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.

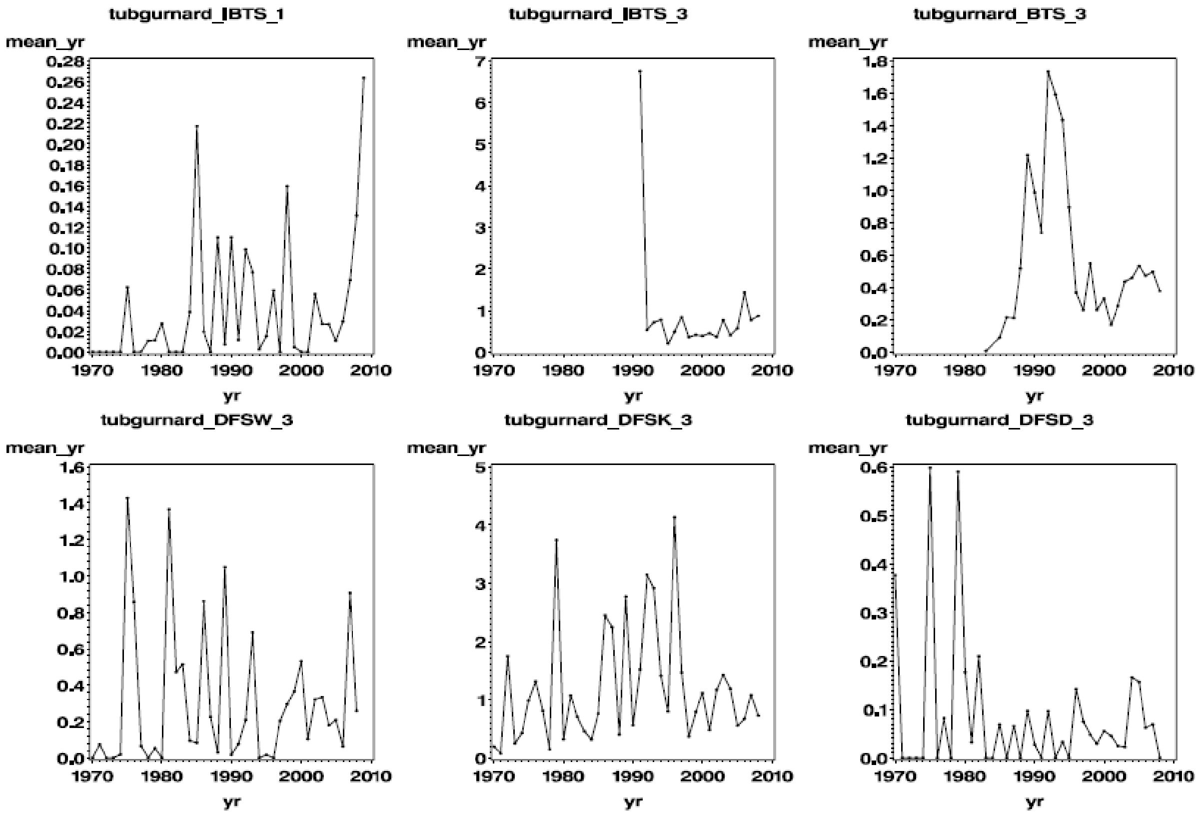


Figure 2.1.1 – Time series of abundance of tub gurnard by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

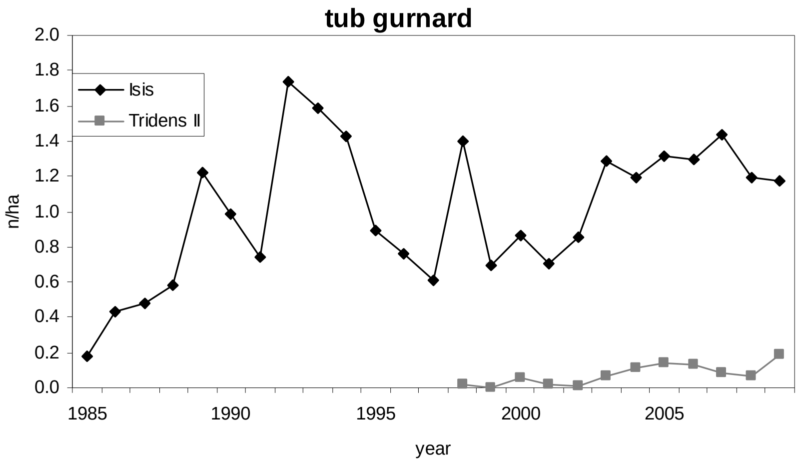


Figure 2.1.2 – Time series of abundance of tub gurnard in the BTS3 survey by vessel.

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.

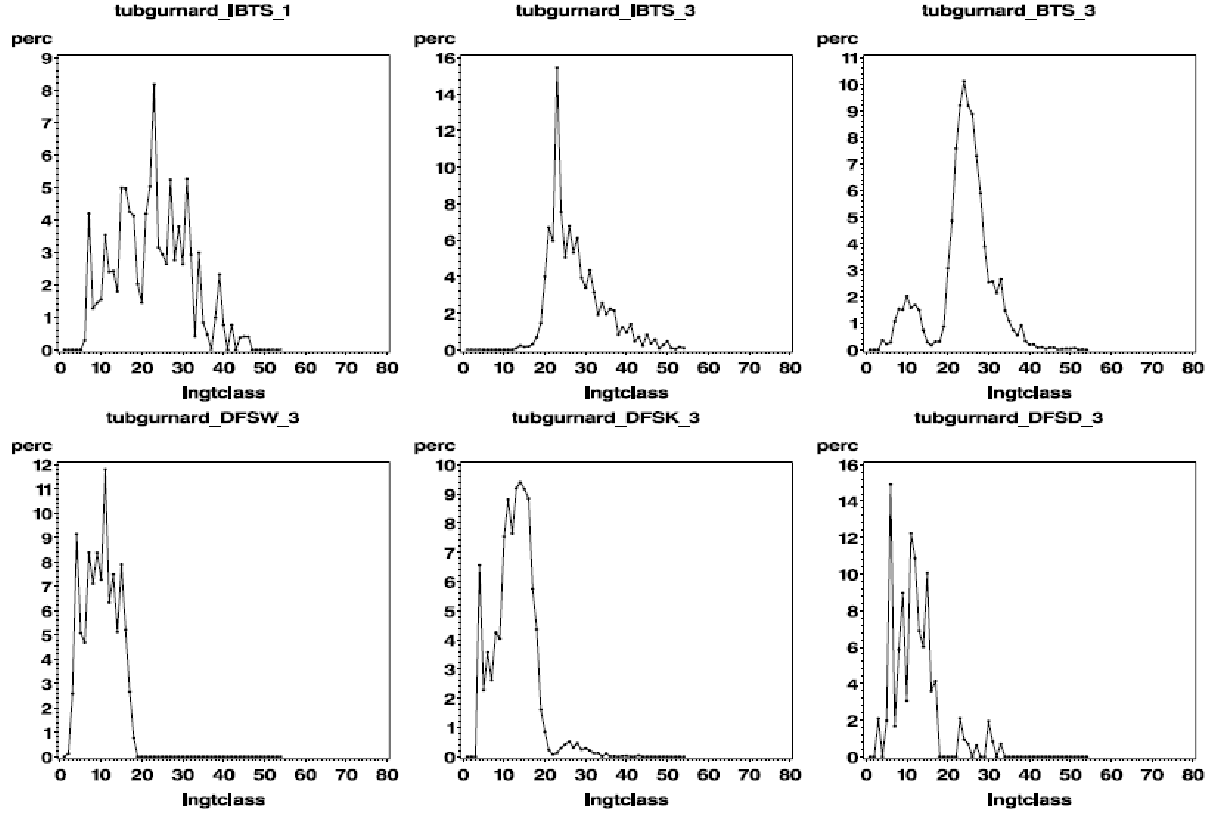


Figure 2.1.3 – Length frequency distribution of tub gurnard by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

<u>Distribution</u> (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.

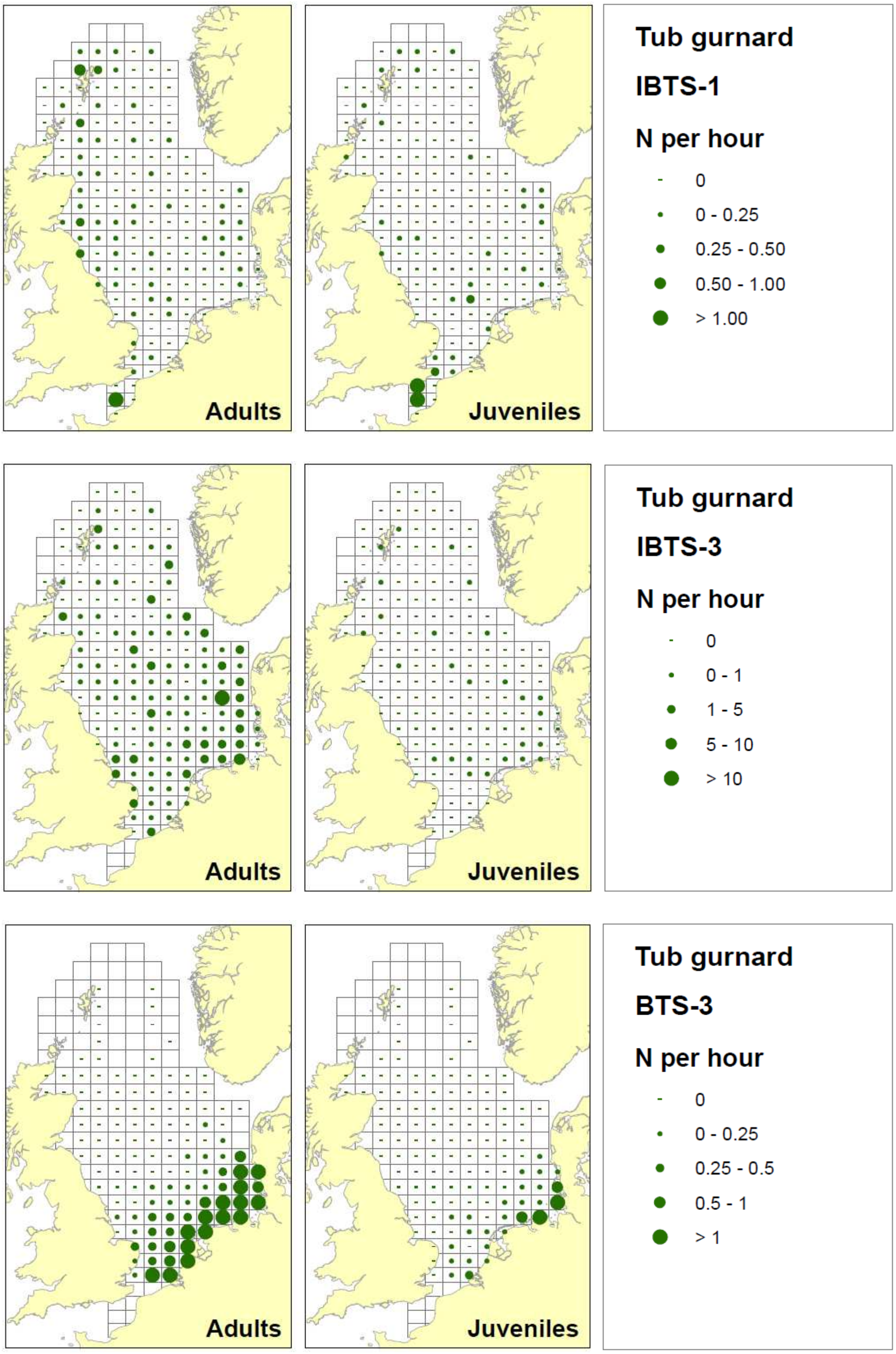


Figure 2.1.4 – Distribution of tub gurnard in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

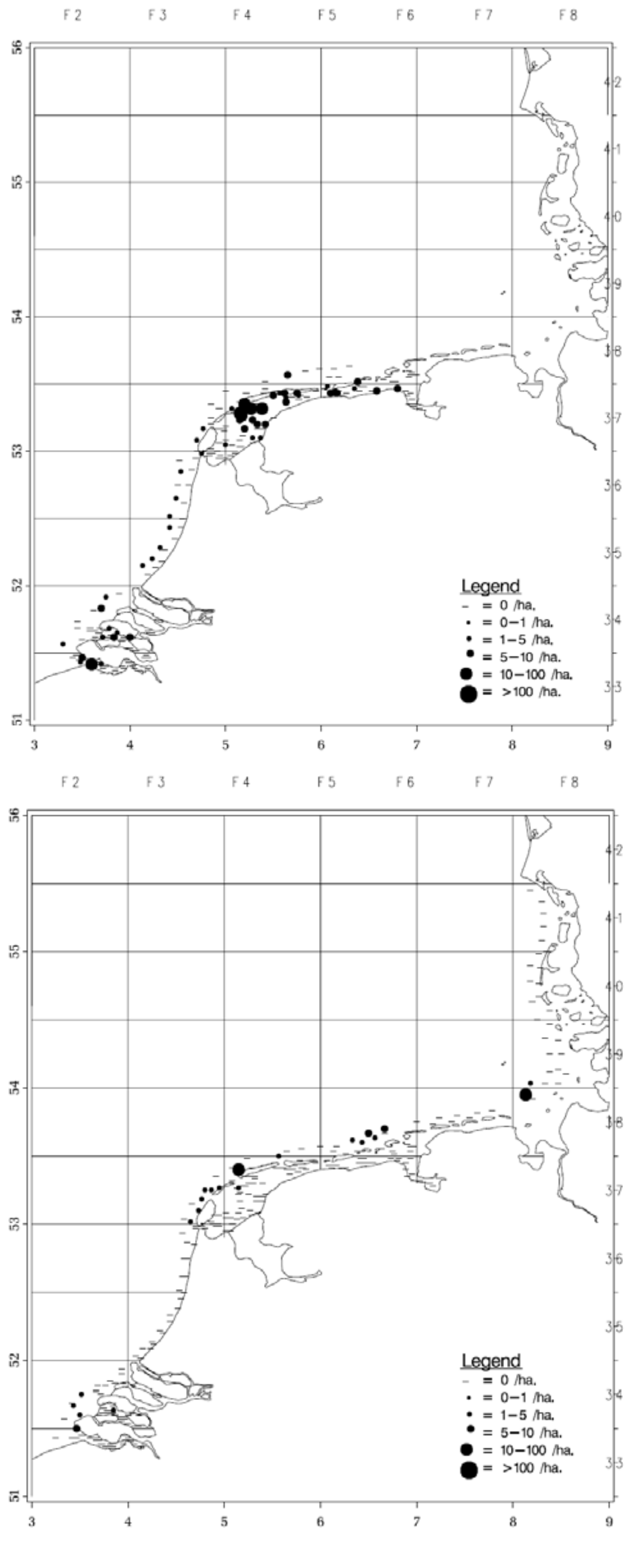


Figure 2.1.5 – Two examples of the distribution of tub gurnard in the DFS survey. Upper panel 1975, lower panel 1990.

2.1.3 Grey gurnard in IV

Time series of abundance (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.

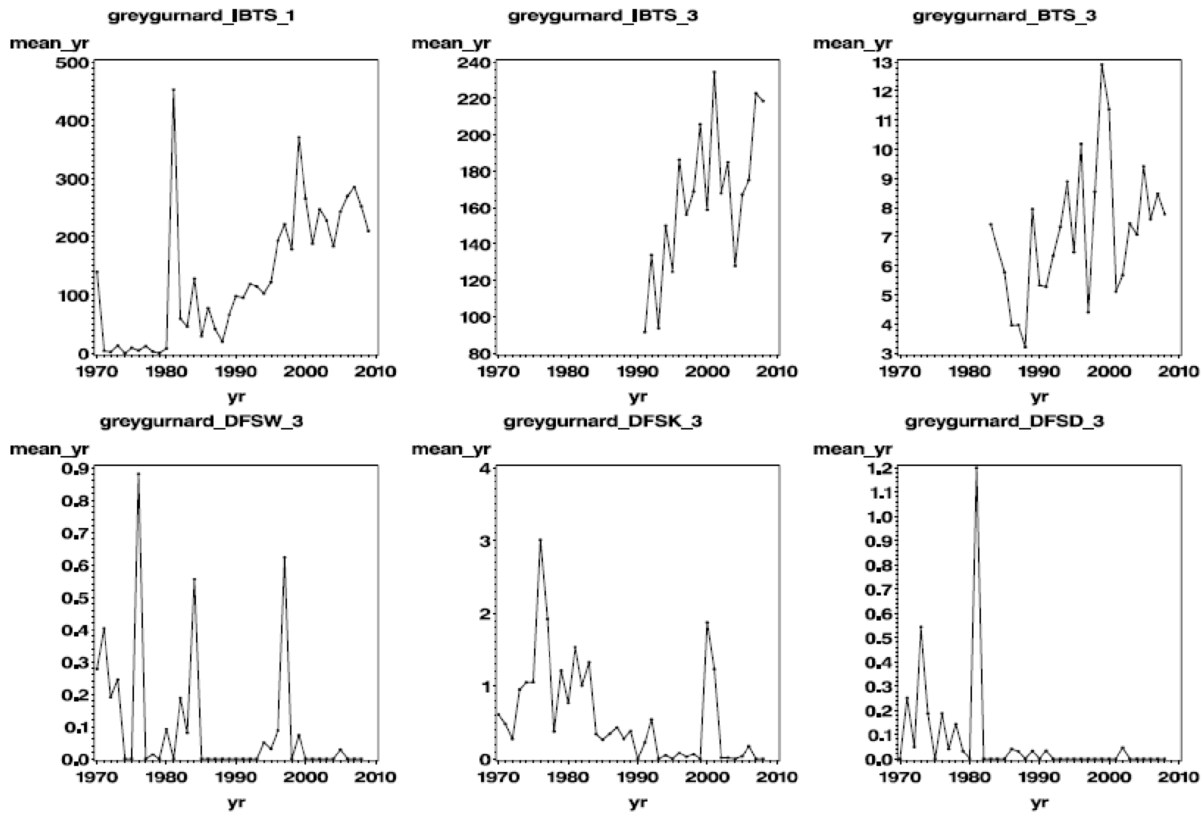


Figure 2.1.6 – Time series of abundance of grey gurnard by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

Length composition (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.

