0.055	0.082
30.5	0.029	0.093	0.028	0.151	0.028	0.081	0.067
31.5	0.277	0.033	0.096	0.248	0.107	0.089	0.309
32.5	0.054	0.083	0.082	0.026	0.023	0.000	0.110
33.5	0.000	0.042	0.011	0.021	0.000	0.035	0.090
34.5	0.000	0.020	0.000	0.000	0.000	0.000	0.000
35.5	0.000	0.013	0.014	0.000	0.000	0.000	0.046
36.5	0.000	0.000	0.000	0.000	0.000	0.000	0.026
37.5	0.000	0.000	0.000	0.000	0.000	0.000	0.031
38.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39.5	0.019	0.000	0.000	0.000	0.000	0.000	0.000
40.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41.5	1.209	0.143	1.263	0.196	1.546	0.651	0.913
Sum	55.801	23.569	33.250	31.314	14.694	24.990	15.883

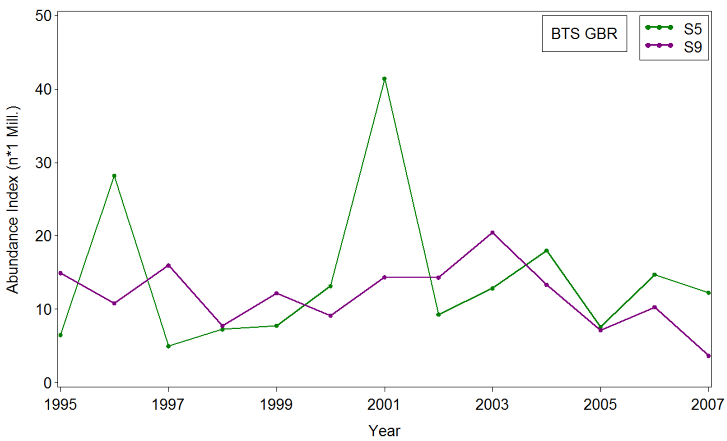

Figure App2.4.18 – BTS GBR Dab abundance indices (n*1 Mill.) by stratum for west North Sea, 1995-2007

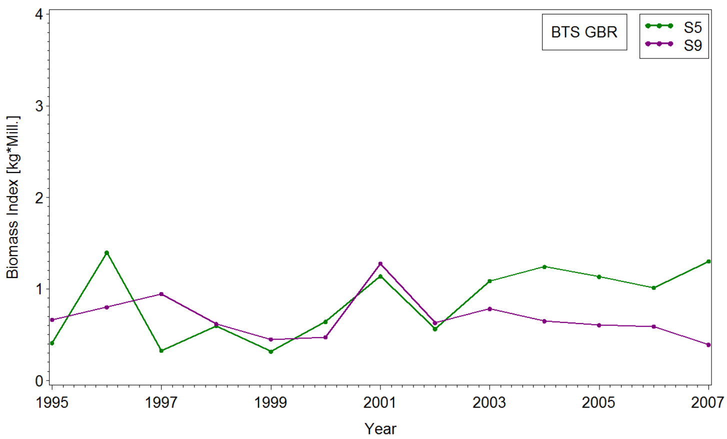

Figure App2.4.19 – BTS GBR Dab biomass indices (kg*Mill.) by stratum for west North Sea, 1995-2007

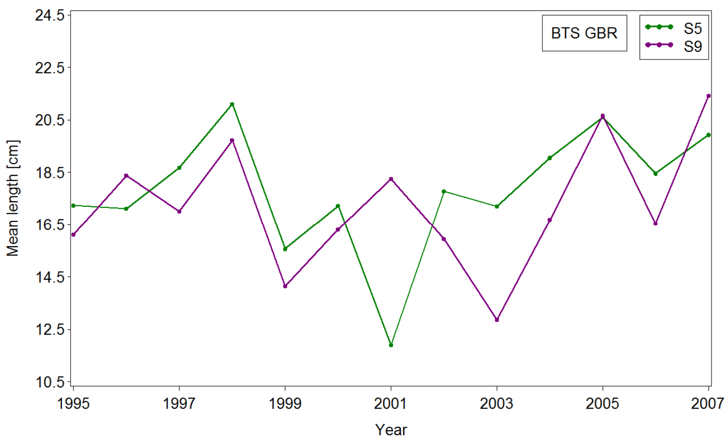

Figure App2.4.20 – BTS GBR Dab mean length [cm] by stratum for west North Sea, 1995-2007

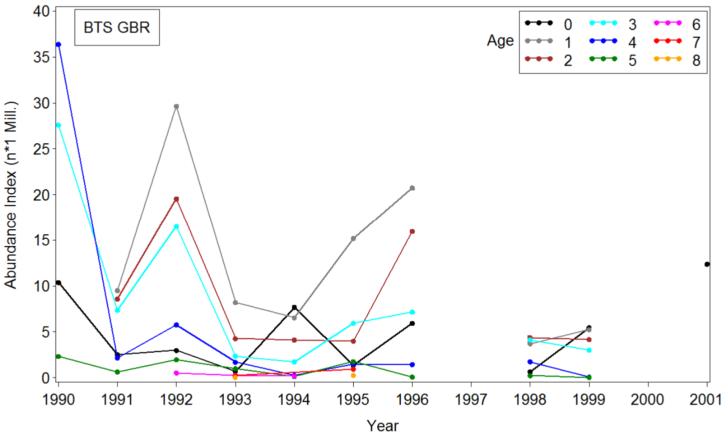

Figure App2.4.21 – BTS GBR Dab age frequency [n*1 Mill.] for west North Sea, 1990-2007

Table App2.4.21 – BITS Q1 Dab abundance indices (n*1 Mill.) by area and total for west Baltic Sea, 1991-2010. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance

Year	c22	d24	Sum	CI
1991	21.2	0.4	21.6	35
1992	37.7	8.5	46.2	56
1993	22.3	10.7	33.0	28
1994	20.6	2.8	23.3	32
1995	3.7	2.7	6.4	41
1996	92.8	0.7	93.5	122
1997	20.9	0.4	21.3	82
1998	100.5	1.2	101.7	68
1999	61.0	0.2	61.2	62
2000	643.4	0.4	643.8	139
2001	169.7	2.9	172.6	58
2002	116.4	1.2	117.6	31
2003	384.5	8.5	393.0	48
2004	328.5	5.2	333.7	63
2005	428.3	9.3	437.6	53
2006	277.8	4.9	282.7	47
2007	501.6	2.9	504.5	74
2008	269.0	7.6	276.6	49
2009	257.0	9.3	266.3	59
2010	252.7	9.1	261.8	66

Table App2.4.22 – BITS Q1 Dab biomass indices (n*Mill.) by stratum and total for west Baltic Sea, 1991-2010

Year	c22	d24	Sum
1991	2.20	0.06	2.26
1992	2.11	0.37	2.48
1993	2.17	0.96	3.13
1994	2.70	0.40	3.10
1995	0.51	0.32	0.84
1996	3.96	0.10	4.07
1997	1.41	0.02	1.43
1998	4.58	0.07	4.65
1999	3.57	0.03	3.60
2000	31.36	0.03	31.39
2001	7.33	0.20	7.53
2002	5.40	0.10	5.50
2003	16.81	0.55	17.36
2004	17.10	0.51	17.61
2005	20.76	0.85	21.60
2006	17.10	0.67	17.76
2007	22.22	0.40	22.62
2008	14.64	0.55	15.18
2009	12.99	1.19	14.18
2010	27.89	1.06	28.95

Table App2.4.23 – BITS Q1 Dab length frequency (n*1Mill.) for west Baltic Sea, 1991-2010

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Length										
1.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.023
6.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.173	0.000
7.5	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.245	0.249
8.5	0.000	0.017	0.000	0.000	0.000	0.000	0.085	0.017	0.245	0.567
9.5	0.009	0.298	0.000	0.017	0.000	3.832	0.172	1.115	0.433	6.640
10.5	0.088	0.883	0.000	0.034	0.015	11.096	0.646	3.064	1.387	8.399
11.5	0.229	1.735	0.109	0.059	0.015	11.522	0.597	4.598	1.598	9.156
12.5	0.502	3.583	0.228	0.084	0.036	10.420	1.174	6.001	2.535	27.830
13.5	0.696	5.547	0.579	0.110	0.015	8.040	2.083	12.924	2.364	26.923
14.5	0.908	6.532	0.884	0.229	0.043	9.694	1.768	13.483	4.054	70.676
15.5	1.146	5.690	1.355	0.387	0.190	6.696	1.241	11.423	3.592	92.107
16.5	1.241	5.315	1.420	0.398	0.429	5.786	1.411	11.127	8.912	128.449
17.5	1.475	3.393	1.649	0.458	0.647	4.950	1.819	9.952	8.230	99.531
18.5	1.601	2.374	2.339	0.849	0.486	3.941	1.487	6.803	7.614	56.509
19.5	0.914	1.998	3.160	1.108	0.400	2.455	2.014	5.527	4.681	45.019
20.5	1.821	1.575	3.275	1.523	0.429	2.897	1.487	7.642	4.427	24.405
21.5	1.005	1.166	4.522	1.975	0.297	2.146	1.020	3.196	3.323	12.954
22.5	1.909	1.210	3.979	2.559	0.281	1.761	1.190	1.347	2.148	10.172
23.5	1.320	0.981	3.169	2.404	0.399	1.836	0.833	0.963	1.918	11.141
24.5	1.398	1.105	2.258	2.418	0.399	1.970	0.544	0.907	1.351	4.011
25.5	1.477	0.628	1.427	2.289	0.386	2.019	0.527	0.416	0.779	1.496
26.5	0.784	0.580	1.048	1.976	0.422	0.450	0.205	0.216	0.550	2.923
27.5	1.038	0.605	0.562	1.291	0.378	1.033	0.230	0.535	0.315	2.040
28.5	0.693	0.327	0.427	1.195	0.203	0.150	0.264	0.119	0.099	0.589
29.5	0.317	0.187	0.265	0.821	0.283	0.058	0.076	0.149	0.094	0.535
30.5	0.325	0.100	0.127	0.633	0.224	0.000	0.076	0.030	0.058	0.974
31.5	0.237	0.113	0.059	0.262	0.137	0.593	0.110	0.052	0.007	0.272
32.5	0.199	0.094	0.062	0.125	0.131	0.058	0.060	0.045	0.007	0.068
33.5	0.079	0.032	0.015	0.042	0.044	0.125	0.085	0.015	0.014	0.068
34.5	0.097	0.029	0.015	0.033	0.094	0.000	0.034	0.000	0.000	0.068
35.5	0.035	0.029	0.015	0.000	0.000	0.000	0.017	0.007	0.000	0.014
36.5	0.026	0.012	0.000	0.051	0.000	0.000	0.000	0.000	0.007	0.000
37.5	0.009	0.017	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000
38.5	0.000	0.006	0.000	0.000	0.022	0.000	0.000	0.000	0.000	0.000
39.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40.5	0.000	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42.5	0.000	0.000	0.000	0.000	0.022	0.000	0.000	0.000	0.000	0.000
Sum	21.580	46.164	32.963	23.349	6.426	93.530	21.254	101.672	61.222	643.810