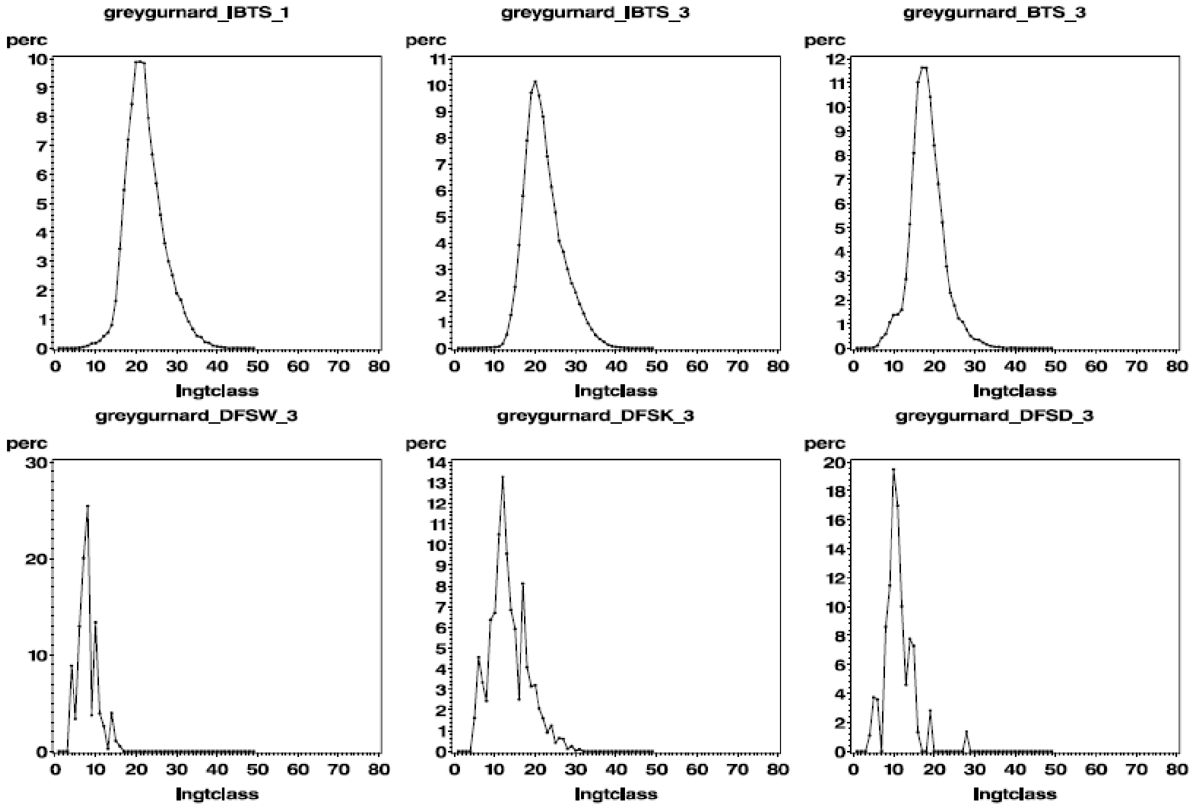


Figure 2.1.7 – Length frequency distribution of grey gurnard by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

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.

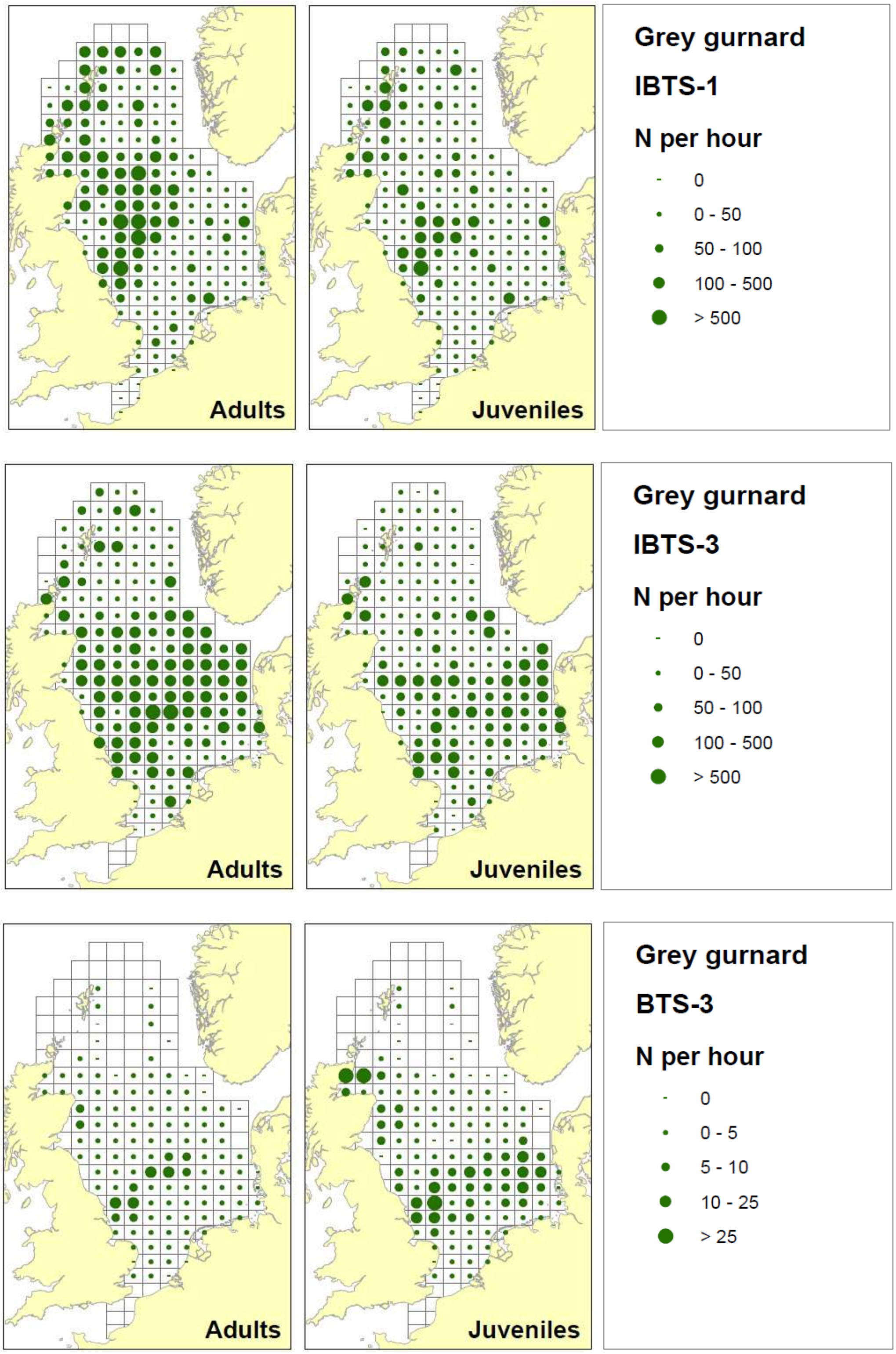


Figure 2.1.8 – Distribution of grey gurnard in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

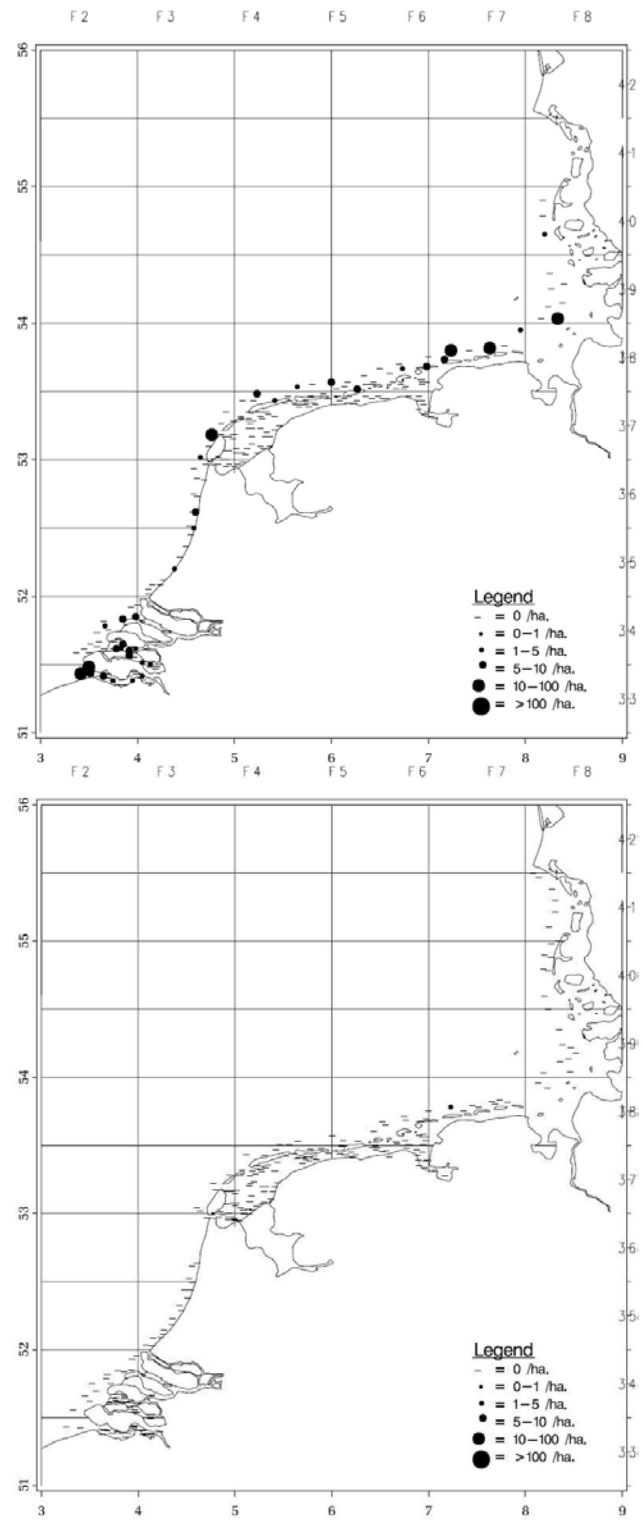


Figure 2.1.9 – Two examples of the distribution of grey gurnard in the DFS survey. Upper panel 1981, lower panel 2004.

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).

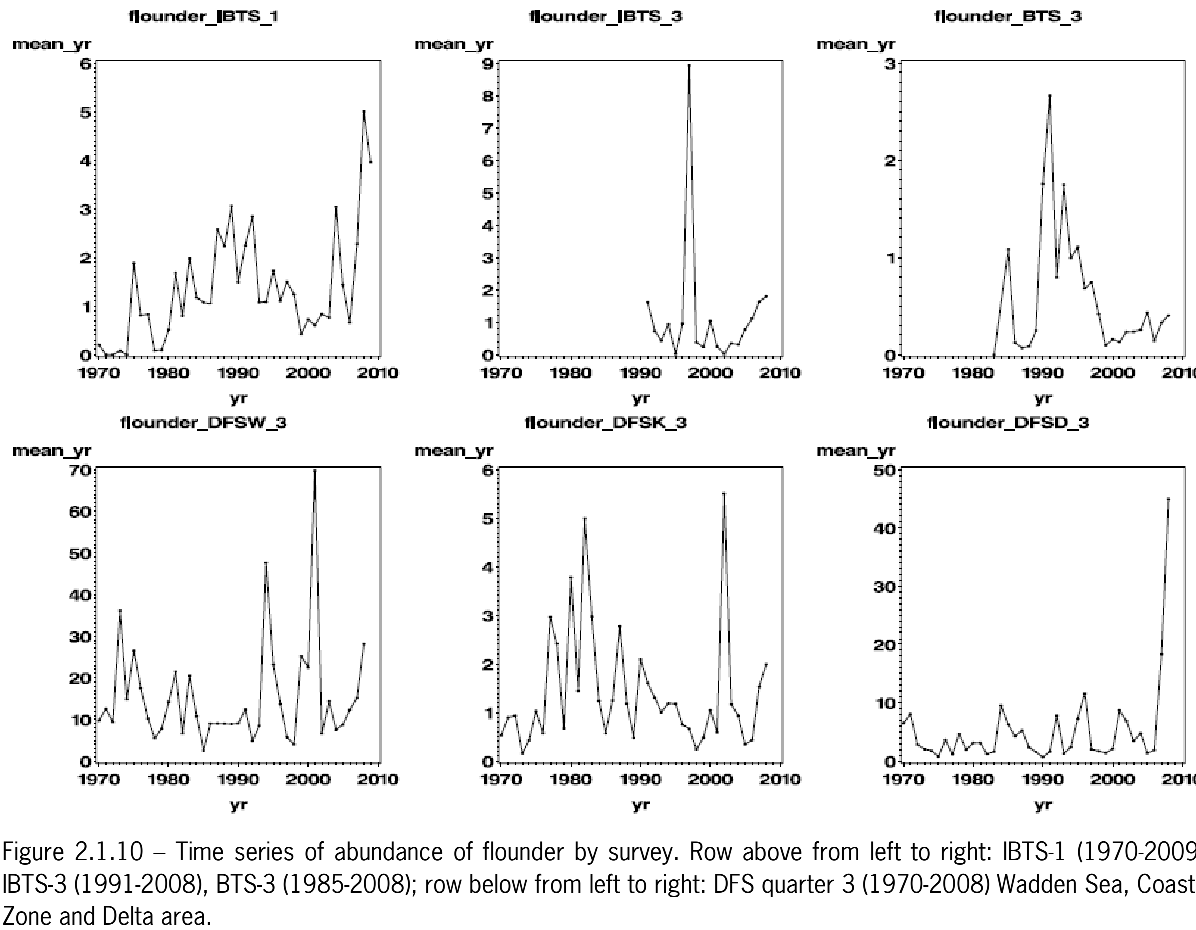


Figure 2.1.10 – Time series of abundance of flounder by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

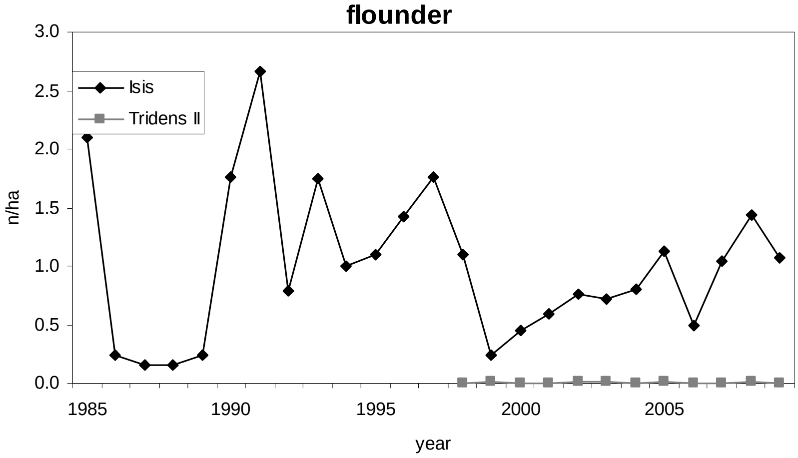


Figure 2.1.11 – Time series of abundance of flounder in the BTS-3 survey by vessel.

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.

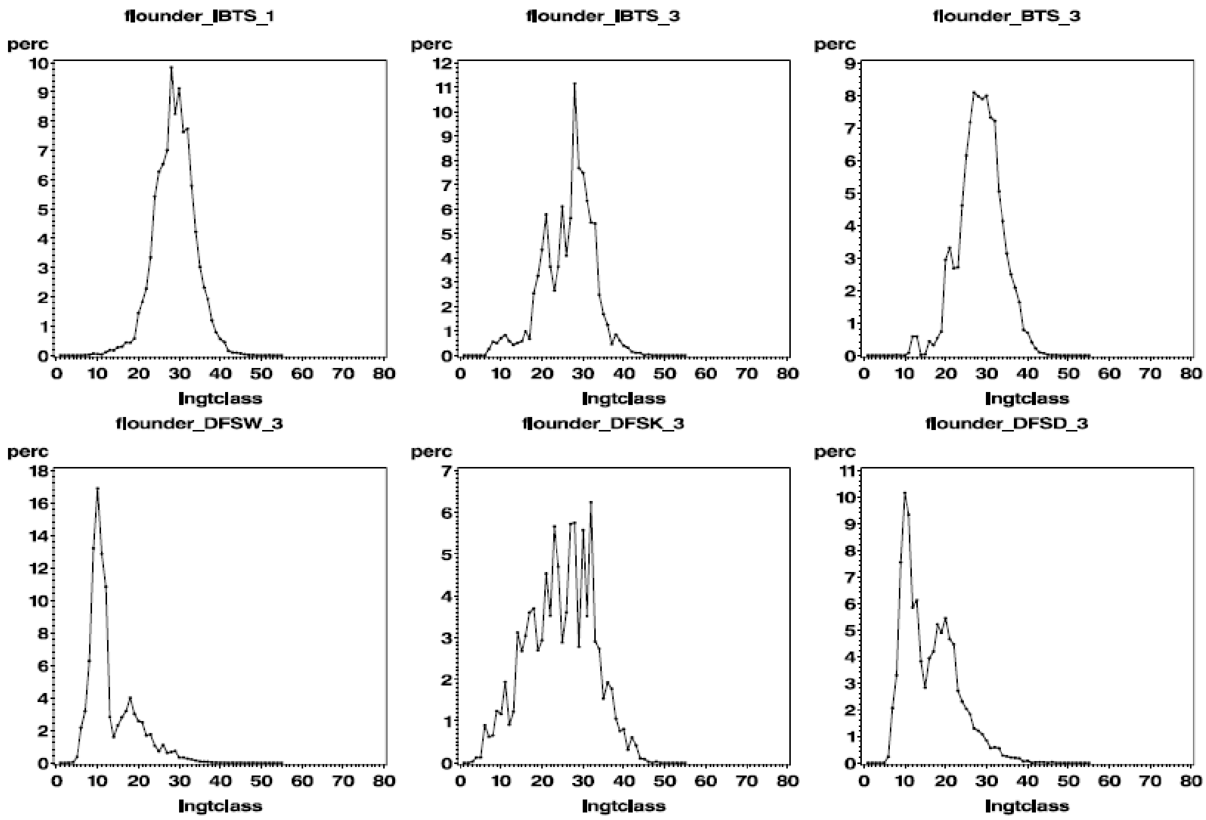


Figure 2.1.12 – Length frequency distribution of flounder by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

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.

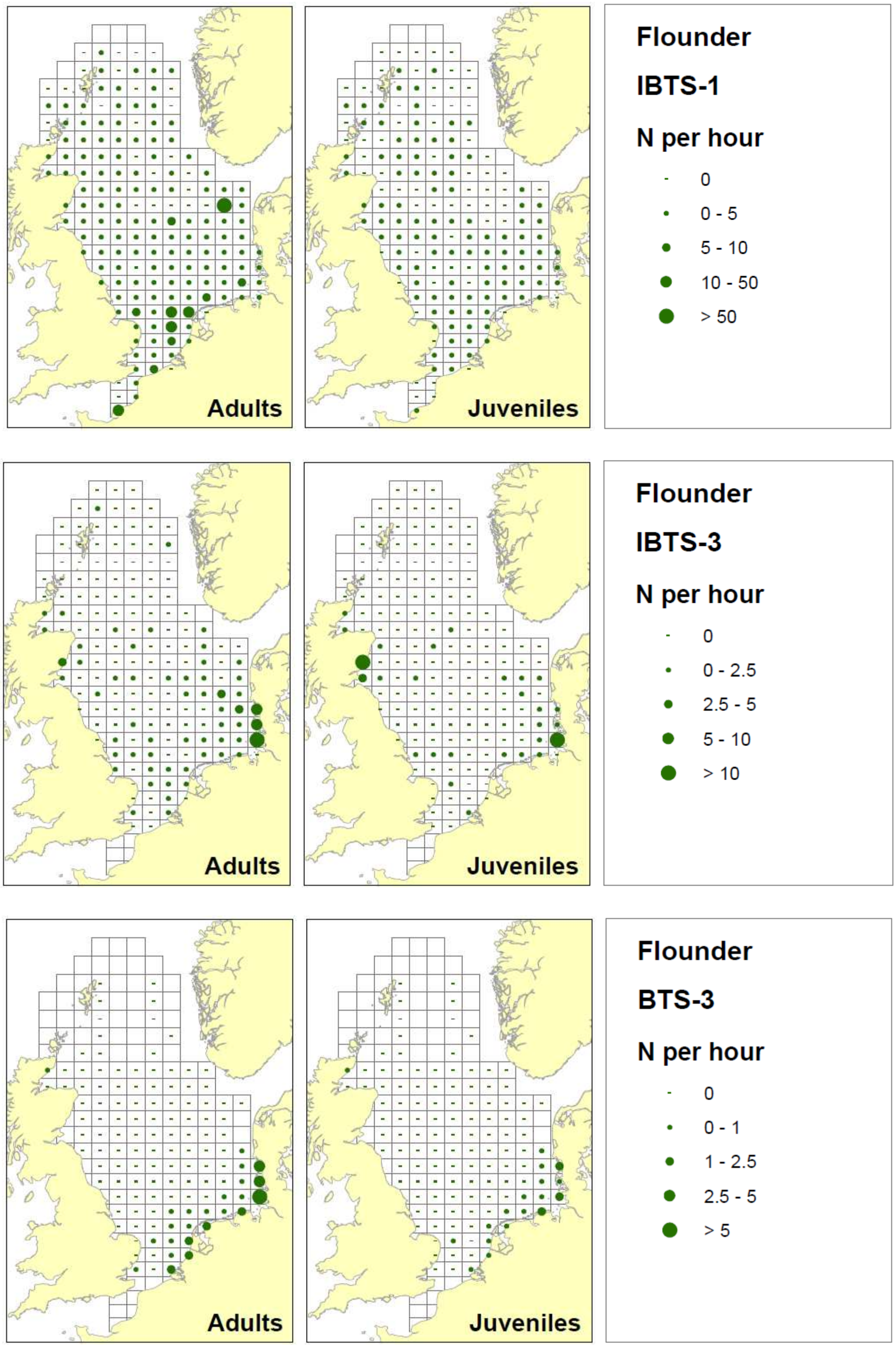


Figure 2.1.13 – Distribution of flounder in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

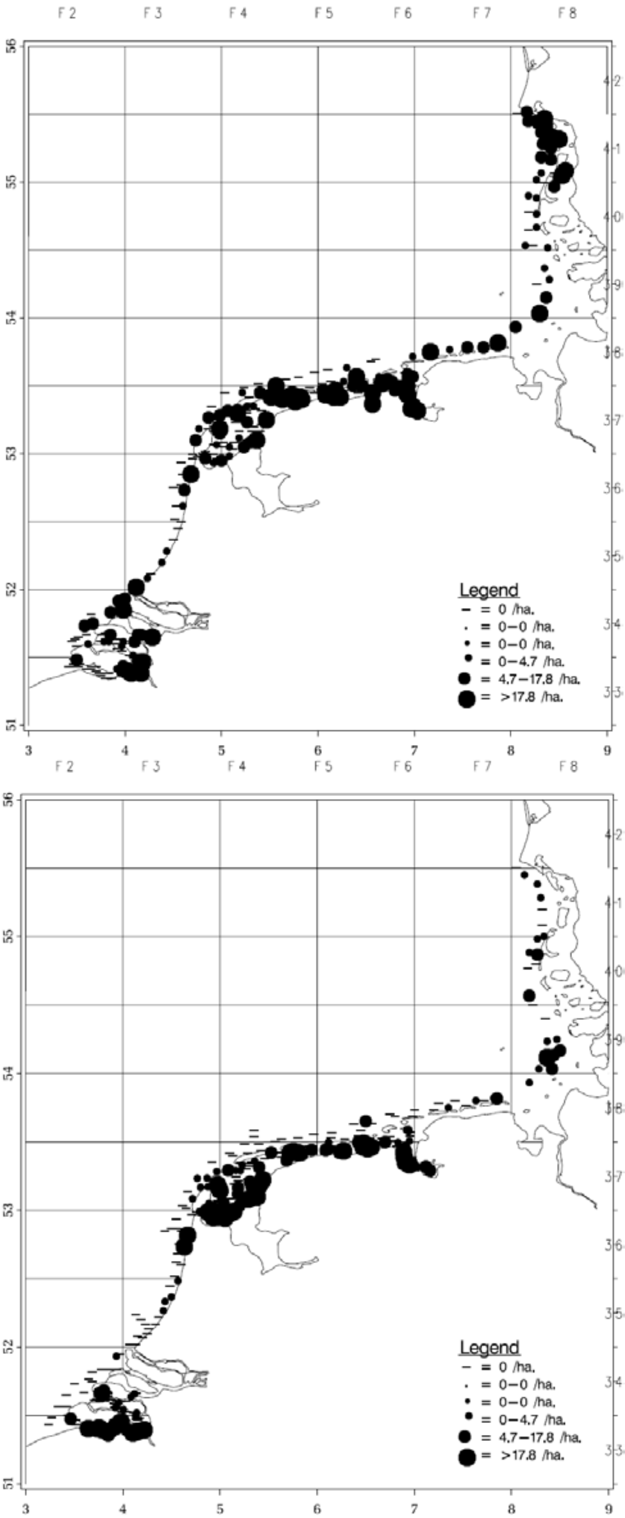


Figure 2.1.14 – Two examples of the distribution of flounder in the DFS survey. Upper panel 1980, lower panel 2007.

2.1.5 Witch flounder in IV

<u>Time series of abundance</u> (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.

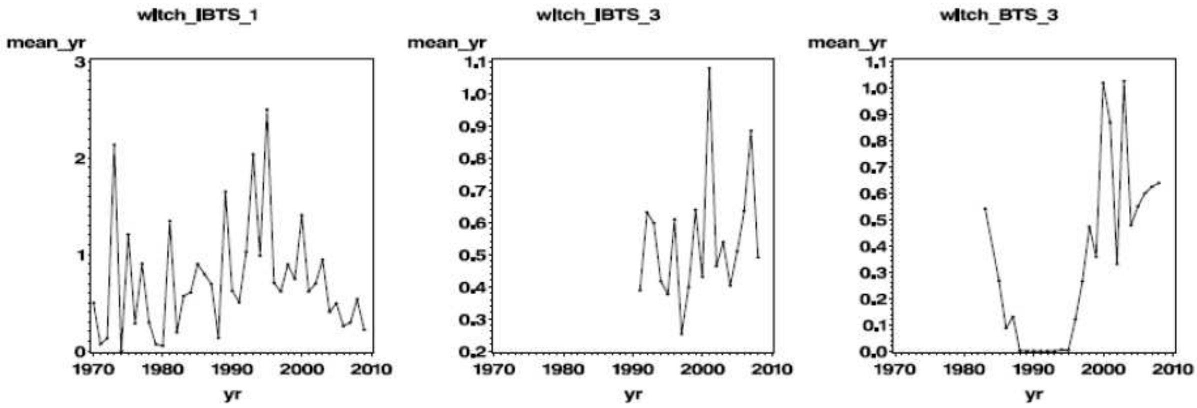


Figure 2.1.15 – Time series of abundance of witch flounder by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

<u>Length composition</u> (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.

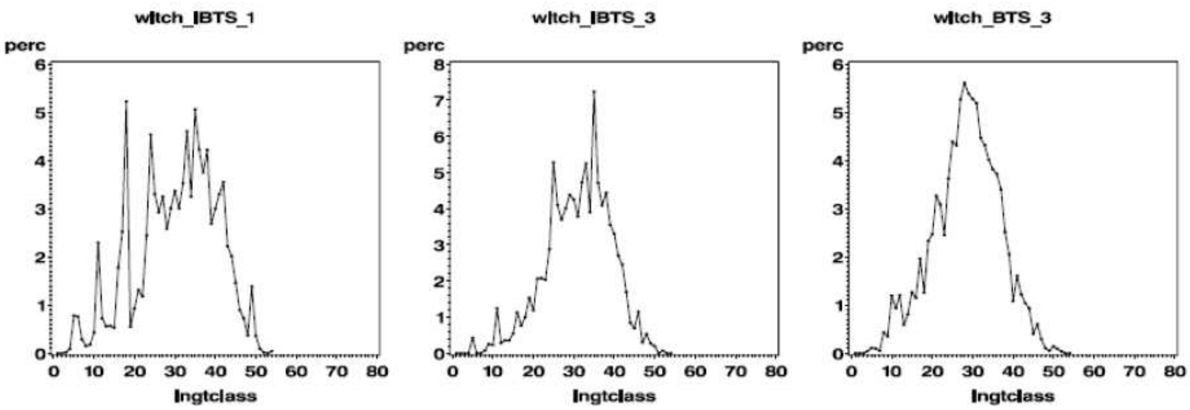


Figure 2.1.16 – Length frequency distribution of witch flounder by survey. From left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008).

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.

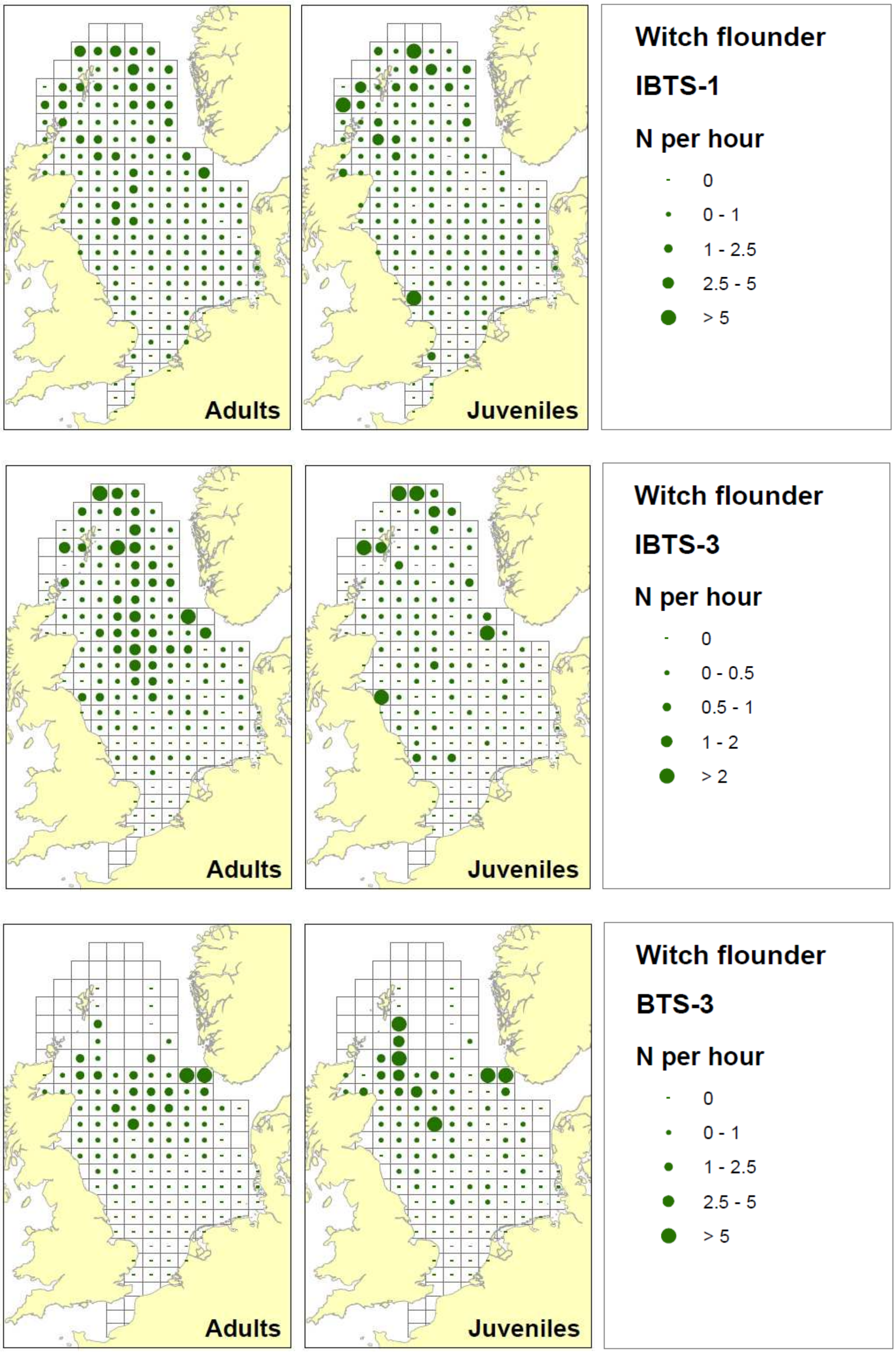


Figure 2.1.17 – Distribution of witch flounder in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

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.