Table App2.4.23 – BITS Q1 Dab length frequency (n*1Mill.) for west Baltic Sea, 1991-2010 (continued)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Length										
1.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.5	0.070	0.119	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.5	0.089	0.204	0.020	0.068	0.159	0.000	2.401	0.398	0.019	0.000
6.5	0.591	0.255	0.000	0.068	0.282	0.659	2.791	0.012	0.000	0.013
7.5	0.983	1.751	0.059	1.872	1.410	0.528	0.181	0.248	0.057	0.183
8.5	1.883	3.297	1.448	5.606	5.093	0.732	2.084	1.237	0.362	1.131
9.5	6.027	4.207	6.068	9.817	15.720	0.897	5.163	4.129	3.922	0.941
10.5	7.676	4.365	20.246	7.977	11.240	4.411	13.377	6.204	8.719	1.080
11.5	6.295	6.532	25.828	12.294	14.553	8.530	40.554	9.991	13.050	0.444
12.5	10.270	6.787	27.106	15.671	23.282	13.948	43.481	16.405	21.553	0.947
13.5	13.015	7.883	38.041	21.228	37.654	15.700	49.084	21.337	24.602	3.307
14.5	12.165	10.164	35.144	20.735	36.617	23.346	53.166	28.421	26.876	4.042
15.5	23.297	9.561	48.272	34.011	48.290	29.470	84.840	32.493	26.331	7.241
16.5	23.602	12.740	45.657	40.962	58.019	35.200	72.471	41.515	37.744	11.020
17.5	25.191	11.695	46.907	38.183	50.117	34.844	32.350	31.111	20.832	12.879
18.5	16.542	10.161	32.075	37.480	38.158	25.831	27.189	19.279	19.677	14.179
19.5	8.340	9.655	20.739	23.082	29.025	14.727	15.363	11.876	11.303	18.919
20.5	4.547	6.857	15.581	19.025	17.011	13.768	14.723	8.213	11.768	20.797
21.5	3.560	3.597	7.703	12.547	12.119	12.194	8.176	11.085	5.256	22.414
22.5	3.341	2.385	6.639	9.732	12.683	11.156	6.573	6.981	9.795	25.612
23.5	1.686	1.671	5.993	8.912	9.206	9.360	4.980	6.019	5.959	29.721
24.5	1.160	0.944	3.384	5.398	6.238	7.610	5.387	4.632	4.052	22.809
25.5	0.809	1.076	1.496	3.543	4.662	5.184	3.711	3.807	2.992	19.860
26.5	0.682	0.885	1.639	1.851	1.937	4.352	4.431	2.691	3.965	15.679
27.5	0.258	0.285	0.684	0.888	0.956	3.424	3.720	1.881	1.774	11.898
28.5	0.084	0.200	0.828	0.919	0.645	2.584	3.057	1.345	1.923	6.972
29.5	0.126	0.051	1.139	1.076	0.555	1.603	2.038	2.347	1.478	4.081
30.5	0.178	0.068	0.074	0.127	0.364	0.918	1.790	1.144	0.638	2.308
31.5	0.086	0.034	0.089	0.414	0.383	0.889	0.713	0.764	1.164	1.616
32.5	0.033	0.102	0.020	0.140	1.051	0.183	0.297	0.356	0.215	0.811
33.5	0.000	0.000	0.054	0.000	0.084	0.494	0.094	0.239	0.110	0.559
34.5	0.000	0.034	0.059	0.045	0.034	0.037	0.099	0.195	0.072	0.216
35.5	0.000	0.017	0.000	0.000	0.016	0.071	0.043	0.134	0.019	0.130
36.5	0.000	0.000	0.020	0.023	0.000	0.055	0.022	0.098	0.038	0.000
37.5	0.000	0.017	0.000	0.000	0.000	0.000	0.130	0.024	0.000	0.000
38.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.019	0.000
39.5	0.000	0.000	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.000
40.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sum	172.585	117.598	393.011	333.694	437.562	282.722	504.480	276.625	266.282	261.808

Table App2.4.24 – BITS Q4 Dab abundance indices (n*1 Mill.) by area and total for west Baltic Sea, 1991-2009. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance

Year	c22	d24	Sum	CI
1991	48.7	24.1	72.8	40
1992	244.7	28.2	272.9	32
1993	131.3	5.6	136.9	35
1994	41.0	1.4	42.5	36
1995	21.7	2.3	24.1	31
1996	35.2	0.6	35.8	36
1997	116.6	4.1	120.8	31
1998	47.0	0.4	47.4	27
1999	251.3	1.1	252.5	79
2000	276.4	1.9	278.3	76
2001	531.4	1.1	532.5	43
2002	736.2	17.9	754.1	44
2003	704.2	15.1	719.2	44
2004	826.5	60.2	886.6	43
2005	606.0	12.6	618.6	39
2006	946.5	13.2	959.7	62
2007	670.2	5.4	675.5	49
2008	456.3	23.2	479.4	39
2009	538.5	11.4	550.0	38

Table App2.4.25 – BITS Q4 Dab biomass indices (n*Mill.) by stratum and total for west Baltic Sea, 1991-2009

Year	c22	d24	Sum
1991	4.26	0.75	5.01
1992	17.08	2.31	19.39
1993	13.31	0.75	14.06
1994	3.71	0.17	3.88
1995	2.32	0.23	2.55
1996	4.40	0.07	4.47
1997	5.77	0.26	6.03
1998	4.90	0.05	4.95
1999	10.47	0.08	10.55
2000	8.93	0.10	9.03
2001	22.11	0.11	22.22
2002	28.14	1.29	29.43
2003	31.94	1.21	33.16
2004	36.84	4.30	41.14
2005	30.07	1.60	31.67
2006	42.02	1.49	43.51
2007	33.71	0.50	34.21
2008	26.67	2.48	29.16
2009	45.89	1.61	47.50

Table App2.4.26 – BITS Q4 Dab length frequency (n*1Mill.) for west Baltic Sea, 1991-2009

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Length										
1.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.104	0.000
5.5	0.000	0.000	0.087	0.000	0.000	0.017	0.000	0.000	0.342	0.437
6.5	0.000	0.159	0.296	0.000	0.000	0.068	0.057	0.000	0.654	2.347
7.5	0.000	0.000	0.635	0.026	0.000	0.257	0.025	0.036	3.272	3.839
8.5	0.055	0.312	0.707	0.201	0.000	0.350	0.000	0.036	7.942	23.555
9.5	0.319	1.719	0.851	0.233	0.000	0.158	0.139	0.016	5.785	26.147
10.5	1.179	4.877	0.562	0.485	0.000	0.136	0.402	0.032	6.038	19.841
11.5	2.453	10.162	1.449	1.031	0.041	0.138	1.936	0.210	14.277	21.471
12.5	5.684	14.397	2.242	1.708	0.102	0.155	4.478	0.246	16.062	18.874
13.5	6.968	14.934	2.421	2.057	0.103	0.322	8.593	0.492	18.361	20.776
14.5	7.327	11.863	3.424	2.512	0.243	0.189	16.434	0.738	22.109	21.008
15.5	6.468	10.956	3.857	3.818	0.398	0.186	18.994	0.611	29.798	32.027
16.5	4.400	11.997	3.706	2.285	0.624	0.170	17.611	1.015	33.323	27.912
17.5	4.417	16.306	4.296	2.584	0.840	0.195	14.999	1.118	34.251	20.436
18.5	4.101	23.984	6.835	1.865	1.382	0.586	10.028	2.499	24.881	16.735
19.5	3.052	31.083	8.954	1.951	1.829	1.232	10.025	3.054	14.334	6.388
20.5	4.345	32.673	15.175	2.471	2.666	2.320	7.408	4.970	6.820	4.646
21.5	2.849	26.066	14.372	2.057	3.810	3.612	3.884	6.945	4.378	3.426
22.5	5.450	22.769	14.389	2.172	3.106	4.929	1.761	6.512	4.024	2.229
23.5	3.705	16.046	14.391	2.800	2.886	4.936	1.002	7.104	2.261	1.467
24.5	3.114	10.176	10.545	2.812	2.337	4.603	0.789	4.716	1.312	0.965
25.5	2.169	5.750	9.295	2.548	1.337	4.331	0.566	3.264	1.011	1.206
26.5	1.292	3.009	7.118	2.835	0.940	2.713	0.558	1.912	0.642	0.743
27.5	1.357	1.782	5.446	1.400	0.371	1.908	0.197	1.345	0.256	0.820
28.5	0.884	0.585	2.555	1.318	0.376	1.025	0.361	0.262	0.059	0.592
29.5	0.384	0.555	1.937	0.448	0.227	0.591	0.222	0.171	0.048	0.296
30.5	0.350	0.198	0.655	0.588	0.243	0.413	0.098	0.103	0.089	0.026
31.5	0.157	0.172	0.389	0.136	0.114	0.102	0.115	0.008	0.030	0.026
32.5	0.085	0.238	0.159	0.122	0.025	0.062	0.025	0.000	0.000	0.051
33.5	0.184	0.066	0.043	0.009	0.046	0.025	0.033	0.000	0.000	0.000
34.5	0.051	0.000	0.043	0.009	0.000	0.042	0.016	0.000	0.000	0.000
35.5	0.000	0.000	0.029	0.000	0.000	0.017	0.000	0.000	0.000	0.051
36.5	0.000	0.000	0.028	0.000	0.000	0.017	0.000	0.000	0.000	0.000
37.5	0.000	0.064	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000
Sum	72.799	272.897	136.887	42.482	24.057	35.807	120.758	47.413	252.467	278.338

Table App2.4.26 – BITS Q4 Dab length frequency (n*1Mill.) for west Baltic Sea, 1991-2009 (continued)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Length									
1.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.5	0.399	0.498	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.5	2.261	0.000	0.161	0.000	0.149	0.000	0.000	0.000	0.159
6.5	4.271	0.029	1.079	0.021	0.416	1.040	0.558	0.014	2.062
7.5	7.608	2.286	9.273	3.257	2.439	2.582	4.388	1.560	4.874
8.5	11.824	7.910	21.685	6.071	3.629	6.660	12.675	6.658	3.806
9.5	17.353	25.018	34.240	27.715	14.530	20.194	36.403	13.645	0.791
10.5	28.494	40.031	25.636	35.383	29.908	72.968	38.126	24.079	1.470
11.5	31.285	65.557	34.505	48.026	48.172	100.110	49.168	27.707	3.093
12.5	30.795	79.174	67.825	52.178	47.604	119.052	53.668	26.501	4.813
13.5	33.174	61.594	60.707	74.530	52.180	87.110	54.411	38.310	14.810
14.5	48.622	83.805	55.530	74.552	44.049	73.914	54.979	37.317	23.313
15.5	53.268	108.510	69.781	106.573	57.270	86.578	88.262	36.009	30.893
16.5	68.621	70.043	66.620	131.803	64.194	96.397	68.775	40.314	35.279
17.5	52.020	69.117	58.355	104.563	47.555	67.014	39.961	31.657	41.221
18.5	46.459	45.043	61.767	62.667	42.714	42.588	27.408	32.015	55.410
19.5	35.400	24.141	38.445	40.909	32.331	24.852	20.556	26.991	47.625
20.5	30.100	17.140	24.285	30.419	30.348	25.705	15.621	25.212	48.395
21.5	9.695	15.222	20.475	21.564	26.630	26.980	11.774	23.874	50.953
22.5	11.632	10.942	22.889	15.397	23.317	25.501	17.270	19.303	37.537
23.5	2.393	11.749	13.044	14.433	16.460	21.162	16.567	16.587	38.403
24.5	2.673	5.597	9.935	11.217	13.102	15.125	13.993	14.212	29.750
25.5	1.625	5.891	10.010	9.411	7.493	14.388	13.359	10.829	26.877
26.5	1.258	1.949	6.576	6.077	3.764	10.604	12.729	7.837	18.772
27.5	0.682	0.756	3.773	4.303	2.995	8.688	10.324	5.918	12.769
28.5	0.222	1.462	1.166	2.909	2.947	3.965	5.797	4.583	7.148
29.5	0.128	0.454	0.717	1.350	2.045	3.051	4.235	3.282	4.348
30.5	0.231	0.076	0.225	0.772	0.355	2.222	1.638	1.460	2.411
31.5	0.000	0.065	0.097	0.269	0.801	0.881	1.475	1.190	1.792
32.5	0.000	0.000	0.312	0.085	0.475	0.358	0.590	1.185	0.425
33.5	0.000	0.054	0.020	0.174	0.490	0.015	0.164	0.682	0.490
34.5	0.014	0.000	0.000	0.000	0.104	0.000	0.378	0.518	0.000
35.5	0.000	0.000	0.000	0.000	0.014	0.000	0.163	0.000	0.079
36.5	0.000	0.000	0.020	0.000	0.074	0.000	0.115	0.000	0.212
37.5	0.000	0.000	0.079	0.000	0.000	0.000	0.000	0.000	0.000
Sum	532.506	754.113	719.233	886.631	618.556	959.704	675.531	479.449	549.982

Appendix 3.5

Table App3.5.1 - Dab mortality from shrimp fishery by-catch. A = after sieving out; B = results of controls with samples collected from the catch before sieving; TL = total length; Catch = total catch in one codend; Nb = number in the beginning; Ne = number at the end of the experiment. Source: Berghahn et al. (1992). Sieving refers to an onboard sorting system for shrimp.

Date		TL Range (cm)	Catch (kg)	Water Temperature (°C)	Duration of Experiments (days)	N_b	N_e	Mortality (%)
5/23/88	A	10.5–21	100	12–13.4	5.5	63	46	27
	B	12–22				26	23	12
8/2/88	B	14.5–24	50	17.2–17.4	5.5	40	31	23
8/8/88	A	12–20.5	70	18.0–18.8	5.5	6	2	67
8/15/88	A	9.5–20	70	17.6	5.0	13	8	38
5/15/89	A	12.5–20	110	12.0–14.0	6.0	19	17	11
5/21/89	B	10.5–23.5				20	20	0
	A	12–27	55	15.0–15.2	6.0	81	54	33
5/28/89	B	12–26				45	40	11
	A	10.5–25	150	15.7–14.4	5.5	31	23	26
7/49/89	B	11.5–25.5				11	10	9
7/25/89	B	20–20.5	75	15.0–16.0	5.0	2	2	0
5/10/90	A	20.5–26	125	17.2–17.5	5.5	5	4	20
	A	7–19.5	40	16.0	5.0	33	17	48
5/16/90	B	11–16				2	2	0
7/20/91	A	7.5–25	15	14.0–13.6	4.0	40	23	43
	B	12.5–25	50	16.7–17.5	5.0	12	12	0
Average				A		291	196	32.6
				B		159	140	11.9

Table App3.5.1 - Dab discard rates by métier, year and ICES statistical rectangle, North Sea.