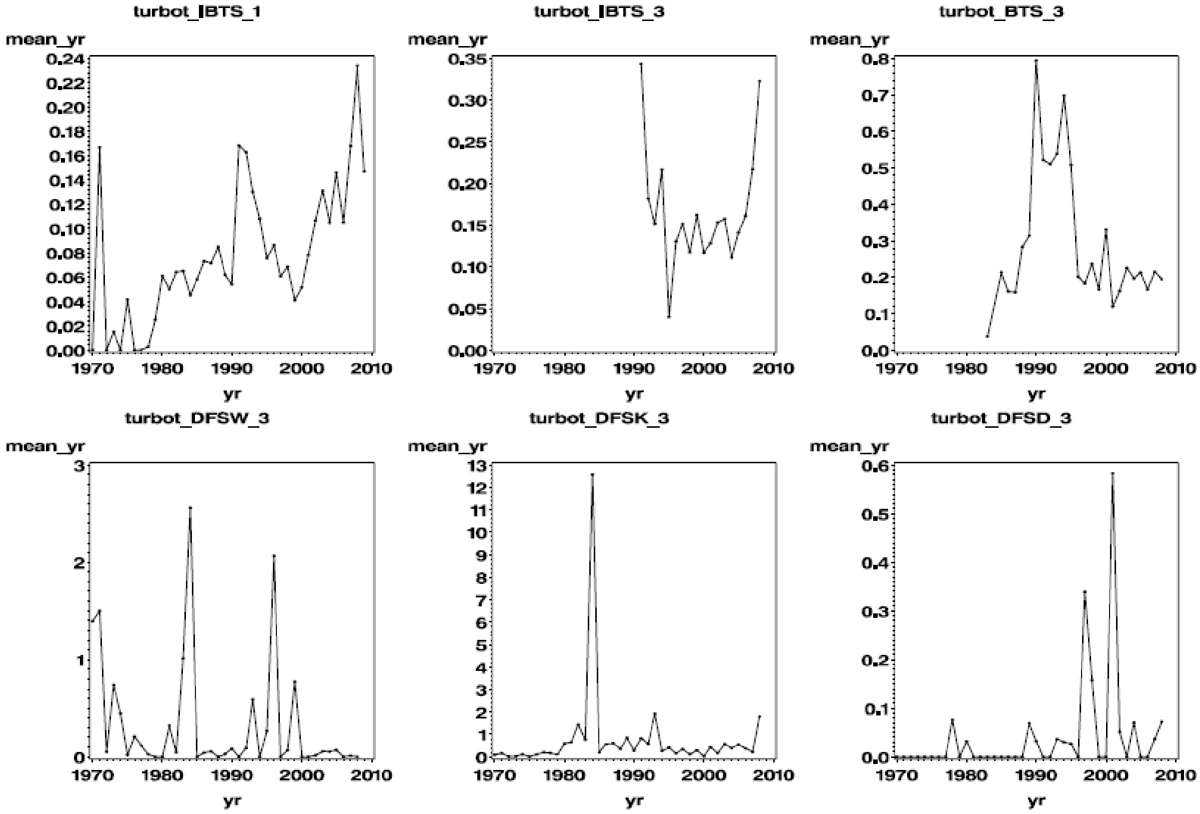


Figure 2.1.18 – Time series of abundance of turbot by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

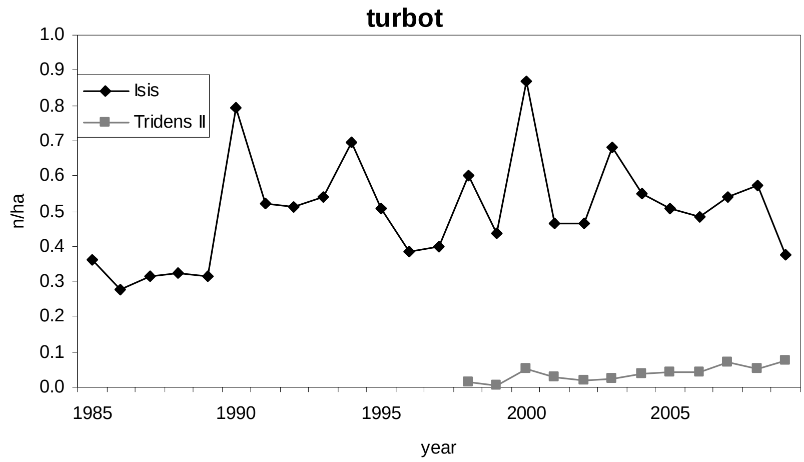


Figure 2.1.19 – Time series of abundance of turbot in the BTS3 survey by vessel

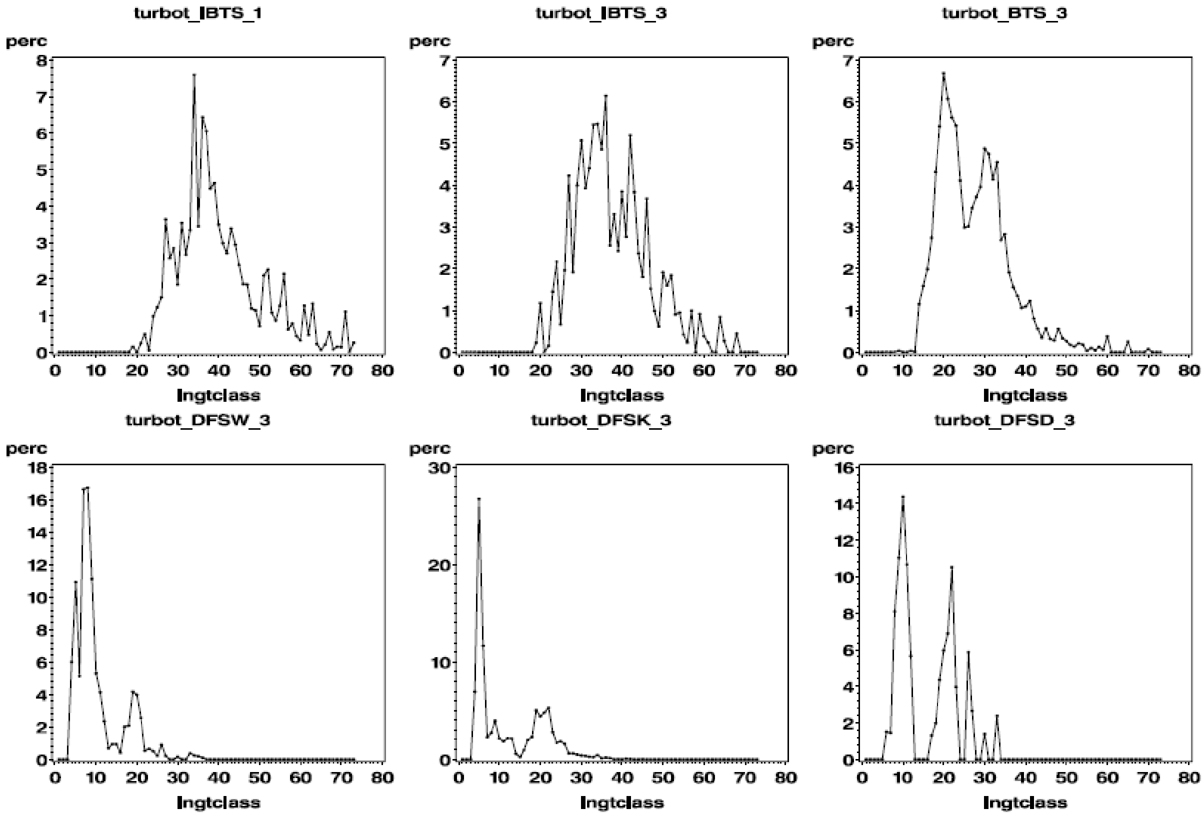


Figure 2.1.20 – Length frequency distribution of turbot by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

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.

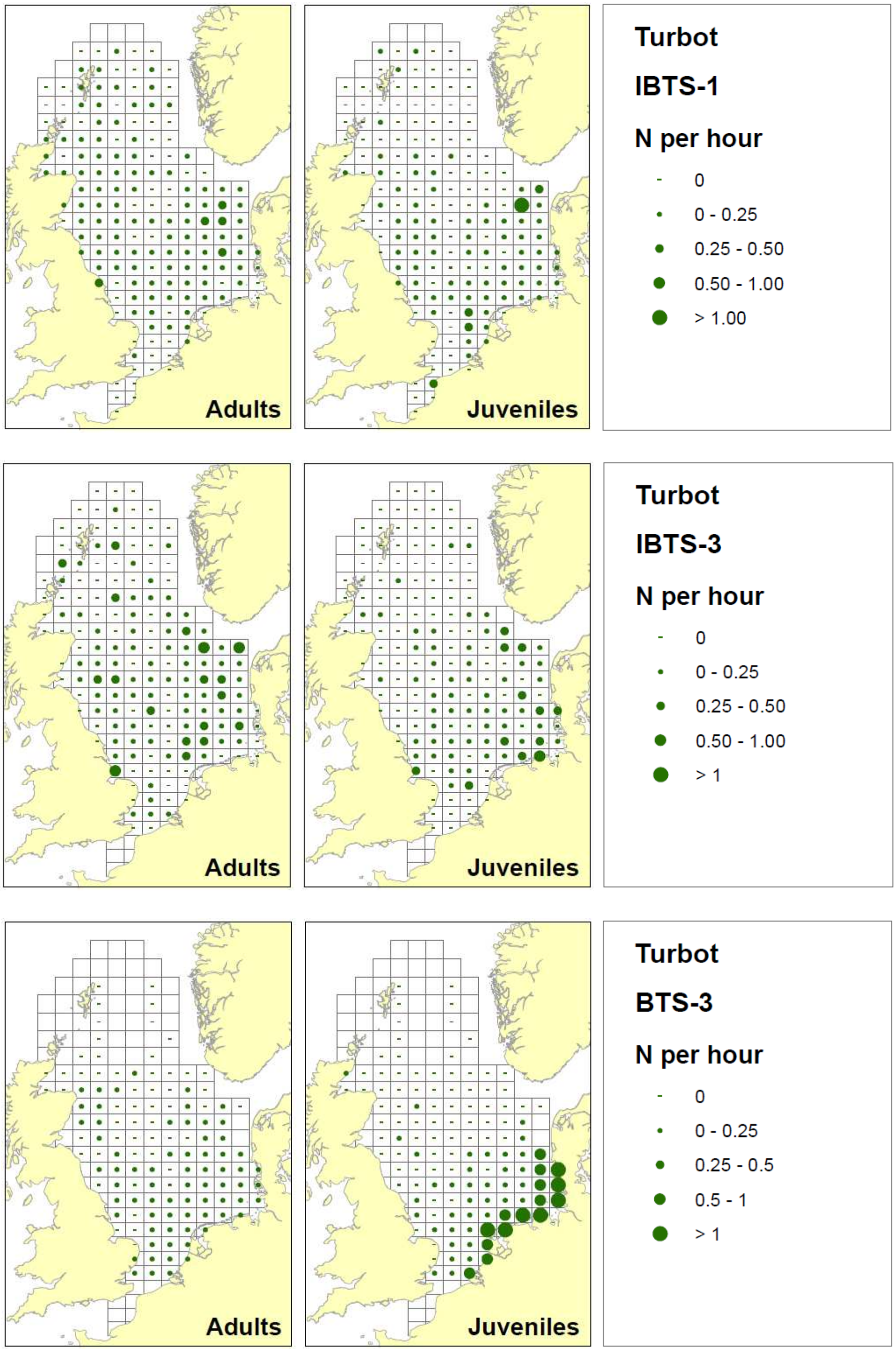


Figure 2.1.21 – Distribution of turbot in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

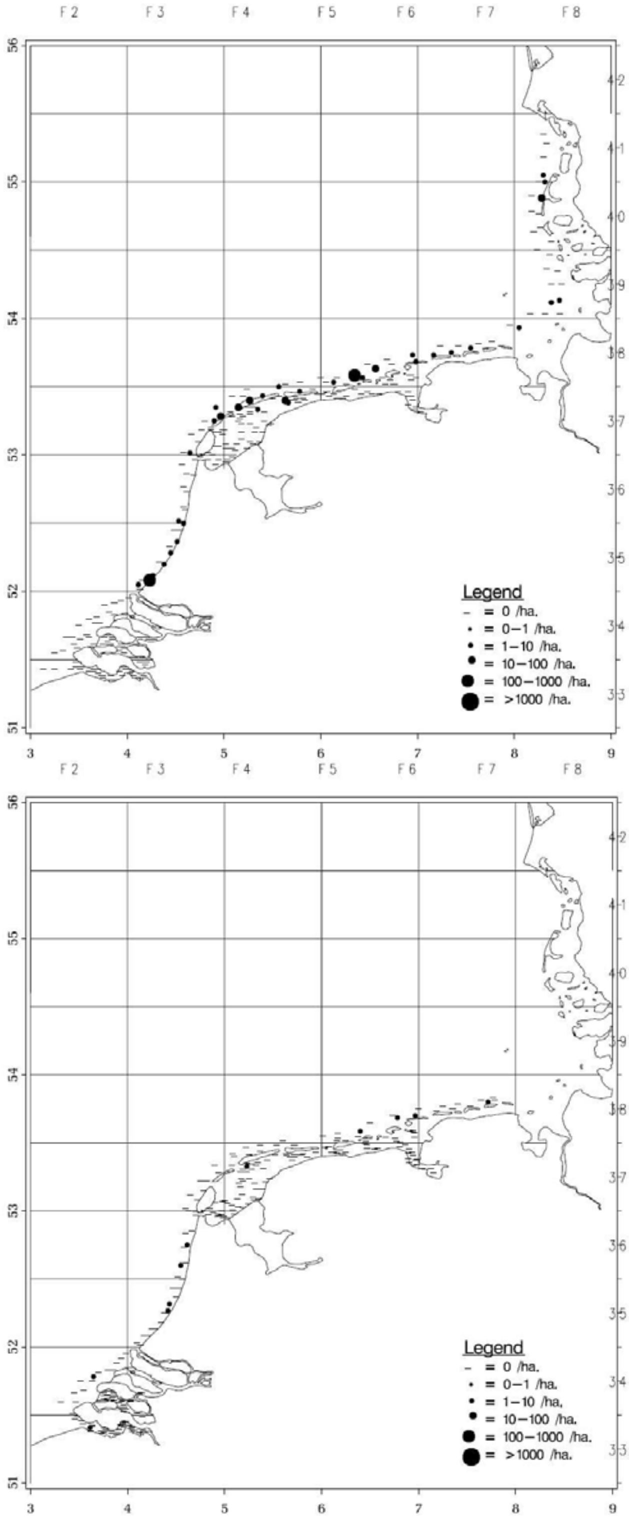


Figure 2.1.22 – Two examples of the distribution of turbot in the DFS survey. Upper panel 1984, lower panel 2002.

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.