Metier	Vessel power	Level of year	Level of ICES_rectangle	No. of sampled months	Discard rate r_{cm}
BEAM100-119	<=221kW	2002		2	0.84174
BEAM100-119	<=221kW		39F7	1	0.84171
BEAM100-119	<=221kW		40F7	1	0.84229
BEAM16-31	<=221kW	2006		1	0.04489
BEAM16-31	<=221kW	2007		1	0.94142
BEAM16-31	<=221kW	2008		3	0.99207
BEAM16-31	<=221kW	2009		3	0.98233
BEAM16-31	<=221kW		36F6	1	0.14894
BEAM16-31	<=221kW		36F7	4	0.99128
BEAM16-31	<=221kW		37F8	3	0.94848
BEAM80-89	<=221kW	2000		5	0.94334
BEAM80-89	<=221kW	2001		2	0.99711
BEAM80-89	<=221kW	2002		3	0.8982
BEAM80-89	<=221kW	2003		10	0.93321
BEAM80-89	<=221kW	2004		6	0.92861
BEAM80-89	<=221kW	2005		7	0.76258
BEAM80-89	<=221kW	2006		2	0.78815
BEAM80-89	<=221kW		32F3	1	0.98319
BEAM80-89	<=221kW		33F3	1	0.57958
BEAM80-89	<=221kW		33F4	1	0.9871

BEAM80-89	<=221kW		34F4	3	0.96298
BEAM80-89	<=221kW		35F3	1	0.58427
BEAM80-89	<=221kW		35F4	4	0.98502
BEAM80-89	<=221kW		35F5	3	0.96057
BEAM80-89	<=221kW		36F3	1	0.87277
BEAM80-89	<=221kW		36F4	4	0.82146
BEAM80-89	<=221kW		36F5	6	0.83802
BEAM80-89	<=221kW		36F6	3	0.89758
BEAM80-89	<=221kW		37F4	1	0.93932
BEAM80-89	<=221kW		37F5	1	0.84094
BEAM80-89	<=221kW		37F7	2	0.95156
BEAM80-89	<=221kW		38F5	1	0.80331
BEAM80-89	<=221kW		38F7	1	0.87627
BEAM80-89	<=221kW		39F7	1	0.75012
BEAM80-89	>221kW	1999		19	0.98317
BEAM80-89	>221kW	2000		23	0.98963
BEAM80-89	>221kW	2001		11	0.99893
BEAM80-89	>221kW	2002		26	0.95517
BEAM80-89	>221kW	2003		37	0.97904
BEAM80-89	>221kW	2004		4	0.94856
BEAM80-89	>221kW	2005		11	0.80314
BEAM80-89	>221kW	2006		10	0.86791
BEAM80-89	>221kW	2007		11	0.88618
BEAM80-89	>221kW	2008		12	0.91271
BEAM80-89	>221kW	2009		7	0.89025
BEAM80-89	>221kW		32F2	2	0.87983
BEAM80-89	>221kW		32F3	4	0.96552
BEAM80-89	>221kW		33F2	3	0.96696
BEAM80-89	>221kW		33F3	14	0.97077
BEAM80-89	>221kW		33F4	5	0.89072
BEAM80-89	>221kW		34F2	5	0.98706
BEAM80-89	>221kW		34F3	8	0.99133
BEAM80-89	>221kW		34F4	7	0.90421
BEAM80-89	>221kW		35F1	1	0.97803
BEAM80-89	>221kW		35F2	5	0.99599
BEAM80-89	>221kW		35F3	10	0.91932
BEAM80-89	>221kW		35F4	6	0.9404
BEAM80-89	>221kW		36F1	4	0.99663
BEAM80-89	>221kW		36F2	6	0.99102
BEAM80-89	>221kW		36F3	8	0.88754
BEAM80-89	>221kW		36F4	13	0.93256
BEAM80-89	>221kW		36F5	6	0.9826
BEAM80-89	>221kW		36F6	2	0.95239
BEAM80-89	>221kW		36F7	1	0.99781
BEAM80-89	>221kW		37F1	3	0.99946
BEAM80-89	>221kW		37F2	6	0.98104
BEAM80-89	>221kW		37F3	1	0.94459
BEAM80-89	>221kW		37F4	4	0.96156
BEAM80-89	>221kW		37F5	7	0.93954
BEAM80-89	>221kW		37F6	5	0.97432
BEAM80-89	>221kW		37F7	4	0.93992

BEAM80-89	>221kW		38F1	1	0.99777
BEAM80-89	>221kW		38F2	2	0.99435
BEAM80-89	>221kW		38F3	2	0.97082
BEAM80-89	>221kW		38F6	7	0.98692
BEAM80-89	>221kW		38F7	2	0.90298
BEAM80-89	>221kW		39F3	3	0.9151
BEAM80-89	>221kW		39F6	4	0.92549
BEAM80-89	>221kW		39F7	4	0.97122
BEAM80-89	>221kW		40F3	1	0.6047
BEAM80-89	>221kW		40F4	1	0.77196
BEAM80-89	>221kW		40F5	1	0.46715
BEAM80-89	>221kW		40F6	2	0.91158
BEAM80-89	>221kW		40F7	1	0.9957
DEM_SEINE100-119	>221kW	2007		2	0
DEM_SEINE100-119	>221kW		42F6	1	0
DEM_SEINE100-119	>221kW		42F7	1	0
DEM_SEINE>=120	>221kW	2009		2	0
DEM_SEINE>=120	>221kW		42F7	1	0
DEM_SEINE>=120	>221kW		44F6	1	0
GILL100-119	<=221kW	2004		2	0.96375
GILL100-119	<=221kW	2005		1	0.51768
GILL100-119	<=221kW		34F3	2	0.93654
GILL100-119	<=221kW		34F4	1	0.39865
GILL90-99	<=221kW	2004		3	0.91681
GILL90-99	<=221kW	2005		1	0.65909
GILL90-99	<=221kW	2008		1	0.13115
GILL90-99	<=221kW		34F3	2	0.91291
GILL90-99	<=221kW		34F4	1	0.7352
GILL90-99	<=221kW		35F3	1	0.96024
GILL90-99	<=221kW		41F7	1	0.13115
GILL>=120	<=221kW	2005		1	0.44813
GILL>=120	<=221kW		42F7	1	0.44813
OTTER100-119	<=221kW	2002		5	0.78012
OTTER100-119	<=221kW	2003		2	0.99142
OTTER100-119	<=221kW	2004		2	0.61697
OTTER100-119	<=221kW	2007		7	0.77171
OTTER100-119	<=221kW		37F5	1	0.67376
OTTER100-119	<=221kW		37F6	1	0.54869
OTTER100-119	<=221kW		38F5	2	0.98186
OTTER100-119	<=221kW		38F6	2	0.95963
OTTER100-119	<=221kW		38F7	2	0.75495
OTTER100-119	<=221kW		39F3	1	0.50533
OTTER100-119	<=221kW		39F5	2	0.87059
OTTER100-119	<=221kW		39F6	2	0.89164
OTTER100-119	<=221kW		39F7	1	0.20794
OTTER100-119	<=221kW		40F3	1	0.42482
OTTER100-119	<=221kW		40F5	1	0.79781
OTTER100-119	>221kW	2003		4	0.91621
OTTER100-119	>221kW	2006		4	0.90487
OTTER100-119	>221kW		38F4	1	0.89166
OTTER100-119	>221kW		38F6	1	0.90095

OTTER100-119	>221kW		39F4	1	0.99167
OTTER100-119	>221kW		39F5	2	0.91314
OTTER100-119	>221kW		39F6	1	0.91768
OTTER100-119	>221kW		40F5	2	0.88201
OTTER80-89	<=221kW	2002		5	0.7737
OTTER80-89	<=221kW	2003		8	0.83831
OTTER80-89	<=221kW	2004		4	0.9273
OTTER80-89	<=221kW	2005		3	0.86451
OTTER80-89	<=221kW	2006		4	0.80906
OTTER80-89	<=221kW	2008		4	0.87254
OTTER80-89	<=221kW	2009		3	0.92921
OTTER80-89	<=221kW		35F5	1	0.94364
OTTER80-89	<=221kW		36F1	1	0.34845
OTTER80-89	<=221kW		36F2	1	0.36741
OTTER80-89	<=221kW		36F3	1	0.68227
OTTER80-89	<=221kW		36F4	1	0.82696
OTTER80-89	<=221kW		36F5	1	0.85268
OTTER80-89	<=221kW		36F6	1	0.82305
OTTER80-89	<=221kW		37F1	1	0.63057
OTTER80-89	<=221kW		37F2	1	0.62843
OTTER80-89	<=221kW		37F3	1	0.93196
OTTER80-89	<=221kW		37F5	2	0.85197
OTTER80-89	<=221kW		38F5	3	0.66618
OTTER80-89	<=221kW		38F6	3	0.89387
OTTER80-89	<=221kW		38F7	1	0.90796
OTTER80-89	<=221kW		39F5	5	0.86156
OTTER80-89	<=221kW		39F6	4	0.89159
OTTER80-89	<=221kW		39F7	1	0.91929
OTTER80-89	<=221kW		40F5	2	0.86105
OTTER80-89	>221kW	2001		3	0.79619
OTTER80-89	>221kW	2006		4	0.93548
OTTER80-89	>221kW	2009		6	0.87096
OTTER80-89	>221kW		37F2	1	0.90556
OTTER80-89	>221kW		37F3	2	0.75547
OTTER80-89	>221kW		37F4	2	0.98879
OTTER80-89	>221kW		37F5	1	0.66128
OTTER80-89	>221kW		38F3	1	0.83784
OTTER80-89	>221kW		38F5	1	0.75863
OTTER80-89	>221kW		38F6	1	0.78187
OTTER80-89	>221kW		39F5	1	0.81932
OTTER80-89	>221kW		39F6	1	0.88471
OTTER80-89	>221kW		40F5	1	0.91758
OTTER80-89	>221kW		40F6	1	0.96212
OTTER90-99	<=221kW	2003		2	0.84398
OTTER90-99	<=221kW	2005		10	0.84161
OTTER90-99	<=221kW		37F3	1	0.96659
OTTER90-99	<=221kW		38F2	1	0.80594
OTTER90-99	<=221kW		38F3	2	0.90564
OTTER90-99	<=221kW		38F5	1	0.43716
OTTER90-99	<=221kW		38F7	1	0.79613
OTTER90-99	<=221kW		39F5	3	0.86954

OTTER90-99	<=221kW		39F6	1	0.79902
OTTER90-99	<=221kW		40F5	2	0.75135
OTTER>=120	<=221kW	2003		4	0.84382
OTTER>=120	<=221kW	2004		2	0.31027
OTTER>=120	<=221kW	2008		1	0.08192
OTTER>=120	<=221kW		36F2	1	0.77226
OTTER>=120	<=221kW		36F3	1	0.73934
OTTER>=120	<=221kW		37F2	1	0.47651
OTTER>=120	<=221kW		37F3	1	0.94373
OTTER>=120	<=221kW		39F6	1	0.24661
OTTER>=120	<=221kW		41F6	1	0.42422
OTTER>=120	<=221kW		42F8	1	0.08192
OTTER>=120	>221kW	2002		1	0.06422
OTTER>=120	>221kW	2003		3	0.26664
OTTER>=120	>221kW	2005		3	0.33594
OTTER>=120	>221kW	2007		3	0.1748
OTTER>=120	>221kW	2008		9	0.33075
OTTER>=120	>221kW	2009		1	0
OTTER>=120	>221kW		36F2	1	0
OTTER>=120	>221kW		37F3	1	0
OTTER>=120	>221kW		40F4	1	0.26407
OTTER>=120	>221kW		41F6	1	0.15
OTTER>=120	>221kW		42F6	1	0.34884
OTTER>=120	>221kW		42F7	5	0.1021
OTTER>=120	>221kW		43F6	1	0.06716
OTTER>=120	>221kW		43F7	5	0.27913
OTTER>=120	>221kW		43F8	3	0.52111
OTTER>=120	>221kW		45G0	1	0.83333

Table App3.5.2 - Dab discard rates by métier, year and ICES statistical rectangle, Baltic Sea

Metier	Vessel power	Level of year	Level of ICES_rectangle	No. of sampled months	Discard rate r_{cm}
GILL100-119	<=221kW	2008		2	0.15437
GILL100-119	<=221kW		38G0	2	0.15437
GILL>=120	<=221kW	2008		1	0
GILL>=120	<=221kW		37G1	1	0
OTTER100-119	<=221kW	2005		1	0.2
OTTER100-119	<=221kW	2006		4	0.11815
OTTER100-119	<=221kW	2007		8	0.08664
OTTER100-119	<=221kW	2008		16	0.1377
OTTER100-119	<=221kW		37G1	10	0.09566
OTTER100-119	<=221kW		37G3	3	0.20552
OTTER100-119	<=221kW		37G4	2	0.64777
OTTER100-119	<=221kW		38G0	3	0.00192
OTTER100-119	<=221kW		38G2	2	0.22074
OTTER100-119	<=221kW		38G3	7	0.17187
OTTER100-119	<=221kW		38G4	2	0.71005
OTTER100-119	<=221kW		39G5	0	.
OTTER100-119	>221kW	2006		5	0.33271
OTTER100-119	>221kW	2007		1	0.17375
OTTER100-119	>221kW		37G1	1	0.17375
OTTER100-119	>221kW		38G2	4	0.16674
OTTER100-119	>221kW		38G3	1	0.43783
OTTER55-69	<=221kW	2006		2	0.12153
OTTER55-69	<=221kW	2007		4	0.03777
OTTER55-69	<=221kW		37G1	3	0.1039
OTTER55-69	<=221kW		38G2	2	0.11854
OTTER55-69	<=221kW		38G3	1	0
OTTER>120	<=221kW	2006		3	0.38547
OTTER>120	<=221kW		37G1	2	0.38885
OTTER>120	<=221kW		38G3	1	0.25773
OTTER>=120	<=221kW	2005		5	0.13423
OTTER>=120	<=221kW	2007		2	0.32997
OTTER>=120	<=221kW		37G1	1	0.33333
OTTER>=120	<=221kW		37G5	1	0.40006
OTTER>=120	<=221kW		38G2	3	0.23087
OTTER>=120	<=221kW		38G3	2	0.07331
TRAMMEL>=120	<=221kW	2007		1	0
TRAMMEL>=120	<=221kW	2008		1	0
TRAMMEL>=120	<=221kW		37G1	1	0
TRAMMEL>=120	<=221kW		38G5	1	0

Appendix 4.1

Flounder

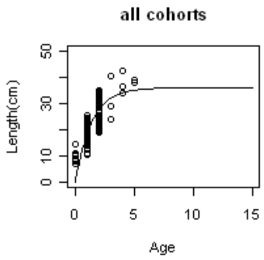

Figure App 4.1.1 – Age-length relationship of female flounder for all cohorts from 1996-1997, 1999-2000, 2003-2005 together and corresponding von Bertalanffy growth curve. Based on survey data.

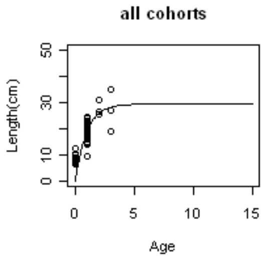

Figure App 4.1.2 – Age-length relationship of male flounder for all cohorts from 2004-2005 together and corresponding von Bertalanffy growth curve. Based on survey data.

Lemon sole

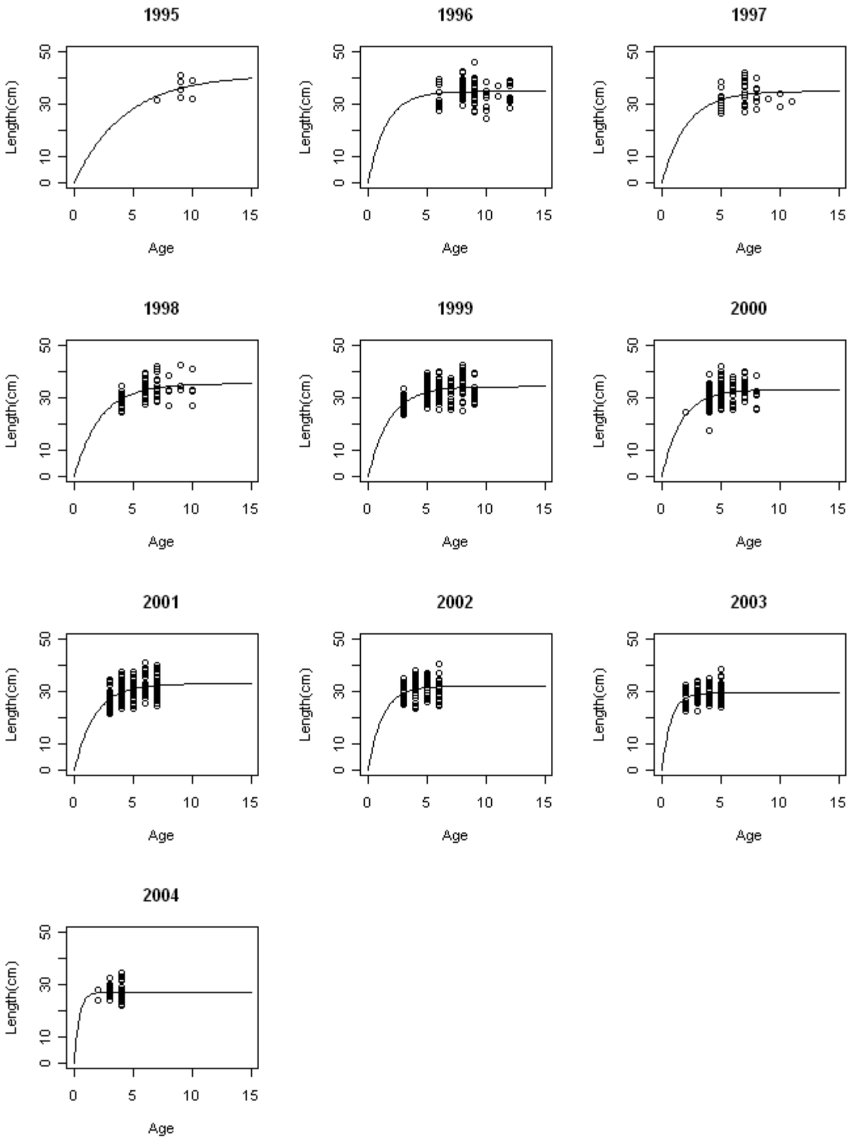

Figure App 4.1.3 – Age-length relationship of female lemon sole for cohorts from 1995-2004 and corresponding von Bertalanffy growth curve. Based on market data.

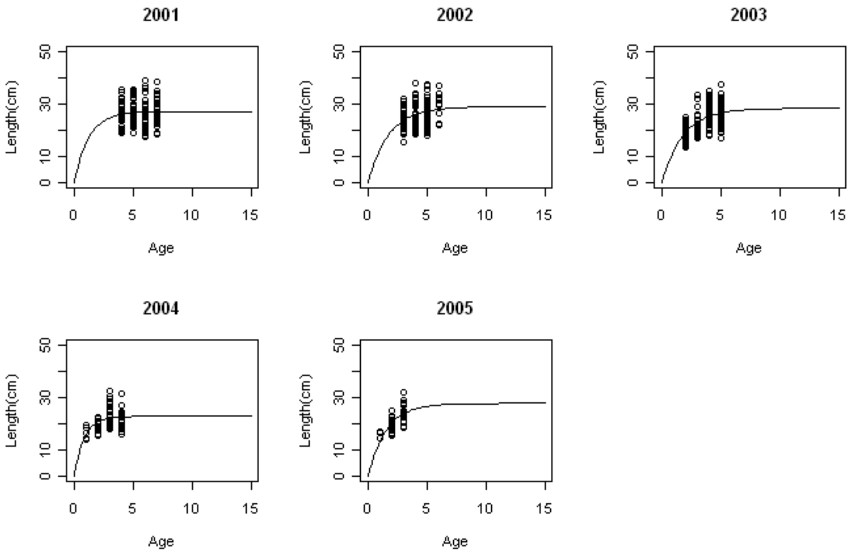

Figure App 4.1.4 – Age-length relationship of female lemon sole for cohorts from 2001-2005 and corresponding von Bertalanffy growth curve. Based on survey data.

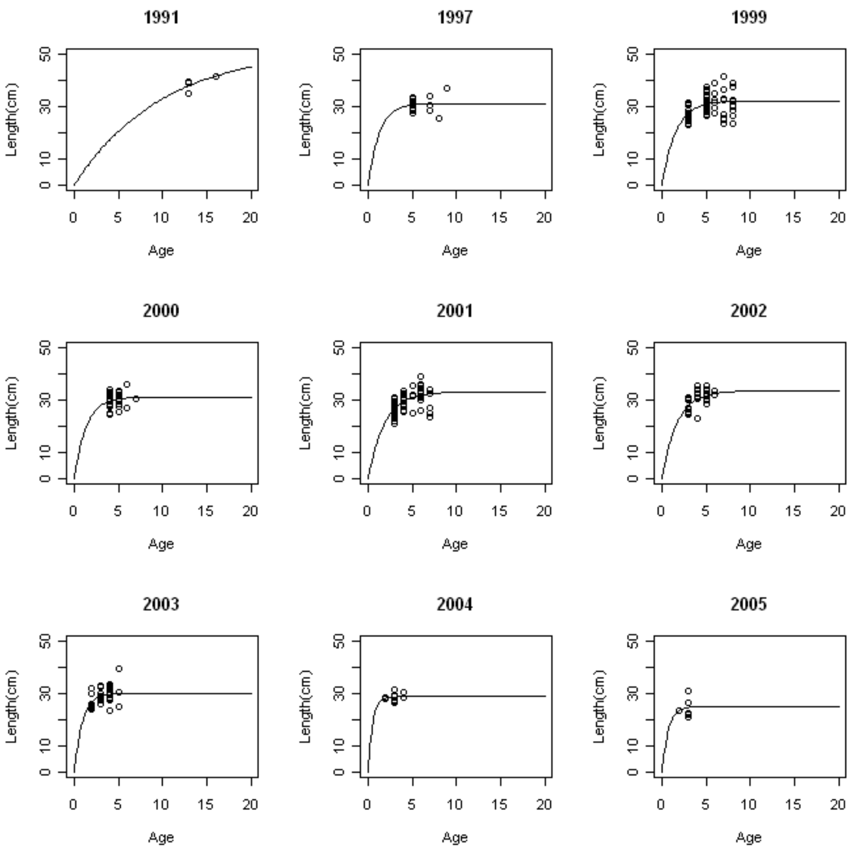

Figure App 4.1.5 – Age-length relationship of male lemon sole for cohorts from 1991, 1997, 1999-2005 and corresponding von Bertalanffy growth curve. Based on market data.

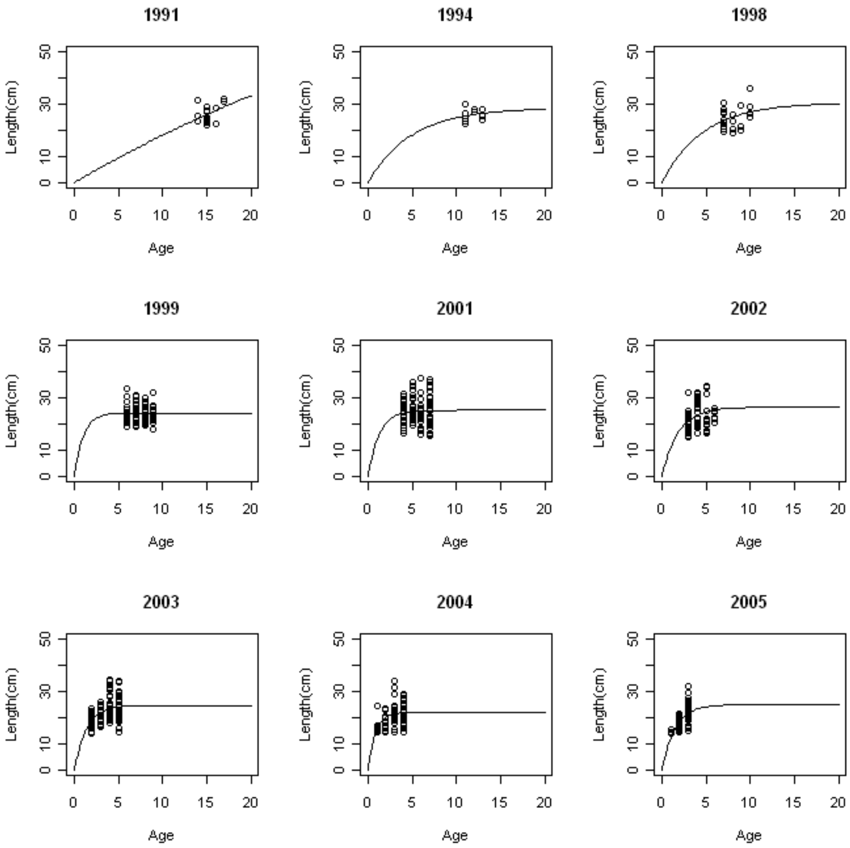

Figure App 4.1.6 – Age-length relationship of male lemon sole for cohorts from 1991, 1994, 1998-1999, 2001-2005 and corresponding von Bertalanffy growth curve. Based on survey data.