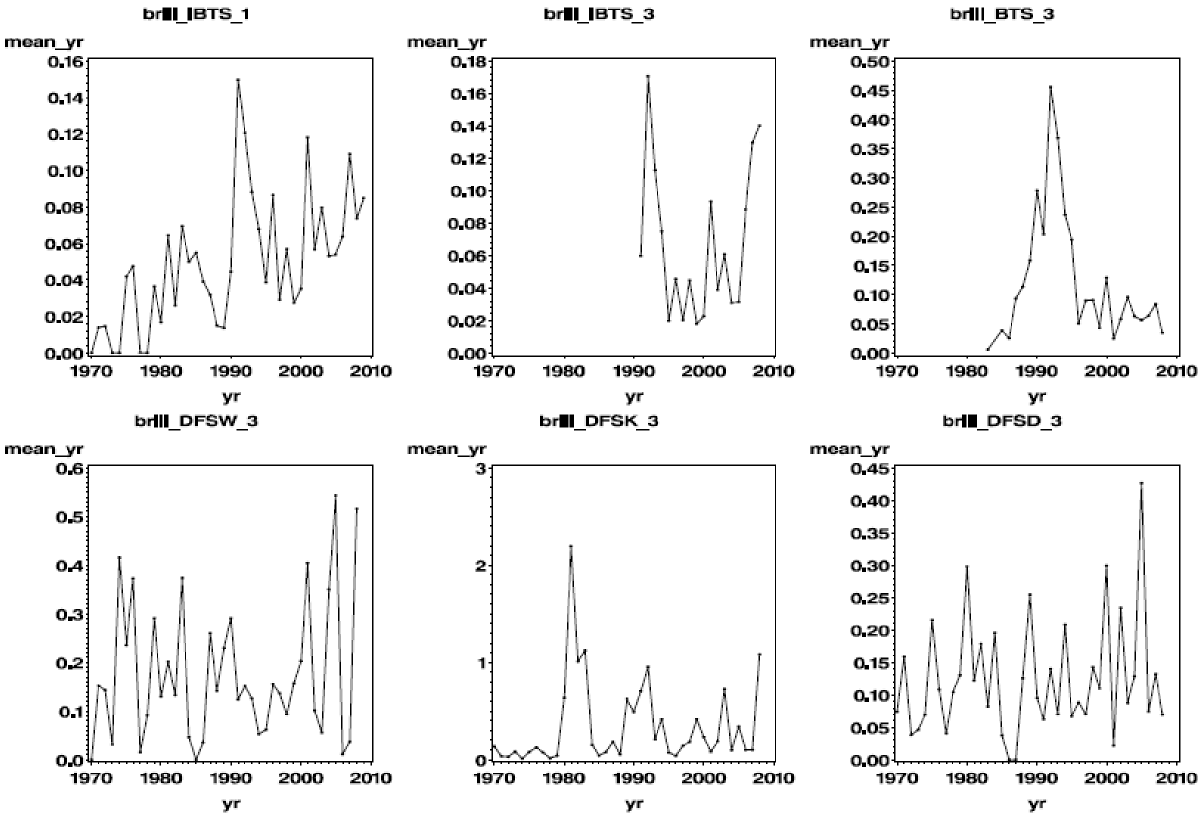


Figure 2.1.23 – Time series of abundance of brill by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

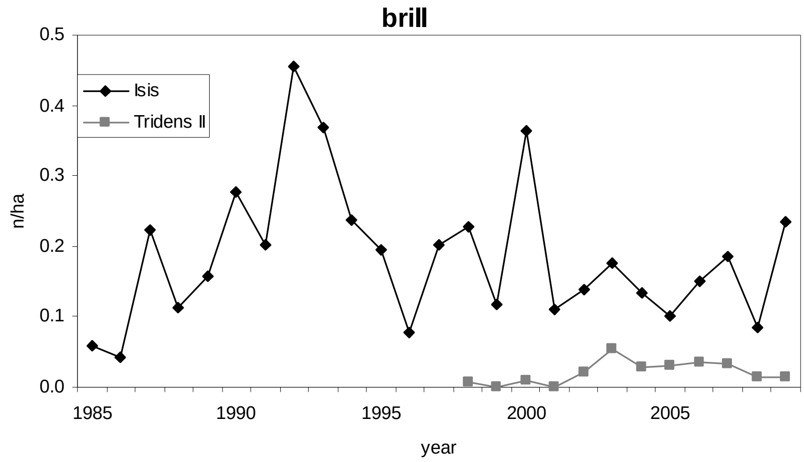


Figure 2.1.24 – Time series of abundance of brill in the BTS3 survey by vessel.

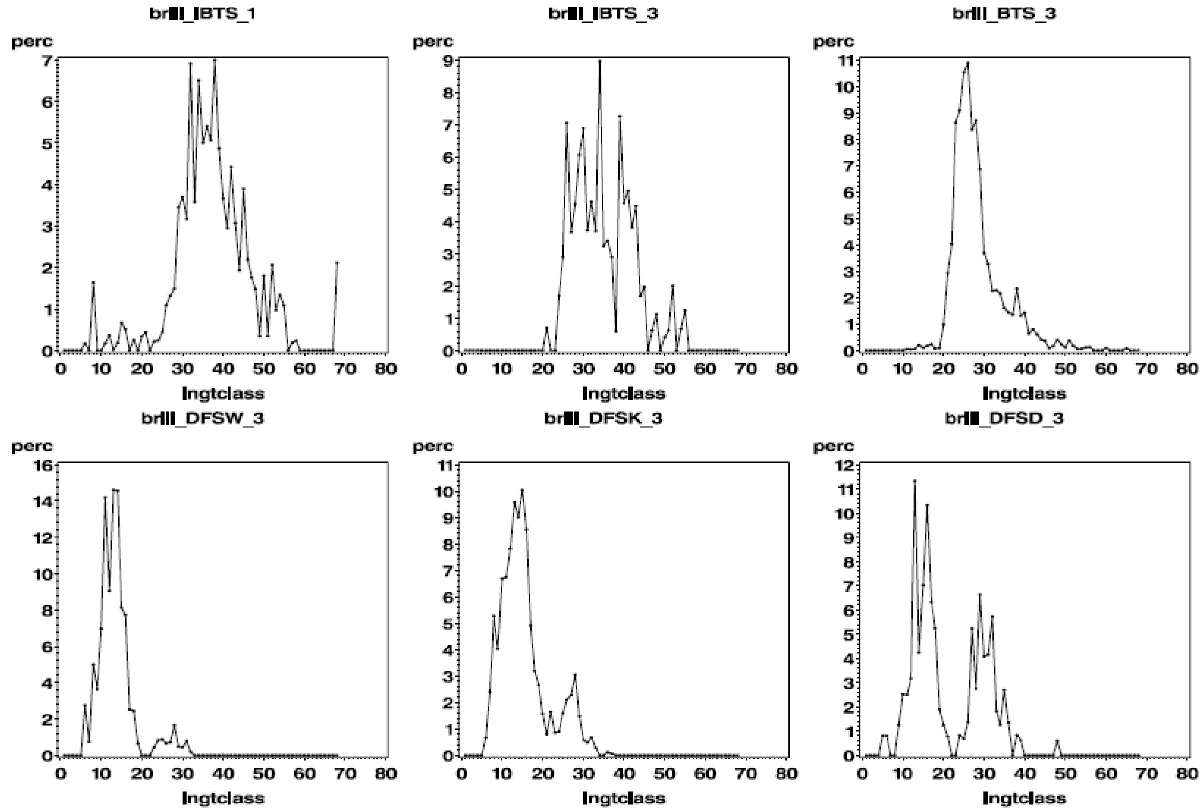


Figure 2.1.25 – Length frequency distribution of brill by survey. Row above from left to right: IBTS-1 (1970-2009), IBTS-3 (1991-2008), BTS-3 (1985-2008); row below from left to right: DFS quarter 3 (1970-2008) Wadden Sea, Coastal Zone and Delta area.

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.

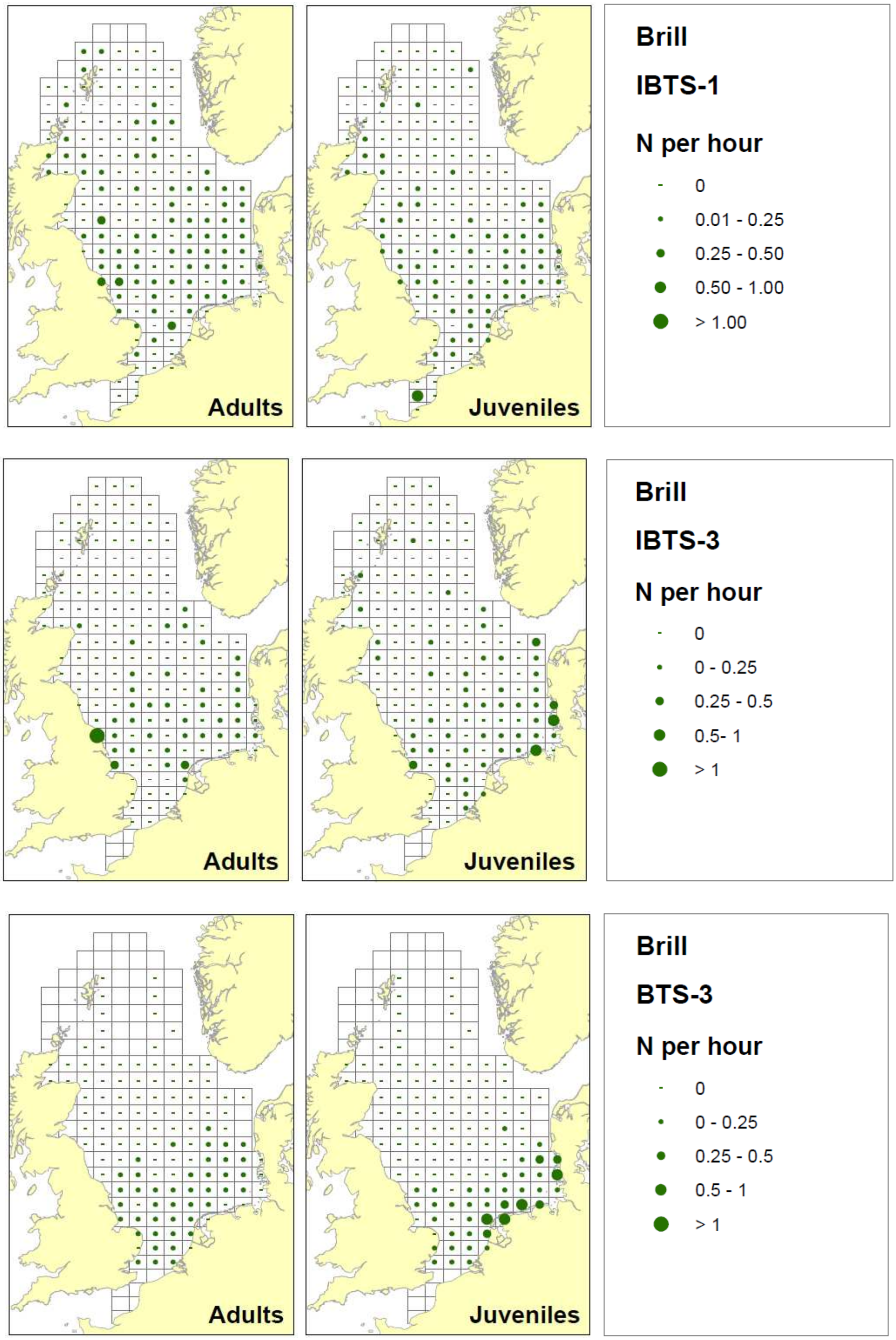


Figure 2.1.26 – Distribution of brill in IBTS-1 (average 1970-2009), IBTS-3 (average 1991-2008) and BTS-3 (average 1985-2008).

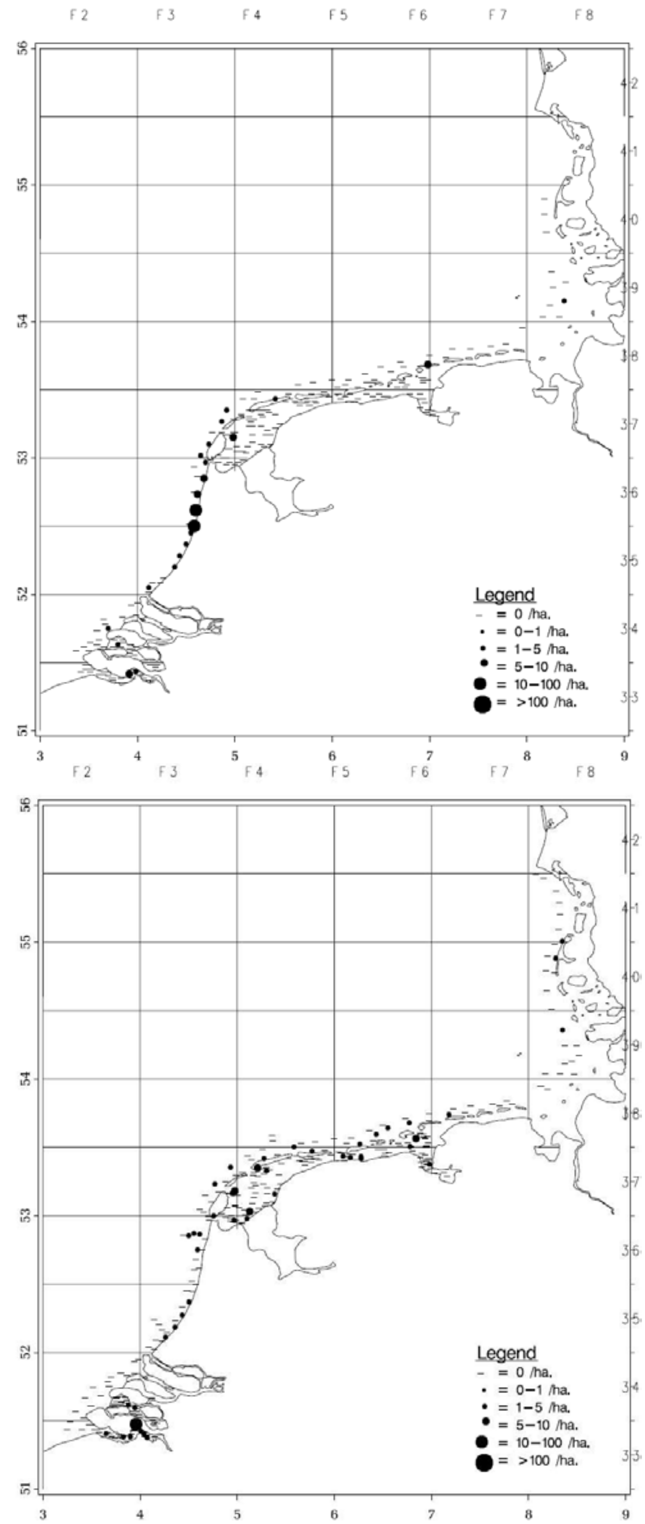


Figure 2.1.27 – Two examples of the distribution of brill in the DFS survey. Upper panel 1981, lower panel 2005.

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.

[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

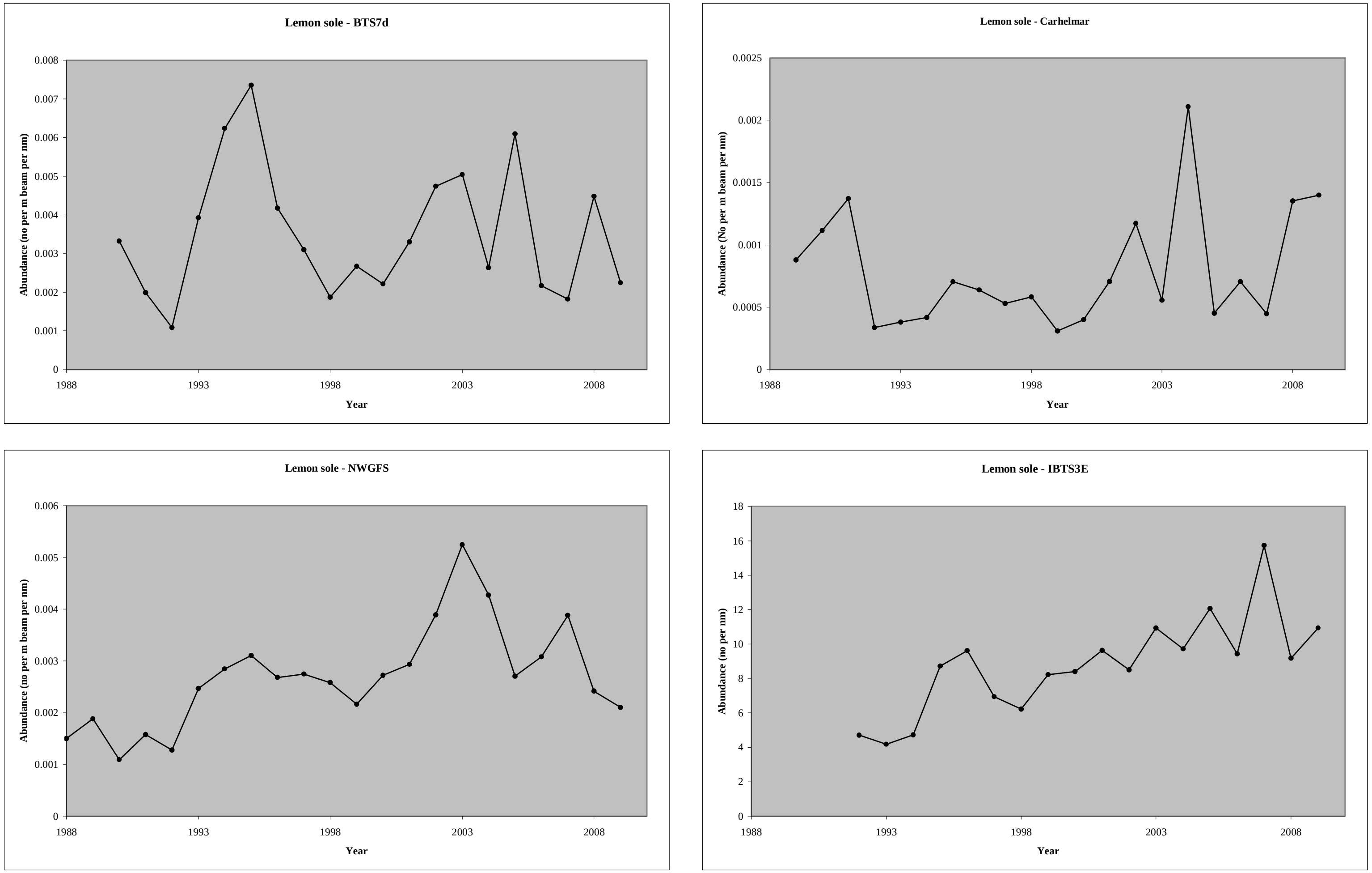


Figure 2.2.1 - Indices of abundance of lemon sole caught in 4 Cefas surveys: the eastern Channel Beam Trawl survey (BTS7d), the western Channel (VIIe) (Carhelmar) Beam Trawl survey, the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl survey (NWGFS) and the 3rd Quarter North Sea IBTS Groundfish Survey (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.