Brill

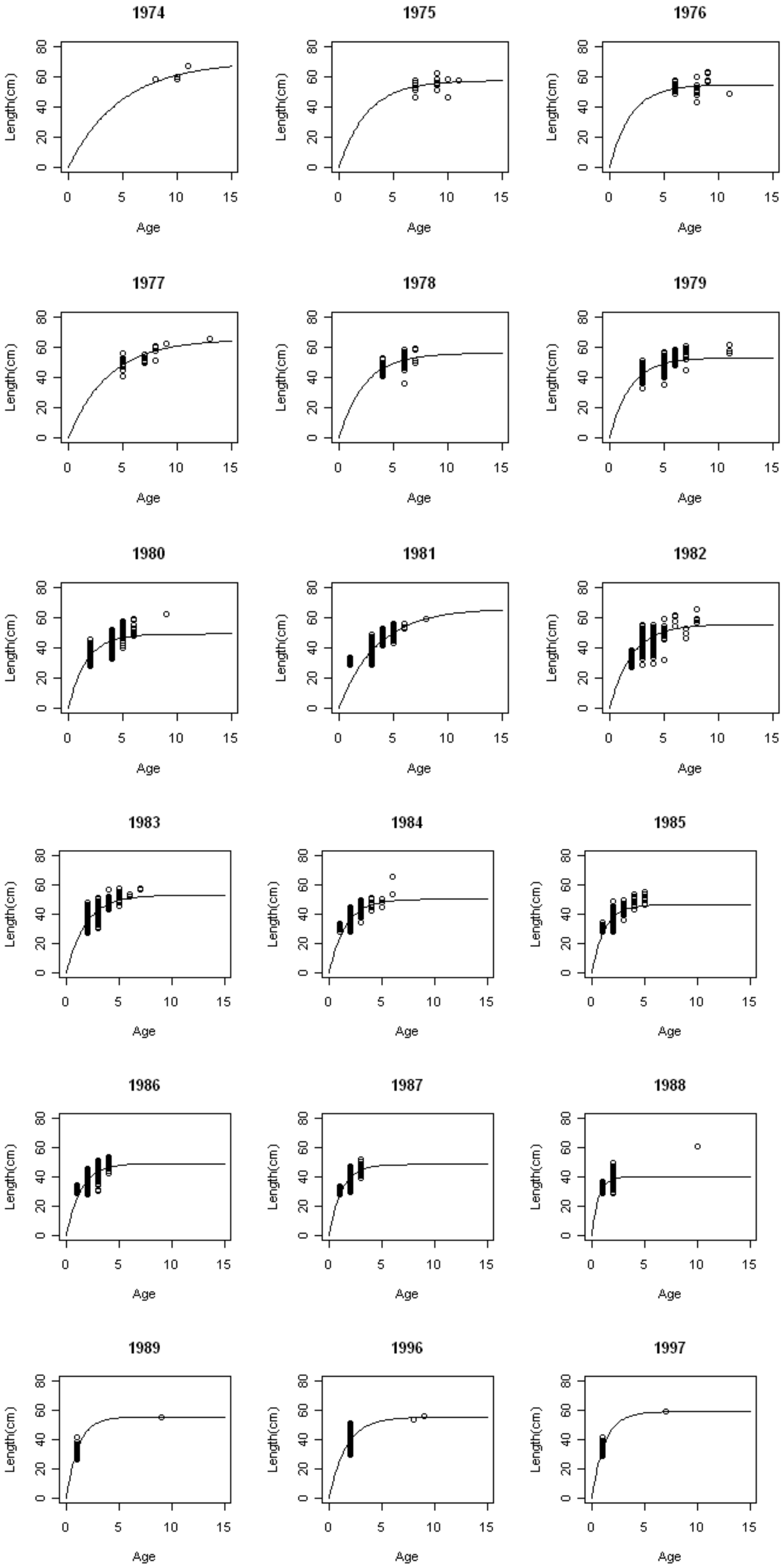

Figure App 4.1.7 – Age-length relationship of female brill for cohorts from 1974-1989, 1996-2005 and corresponding von Bertalanffy growth curve. Based on market data.

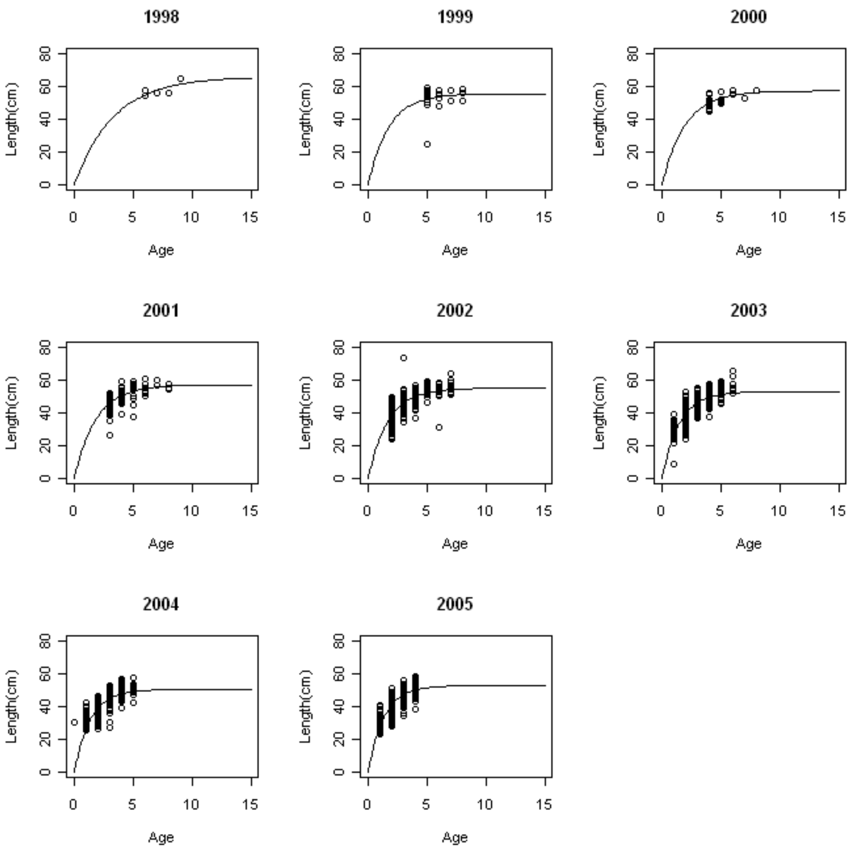

Figure App 4.1.7 – Continued.

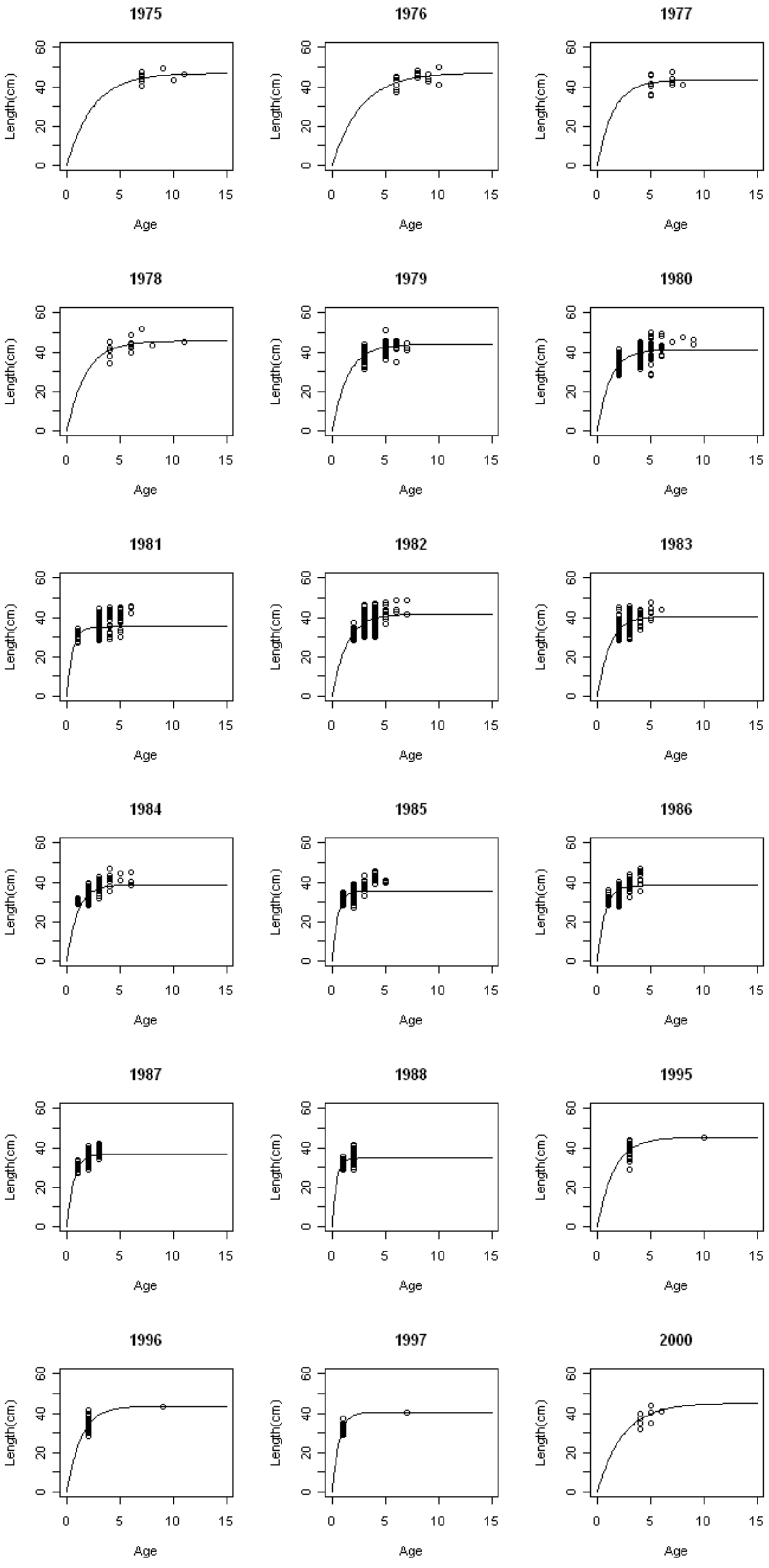

Figure App 4.1.8 – Age-length relationship of male brill for cohorts from 1975-1988, 1995-1997, 2000-2005 and corresponding von Bertalanffy growth curve. Based on market data.

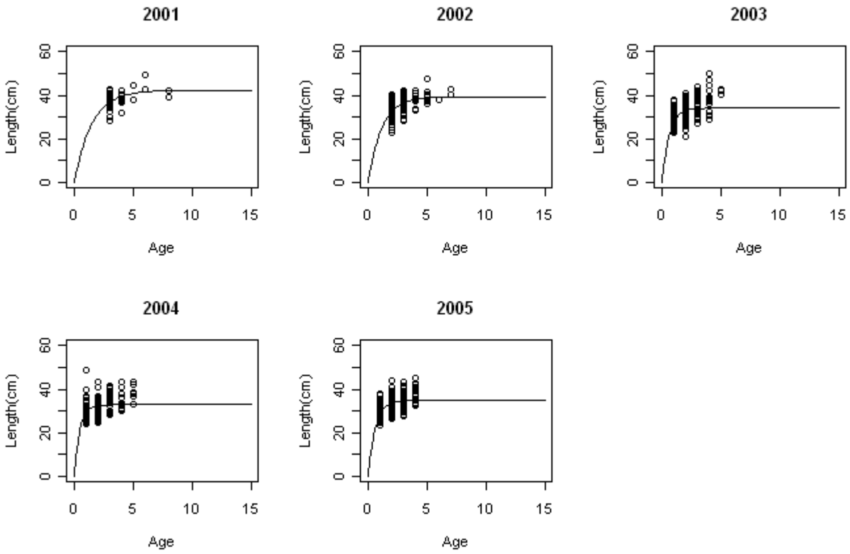

Figure App 4.1.8 – Continued.

Dab

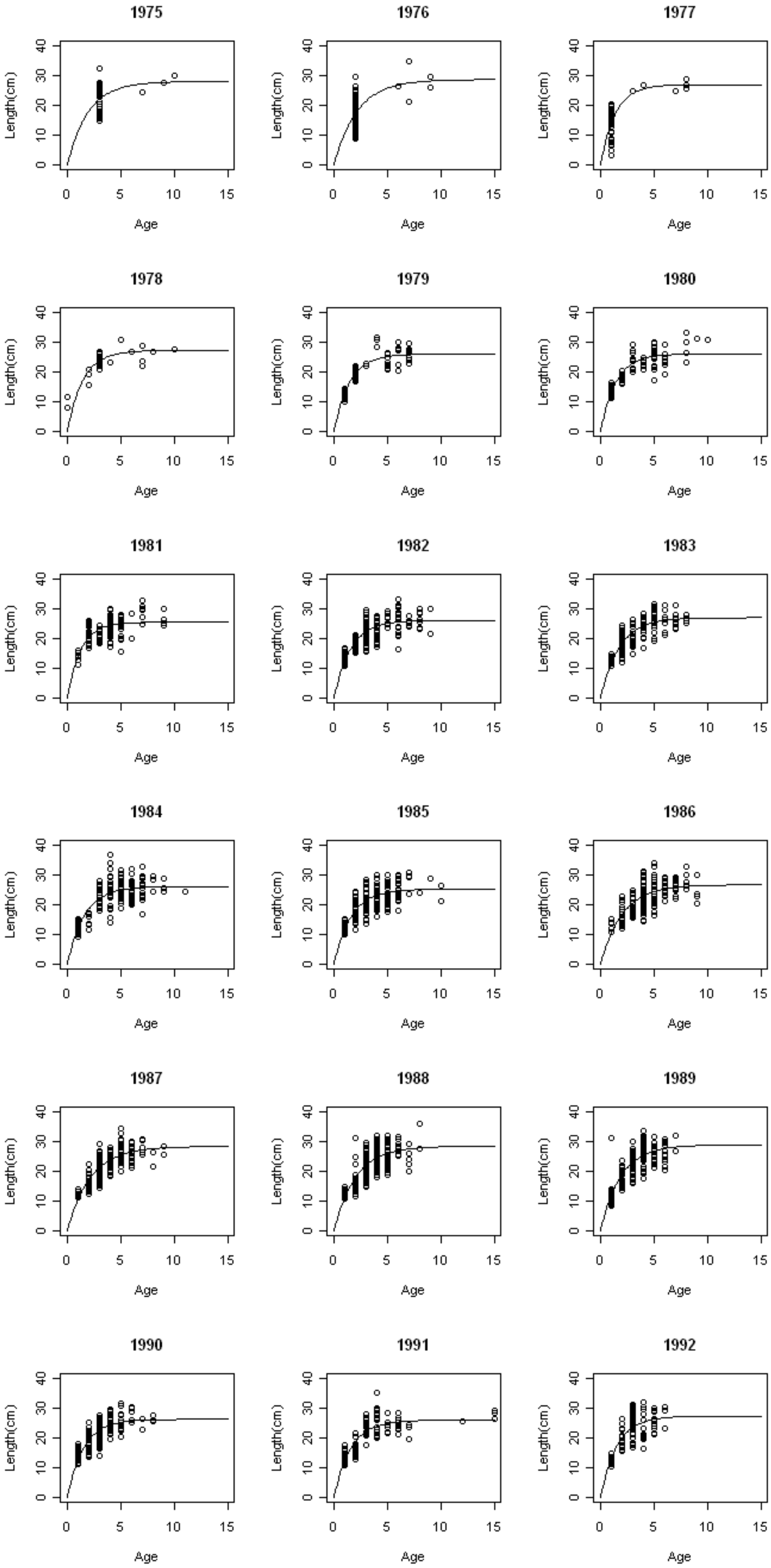

Figure App 4.1.9 – Age-length relationship of female dab for cohorts from 1975-2005 and corresponding von Bertalanffy growth curve. Based on survey data.

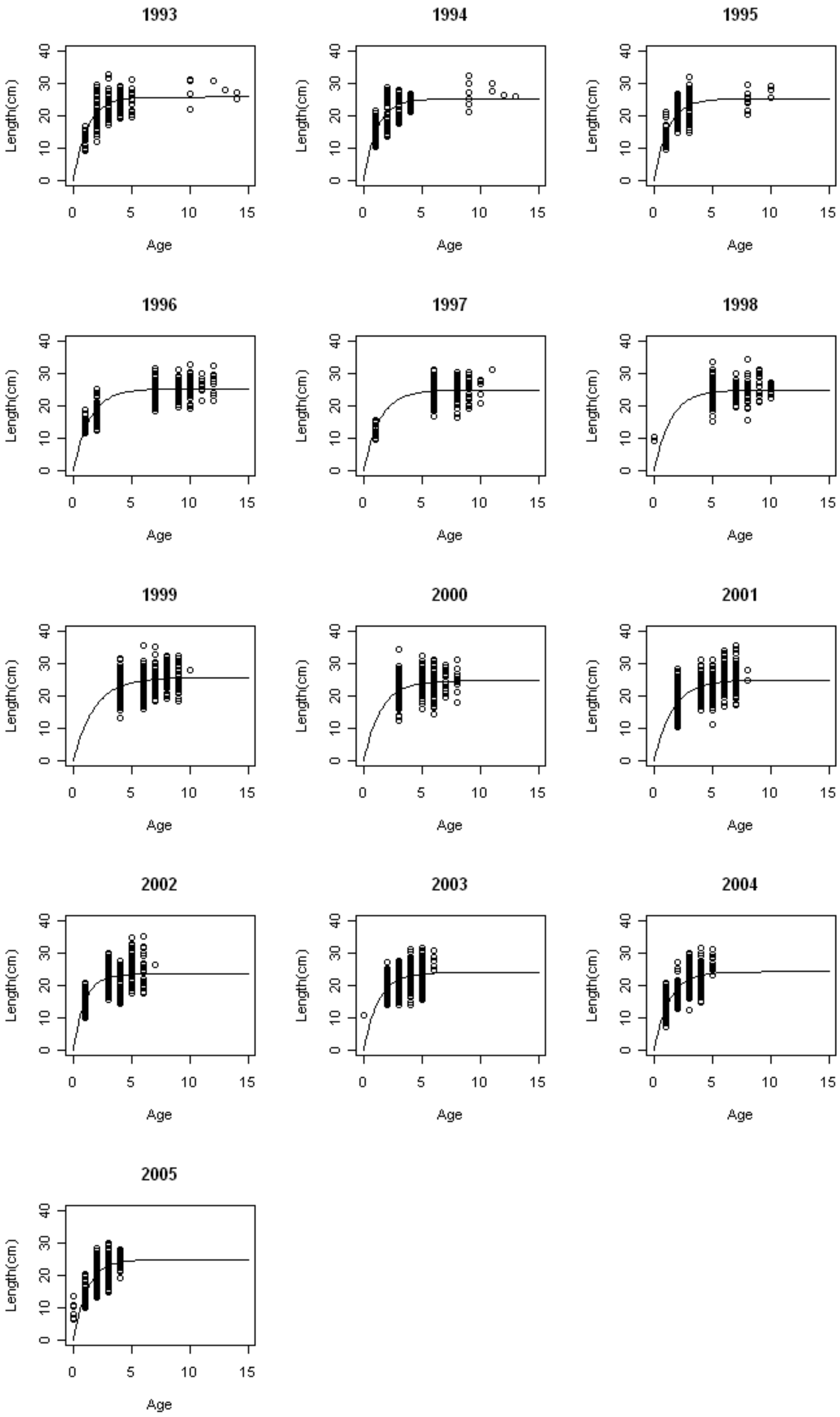

Figure App 4.1.9 – Continued

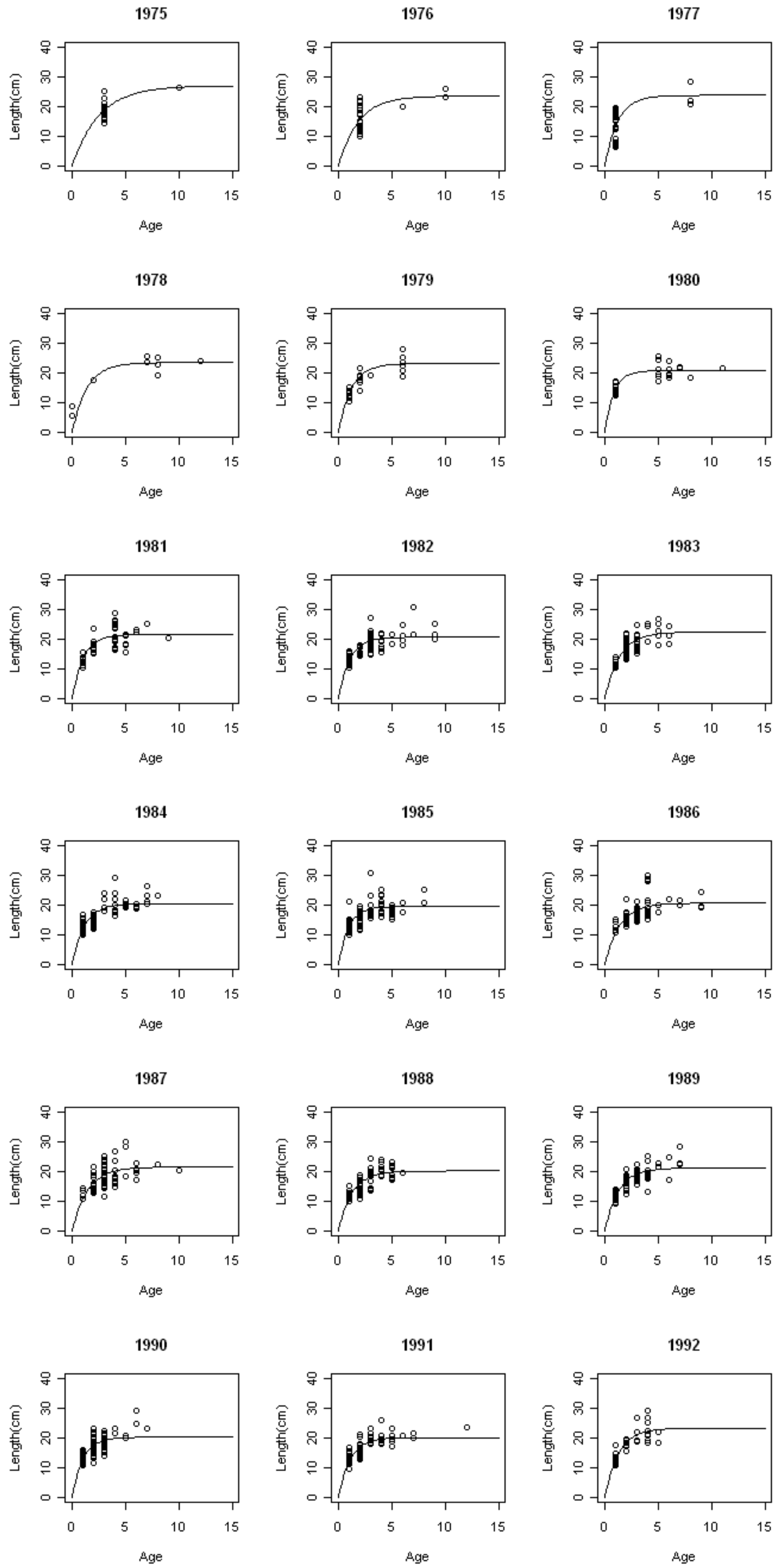

Figure App 4.1.10 – Age-length relationship of male dab for cohorts from 1975-2005 and corresponding von Bertalanffy growth curve. Based on survey data.