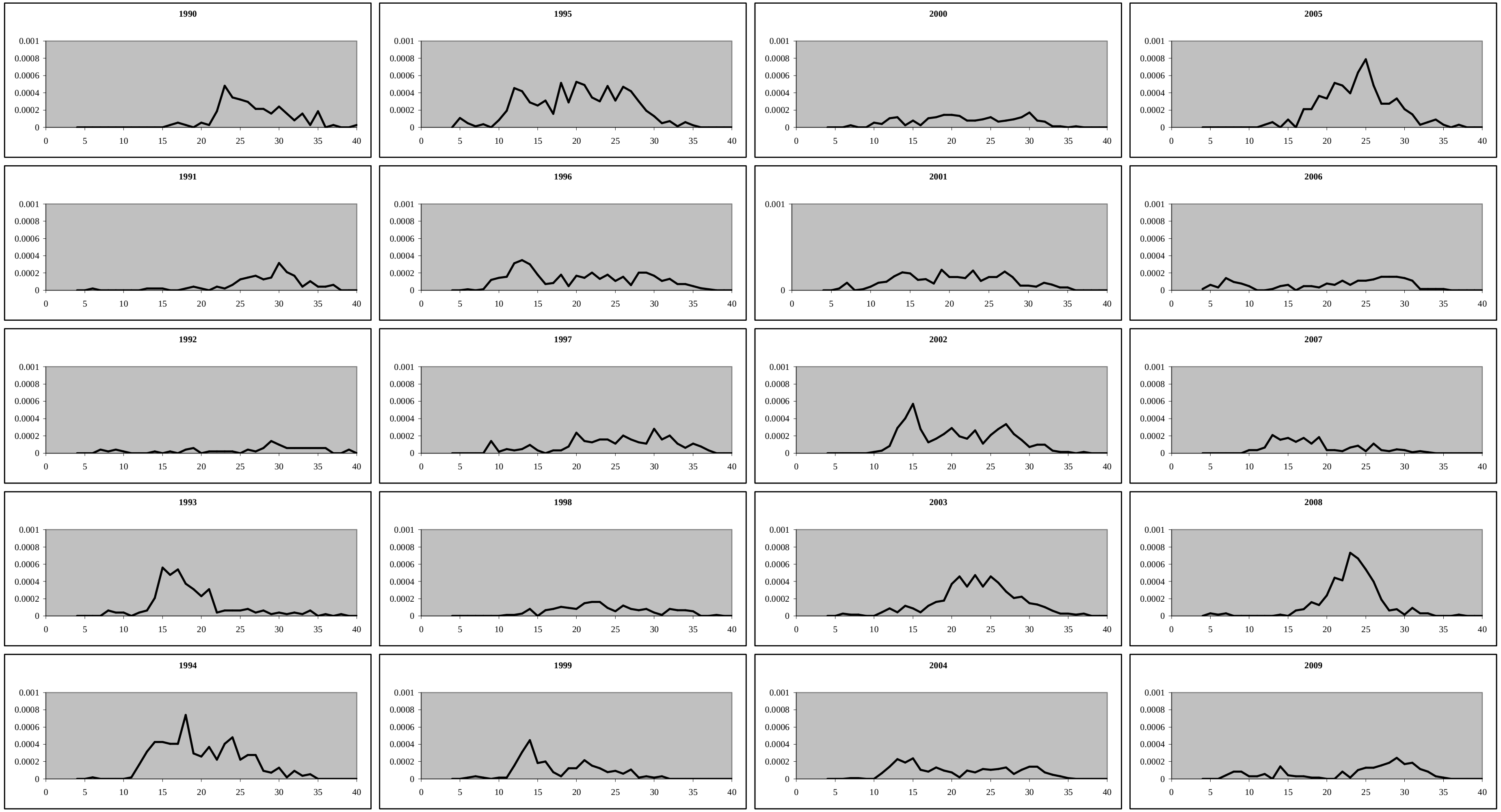


Figure 2.2.2 - Abundance (no per m beam per nm) by length (cm) of lemon sole caught annually in the eastern Channel beam trawl survey, between 1990 and 2009.

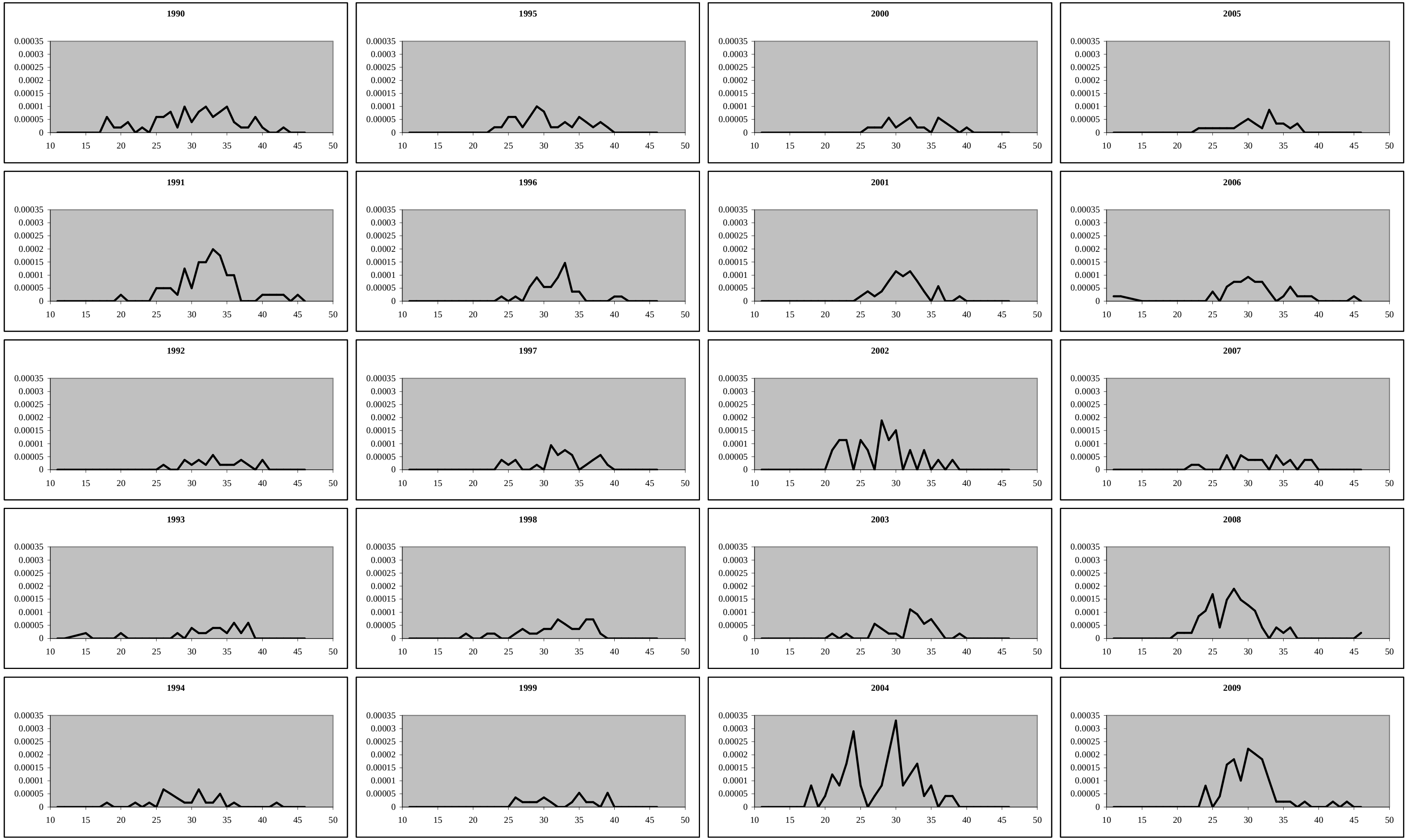


Figure 2.2.3 - Abundance (no per m beam per nm) by length (cm) of lemon sole caught annually in the Carhelmar survey, between 1990 and 2009.

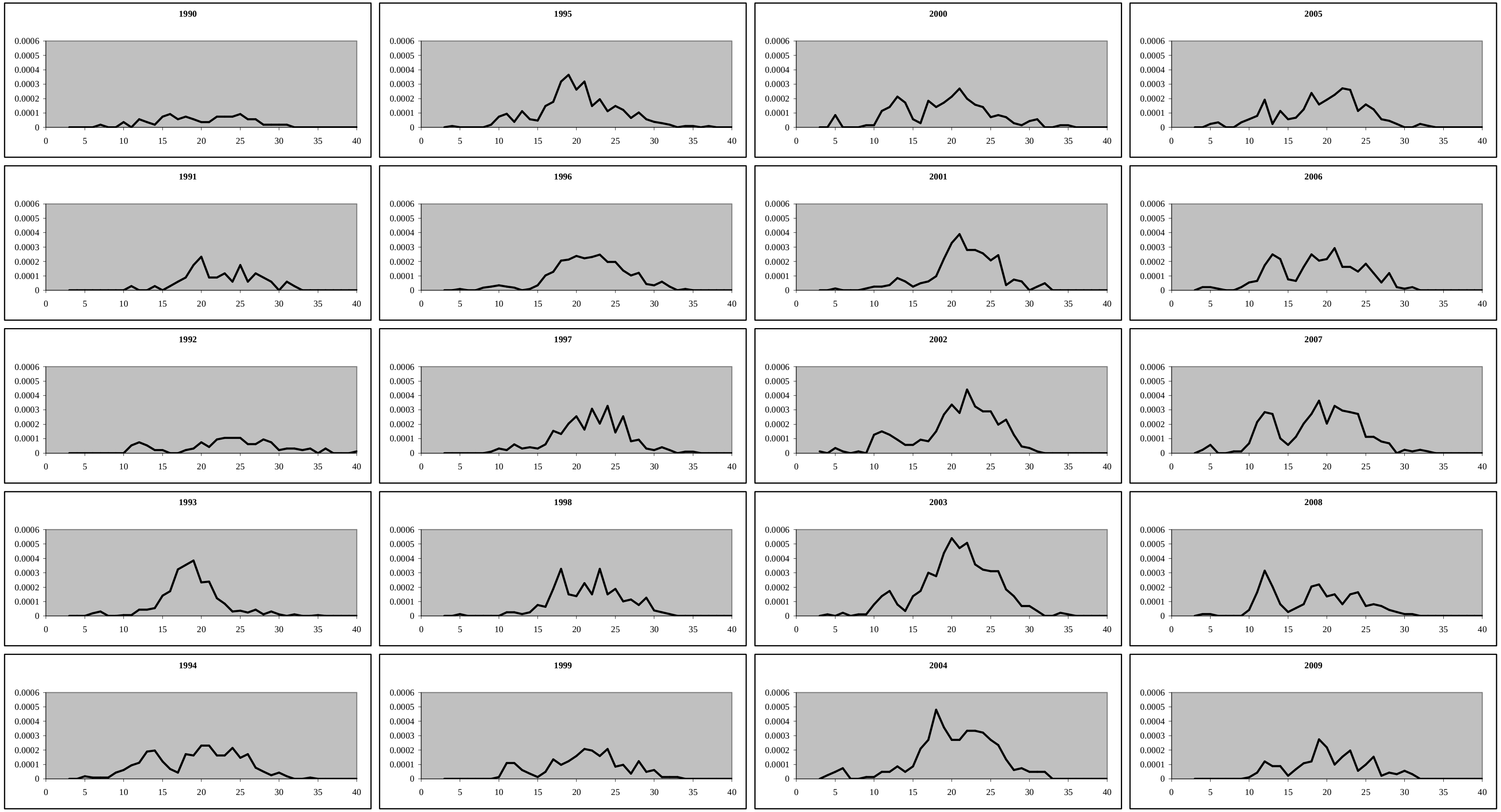


Figure 2.2.4 - Abundance (no per m beam per nm) by length (cm) of lemon sole caught annually in the Irish Sea/Bristol Channel beam trawl survey, between 1991 and 2009.

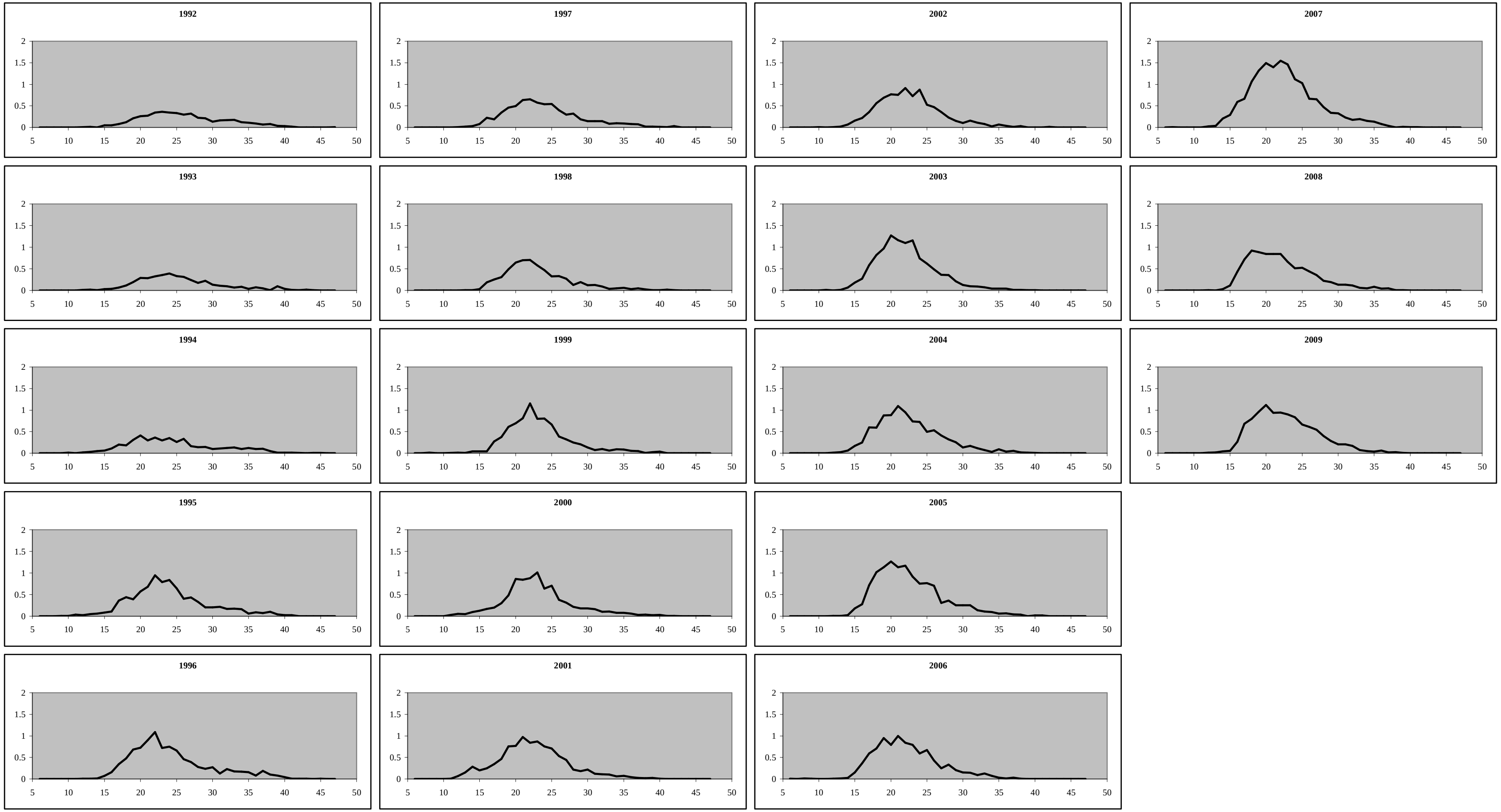


Figure 2.2.5 - Abundance (no per nm) by length (cm) of lemon sole caught annually in the North Sea survey, between 1992 and 2009.