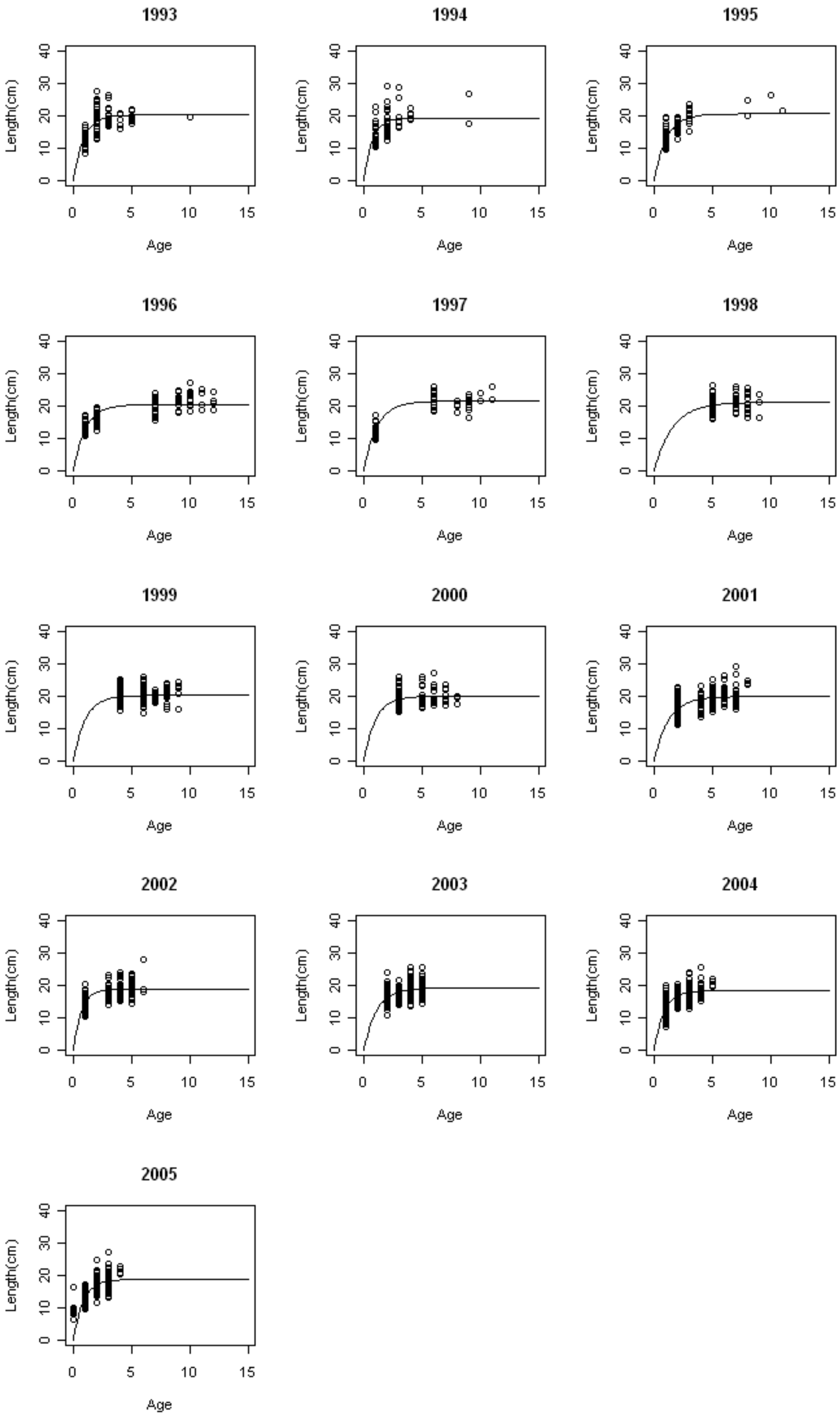

Figure App 4.1.10 – Continued.

Turbot

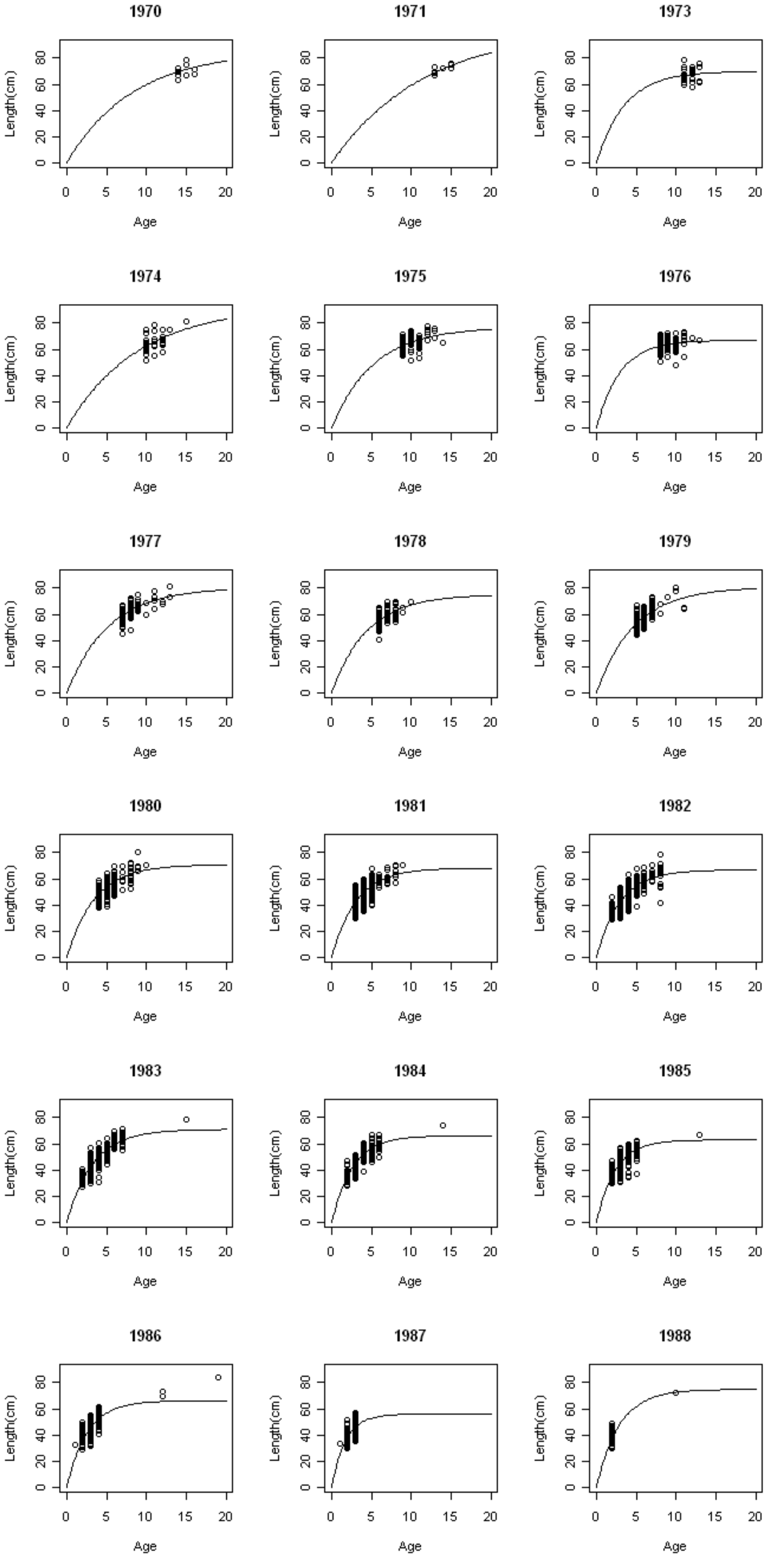

Figure App 4.1.11 – Age-length relationship of female turbot for cohorts from 1970-1971, 1973-1989, 1991-1992, 1994-1996, 1998-2005 and corresponding von Bertalanffy growth curve. Based on market data.

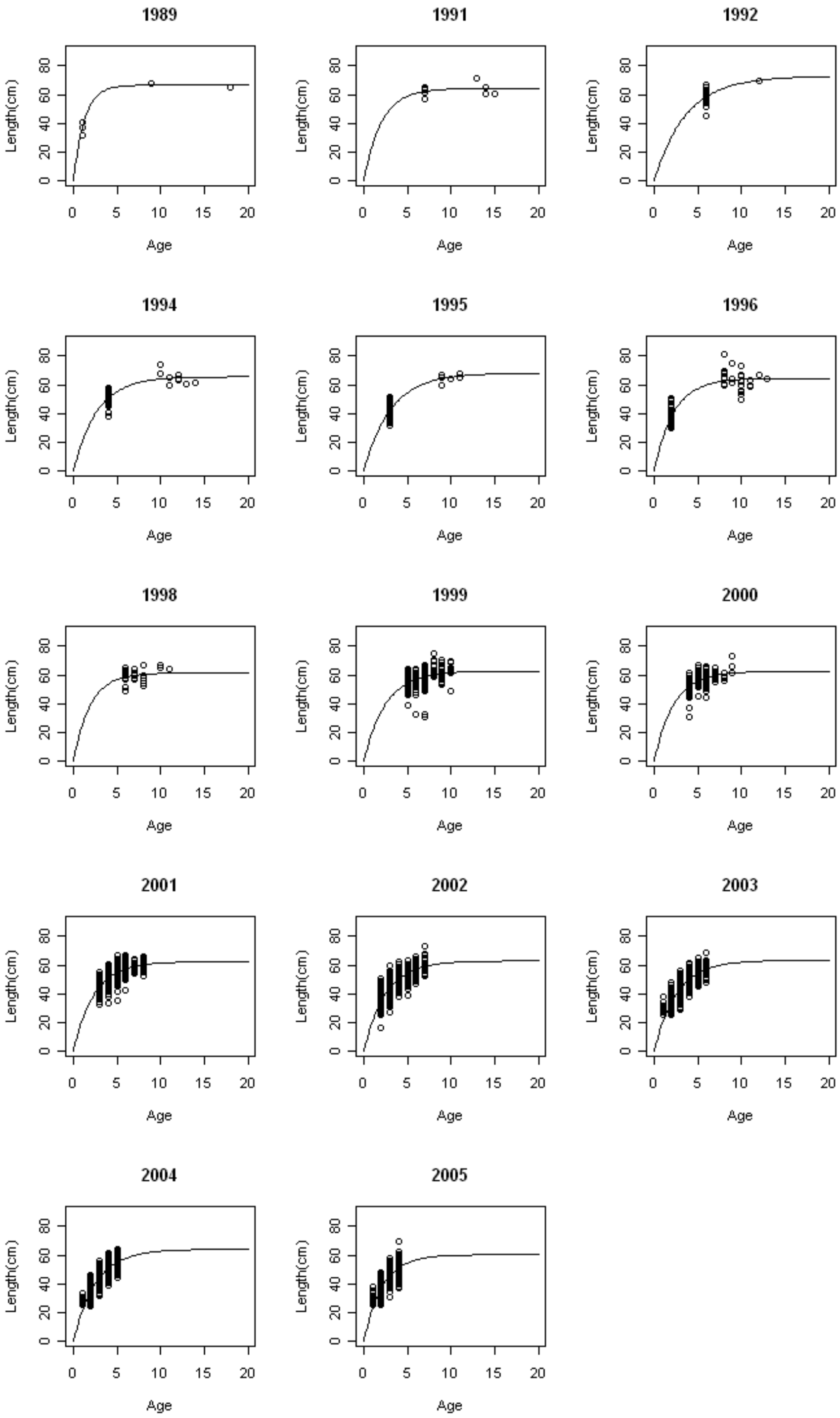

Figure App 4.1.11 – Continued.

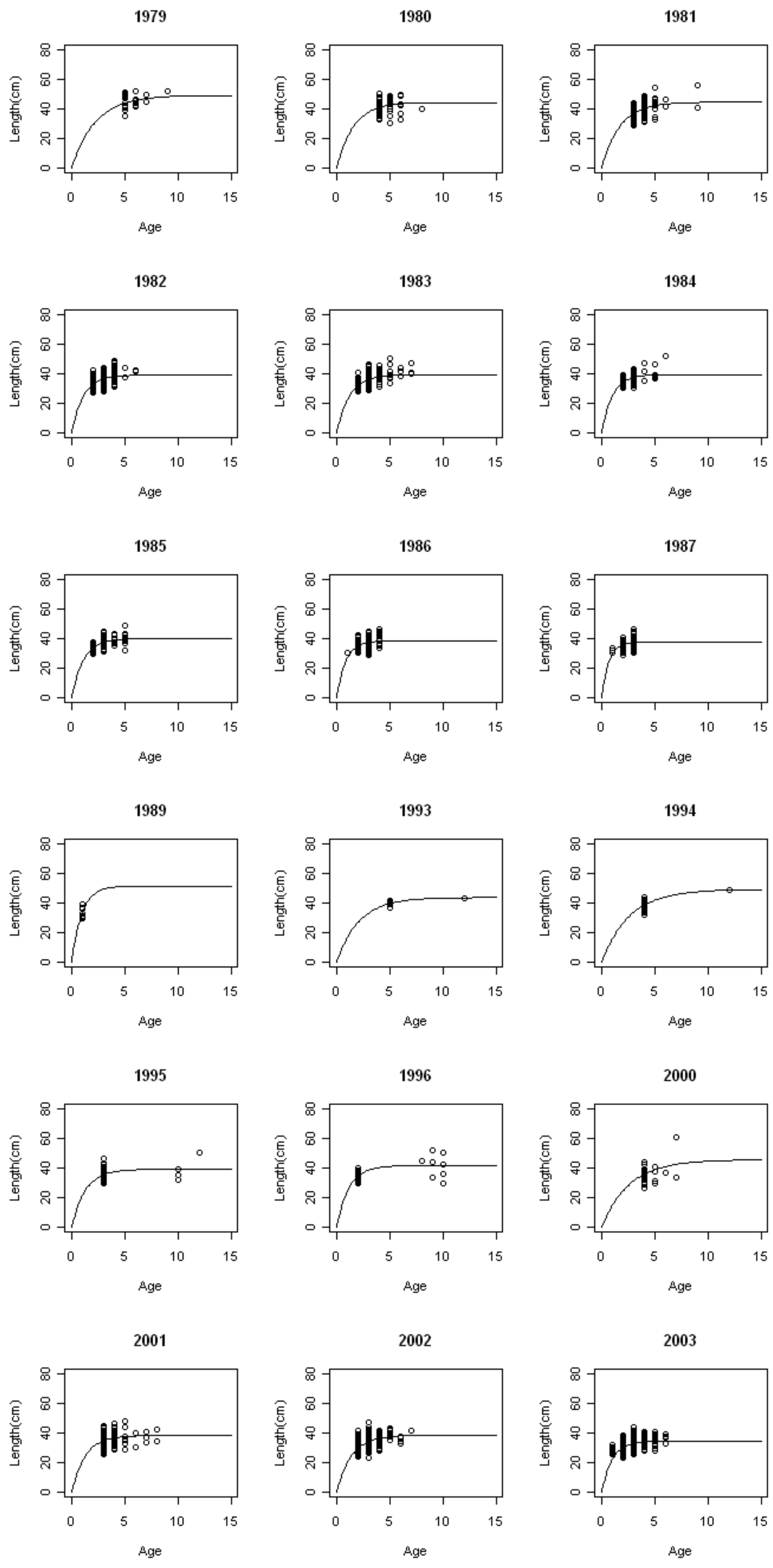

Figure App 4.1.12 – Age-length relationship of male turbot for cohorts from 1979-1987, 1989, 1993-1996, 2000-2005 and corresponding von Bertalanffy growth curve. Based on market data.

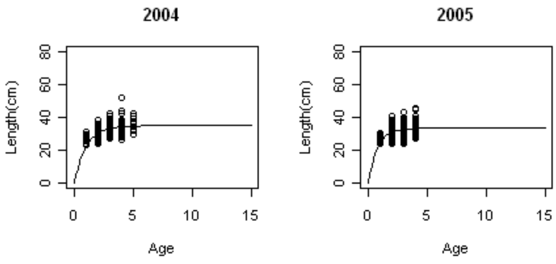

Figure App 4.1.12 – Continued.

Seabass

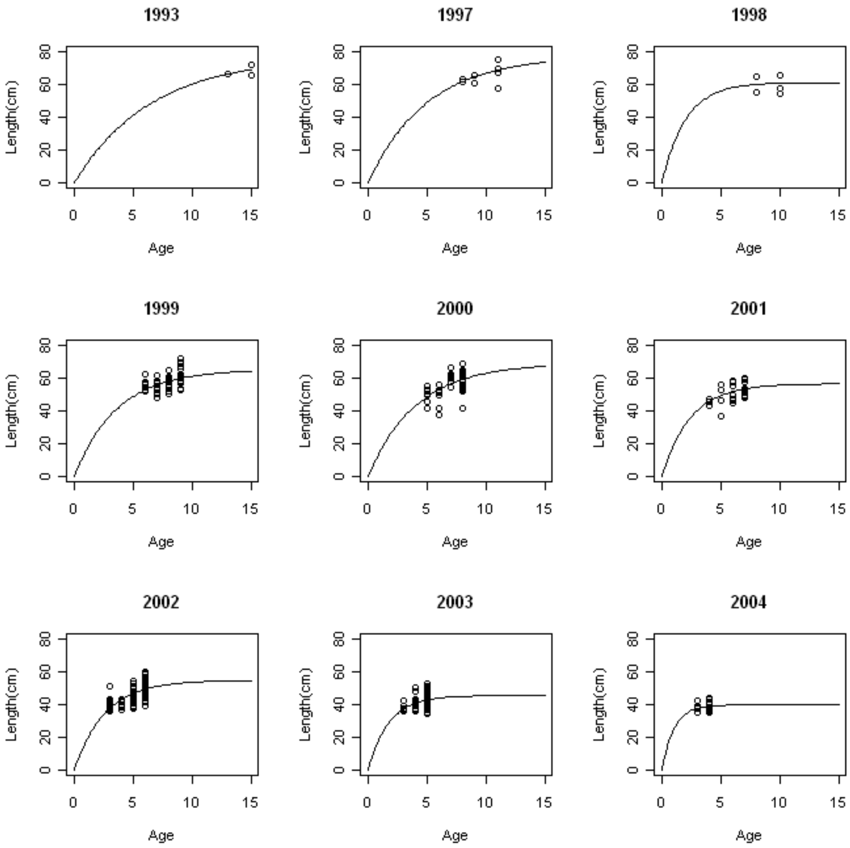

Figure App 4.1.13 – Age-length relationship of sea bass cohorts for 1993, 1997-2004 and corresponding von Bertalanffy growth curve. Based on market data.

Appendix 4.2

Table App4.2.1 German BTS length-at-age data for Dab, ICES division IVb.
-9 = no age data available.

Year	Sex	Age	N	Length
1999	F	1	43	11.2907
1999	F	2	99	14.5606
1999	F	3	85	17.7471
1999	F	4	73	21.5685
1999	F	5	39	23.4231
1999	F	6	5	27.1
1999	F	7	2	29.5
1999	M	1	54	11.1481
1999	M	2	112	14.6607
1999	M	3	64	17.7344
1999	M	4	38	20.3947
1999	M	5	12	20.6667
1999	M	6	1	25.5
1999	M	7	1	29.5
1999	M	8	1	29.5
2000	F	1	17	11.4412
2000	F	2	24	14.8333
2000	F	3	30	17.5
2000	F	4	15	20.6333
2000	F	5	16	21.75
2000	F	6	6	25
2000	F	7	3	25.8333
2000	F	8	1	28.5
2000	M	1	20	11.65
2000	M	2	18	14.2222
2000	M	3	25	16.7
2000	M	4	12	19.1667
2000	M	5	8	20.5
2000	M	6	1	23.5
2001	F	1	66	11.9697
2001	F	2	72	15.25
2001	F	3	127	17.8701
2001	F	4	110	21.2455
2001	F	5	52	23.3077
2001	F	6	35	24.0429
2001	F	7	13	26.4231
2001	F	8	2	28
2001	M	1	98	11.449
2001	M	2	82	14.9268
2001	M	3	85	17.2176
2001	M	4	74	19.6622
2001	M	5	29	21.6034
2001	M	6	7	22.5

2001	M	7	1	21.5
2002	F	1	61	10.9098
2002	F	2	102	14.9902
2002	F	3	86	18.1744
2002	F	4	92	20.3043
2002	F	5	43	23.686
2002	F	6	24	25.0417
2002	F	7	14	27.2143
2002	F	8	2	28.5
2002	F	9	3	30.1667
2002	M	1	83	11.0904
2002	M	2	99	14.8636
2002	M	3	72	17.7778
2002	M	4	61	19.8443
2002	M	5	19	22.5
2002	M	6	6	24.1667
2003	F	0	22	8.8636
2003	F	1	97	12.0979
2003	F	2	88	15.6364
2003	F	3	122	19.0656
2003	F	4	55	22.5364
2003	F	5	20	24.35
2003	F	6	8	28.25
2003	M	0	31	8.8226
2003	M	1	96	12.0833
2003	M	2	104	15.4712
2003	M	3	83	18.5241
2003	M	4	36	20.8333
2003	M	5	6	24.3333
2003	M	7	1	32.5
2004	F	-9	39	14.2564
2004	F	0	45	8.4778
2004	F	1	163	10.6748
2004	F	2	327	13.3379
2004	F	3	198	18.1818
2004	F	4	119	21.2437
2004	F	5	57	21.886
2004	F	6	21	18.5714
2004	F	7	6	28
2004	M	-9	29	18.8448
2004	M	0	84	9.1548
2004	M	1	185	12.8351
2004	M	2	284	15.9718
2004	M	3	164	19.8293
2004	M	4	94	20.5638
2004	M	5	42	21.7857
2004	M	6	2	20
2007	F	-9	19	21.5526
2007	F	0	1	8.5
2007	F	1	124	13.5081

2007	F	2	73	16.2945
2007	F	3	110	18.9727
2007	F	4	88	21.2386
2007	F	5	87	22.0747
2007	F	6	42	23.9524
2007	F	7	20	23.7
2007	F	8	9	24.0556
2007	F	9	1	31.5
2007	F	10	1	27.5
2007	F	11	1	30.5
2007	M	-9	20	18.95
2007	M	0	4	8.5
2007	M	1	121	13.0455
2007	M	2	83	15.6928
2007	M	3	73	18.2534
2007	M	4	47	19.0319
2007	M	5	41	19.8902
2007	M	6	20	21.4
2007	M	7	9	22.2778
2007	M	8	5	21.3
2007	M	9	2	22
2008	F	-9	31	21.6935
2008	F	0	1	7.5
2008	F	1	128	12.6719
2008	F	2	147	17.5544
2008	F	3	85	20.5353
2008	F	4	67	22.6045
2008	F	5	48	22.9375
2008	F	6	36	23.4444
2008	F	7	9	24.8333
2008	F	8	3	29.1667
2008	F	9	2	29
2008	M	-9	37	20.1486
2008	M	0	3	9.1667
2008	M	1	142	12.669
2008	M	2	130	16.3231
2008	M	3	72	19.0694
2008	M	4	36	20.2222
2008	M	5	20	21.3
2008	M	6	20	21.55
2008	M	7	9	22.7222
2008	M	8	2	21

Table App4.2.2 UK BTS length-at-age data for Dab, ICES division VIId and IVc.
-9 = no age data available.

Year	Sex	Age	N	Length
1990	F	0	4	7.5
1990	F	1	6	15.6667
1990	F	2	6	22
1990	F	3	2	27
1990	F	4	2	23.5
1990	F	5	4	33.5
1990	M	0	3	8
1990	M	1	8	13.625
1990	M	2	3	21.3333
1990	M	3	3	23
1990	M	4	3	23.3333
1991	F	0	5	6
1991	F	1	11	15.5455
1991	F	2	8	20.625
1991	F	3	11	23.7273
1991	F	4	4	24.5
1991	F	5	3	29
1991	M	0	5	6
1991	M	1	10	14.5
1991	M	2	8	20.375
1991	M	3	6	19.6667
1991	M	4	3	21.3333
1992	F	0	4	5.5
1992	F	1	54	15.5556
1992	F	2	27	21.7037
1992	F	3	22	24
1992	F	4	9	24
1992	F	5	7	28
1992	F	6	2	26.5
1992	M	0	5	5
1992	M	1	44	15.5227
1992	M	2	30	20.8667
1992	M	3	15	21.0667
1992	M	4	8	22.875
1992	M	6	1	28
1993	F	-9	1	19.4
1993	F	0	1	7
1993	F	1	53	15.7453
1993	F	2	43	22.2674
1993	F	3	9	21.4444
1993	F	4	9	23.2889
1993	F	5	4	24.375
1993	F	6	3	28.4
1993	F	7	1	29.6
1993	M	0	2	7.2
1993	M	1	36	15.15

1993	M	2	45	21.0689
1993	M	3	20	22.81
1993	M	4	15	22.2267
1993	M	5	4	22.175
1993	M	7	1	21.7
1993	M	8	1	30
1994	F	0	3	6
1994	F	1	64	16.2656
1994	F	2	35	22.2571
1994	F	3	16	24.5625
1994	F	4	2	26
1994	F	6	1	25
1994	F	7	1	38
1994	M	0	2	7
1994	M	1	38	15.5263
1994	M	2	48	19.8542
1994	M	3	19	23.0526
1994	M	4	2	22
1994	M	5	1	21
1994	M	6	1	23
1995	F	1	61	15.9344
1995	F	2	16	22.5625
1995	F	3	12	25.8333
1995	F	4	3	22.6667
1995	F	5	3	27.3333
1995	M	0	3	7
1995	M	1	57	15.2456
1995	M	2	23	19.7391
1995	M	3	20	21.8
1995	M	4	4	23.5
1995	M	5	2	25.5
1995	M	7	2	29
1995	M	8	1	28
1996	F	0	6	9.5
1996	F	1	79	15.3544
1996	F	2	54	22.4074
1996	F	3	14	22.1429
1996	F	4	2	26.5
1996	F	5	1	36
1996	M	0	6	11.3333
1996	M	1	72	14.8472
1996	M	2	66	20.6515
1996	M	3	15	21.7333
1996	M	4	3	25.3333
1998	F	0	5	6
1998	F	1	24	16.25
1998	F	2	50	21.62
1998	F	3	35	24.5714
1998	F	4	7	27.2857
1998	F	5	1	25

1998	M	0	3	6
1998	M	1	35	15.6286
1998	M	2	46	20.413
1998	M	3	38	22.3421
1998	M	4	6	24.3333
1998	M	5	1	28
1999	F	0	3	8.0333
1999	F	1	24	16.6917
1999	F	2	17	21.5706
1999	F	3	19	25.3895
1999	F	5	3	34.3333
1999	M	0	1	8.6
1999	M	1	33	16.2576
1999	M	2	25	18.972
1999	M	3	16	22.7875
1999	M	4	1	23
2001	F	0	2	6.2
2001	M	0	3	5.5333