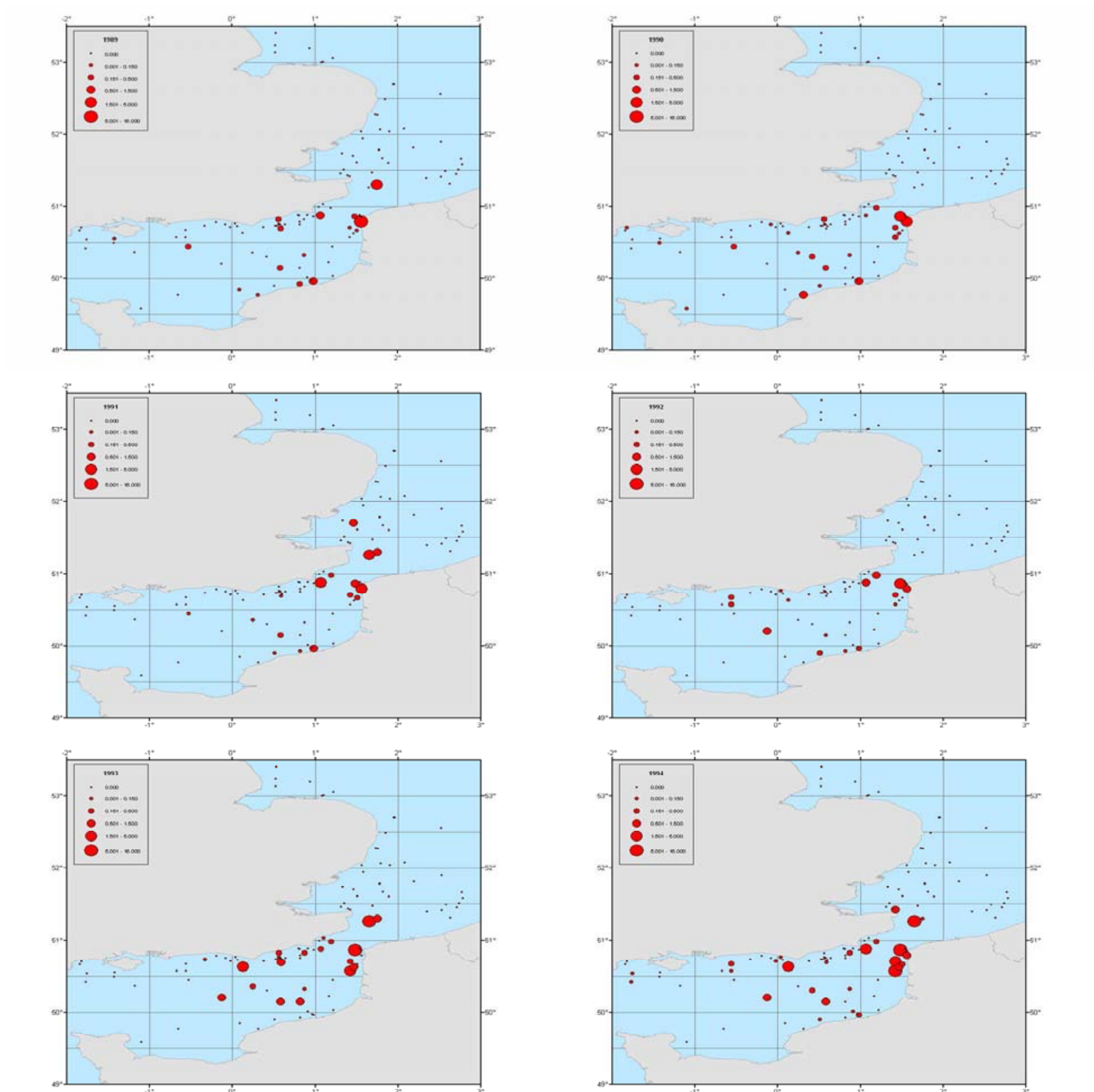


Figure 2.2.6 - Abundance (no per m beam per nm) of lemon sole caught annually in the eastern Channel beam trawl survey, by fishing station, between 1989 and 2009.

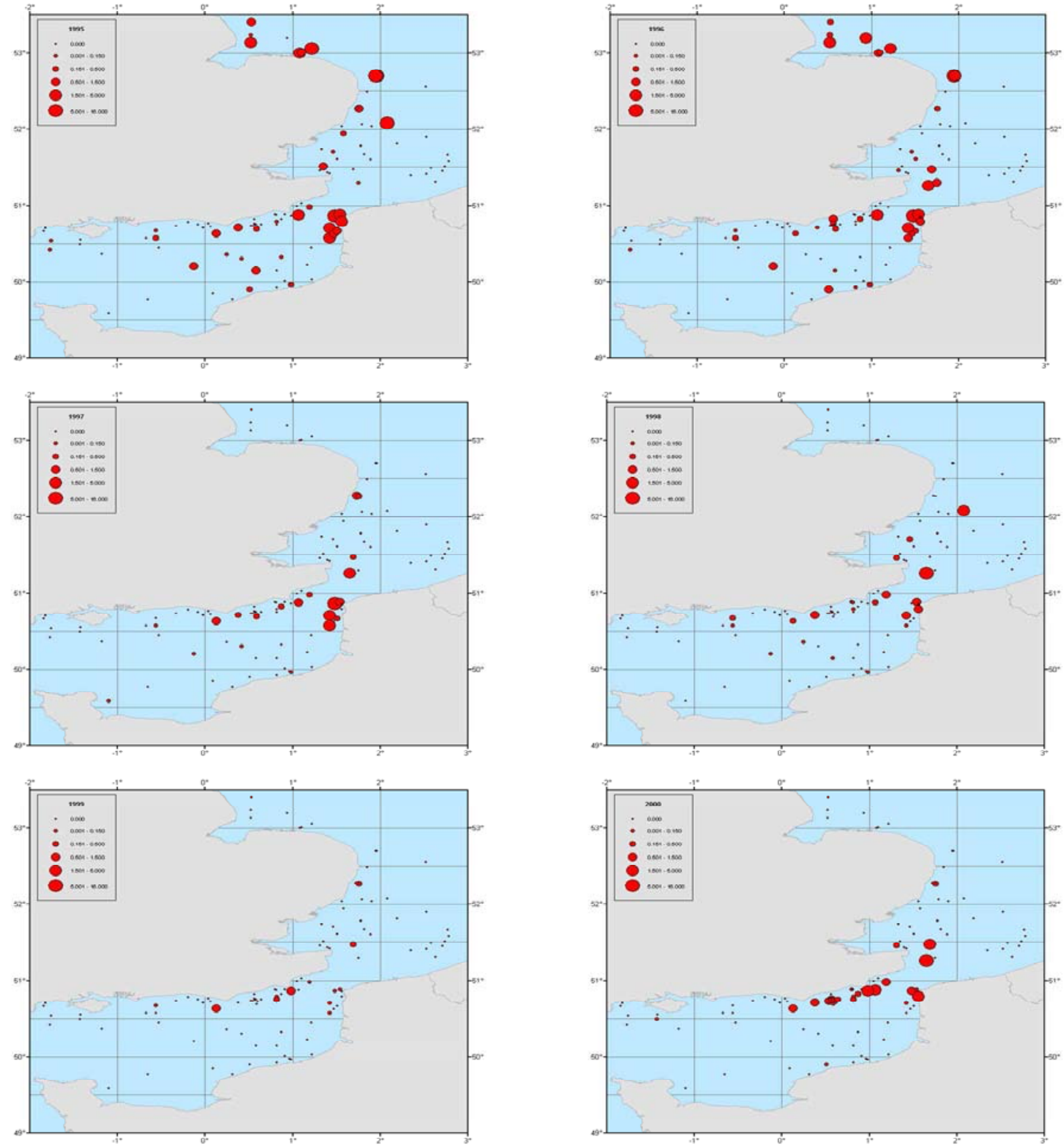
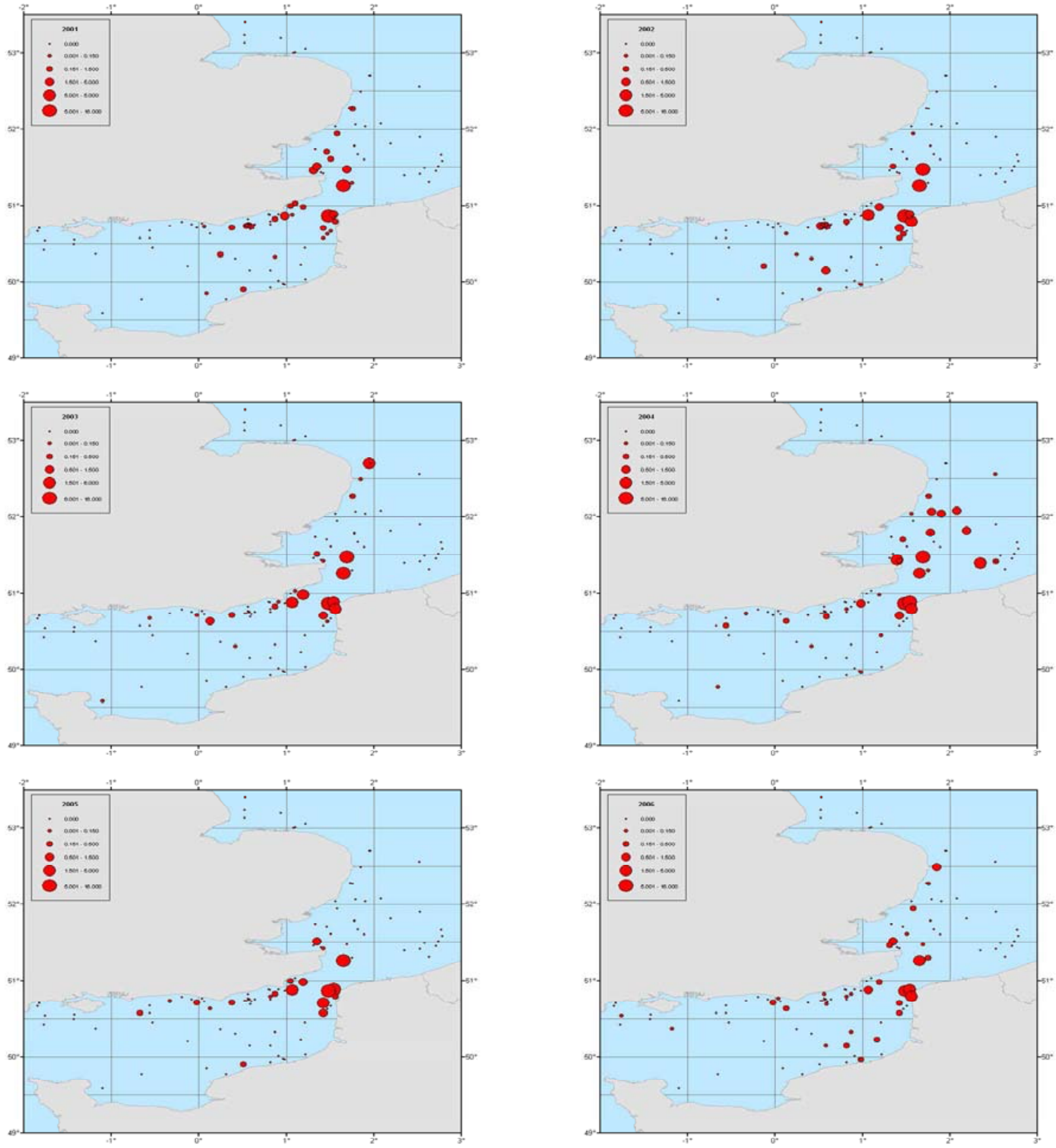


Figure 2.2.6 - Continued.



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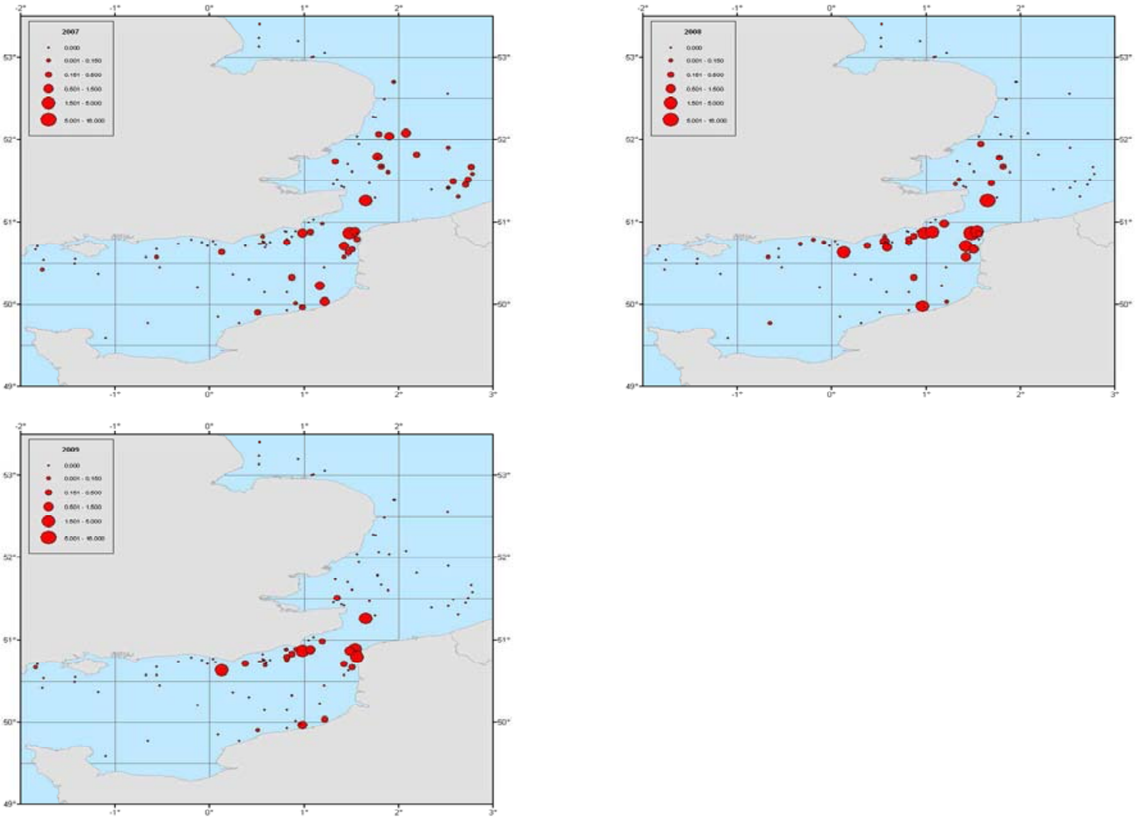


Figure 2.2.6 - Continued.

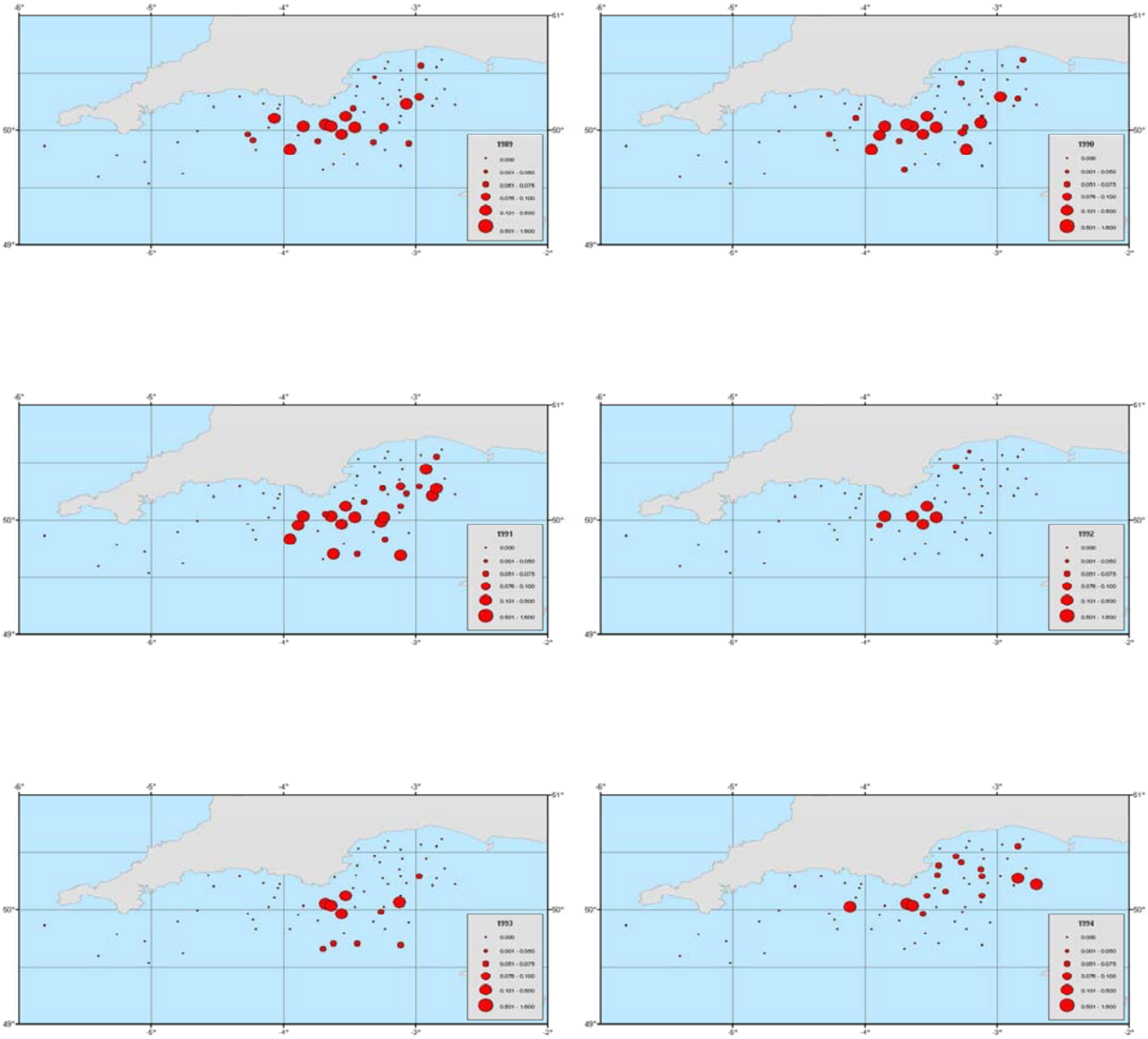


Figure 2.2.7 - Abundance (no per m beam per nm) of lemon sole caught annually in the Carhelmar survey, by fishing station, between 1989 and 2009.

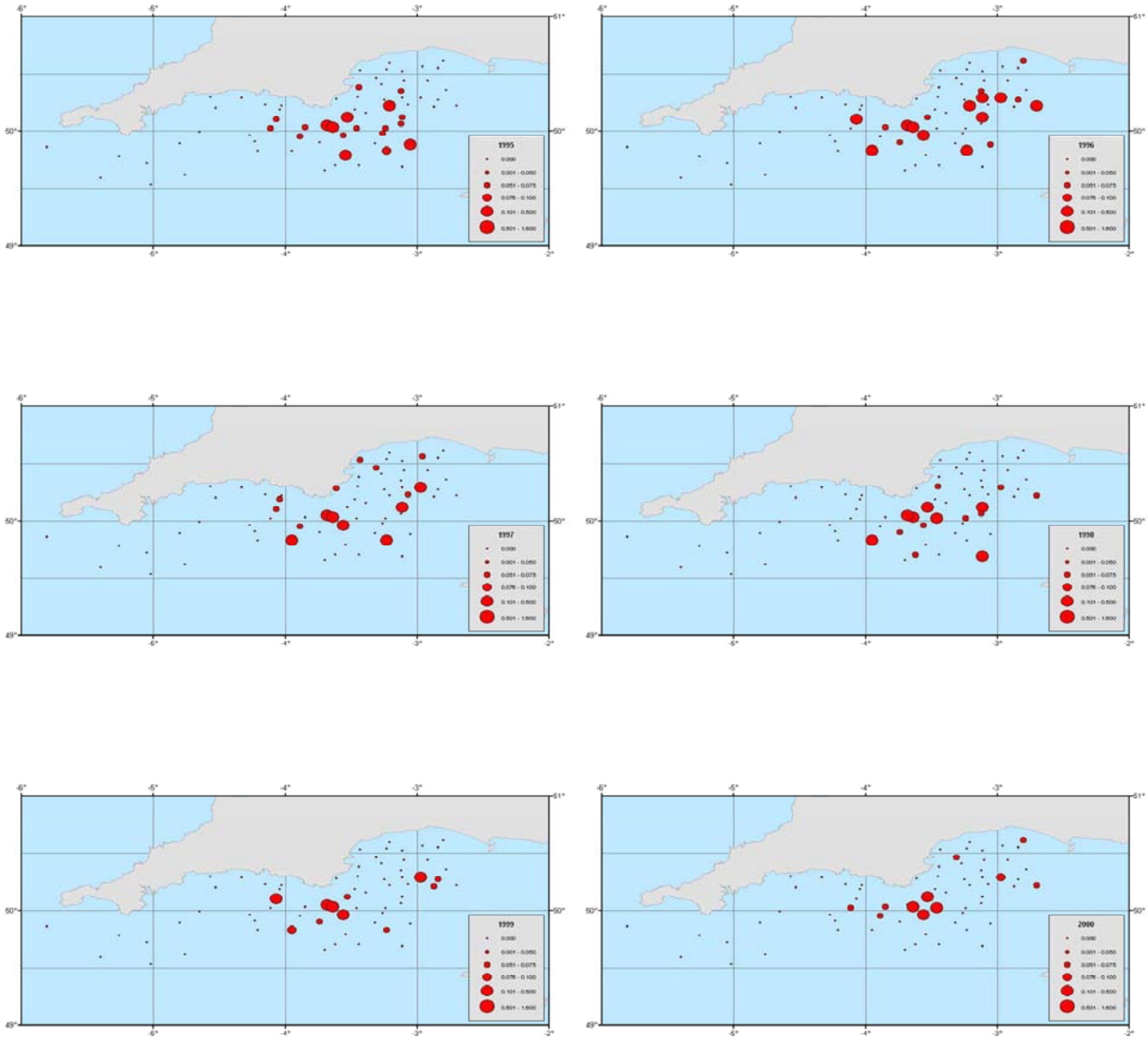


Figure 2.2.7 - Continued.

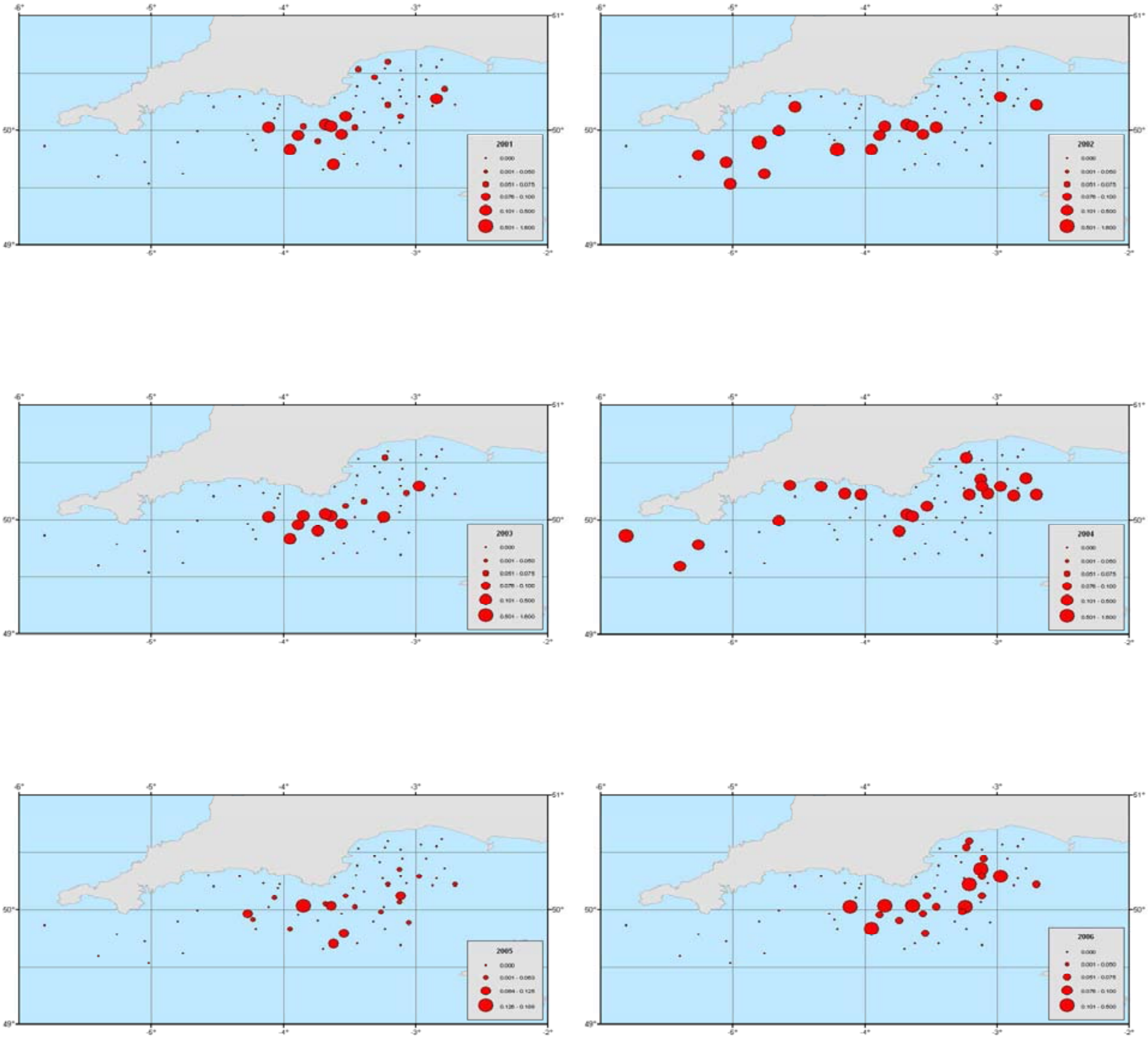


Figure 2.2.7 - Continued.

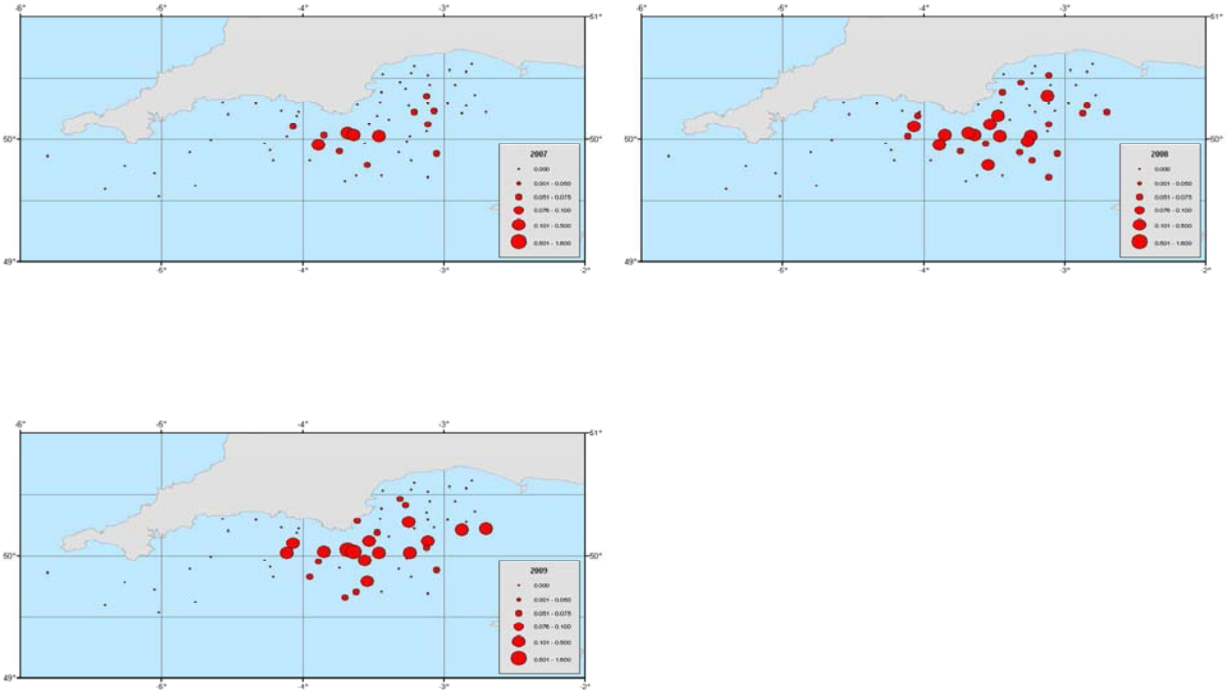


Figure 2.2.7 - Continued.

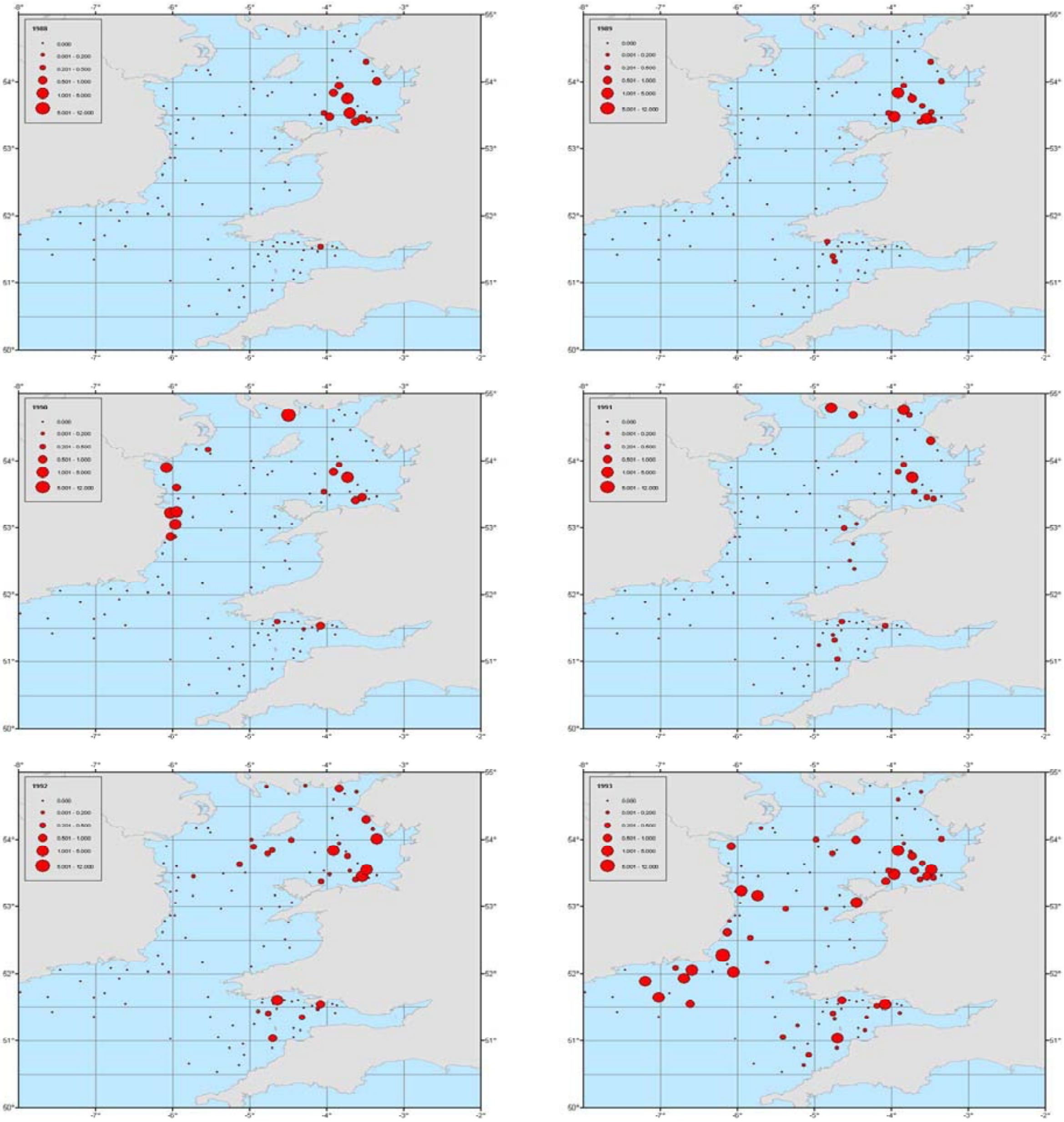


Figure 2.2.8. Abundance (no per m beam per nm) of lemon sole caught annually in the Irish Sea/Bristol Channel beam trawl survey, by fishing station, between 1988 and 2009.

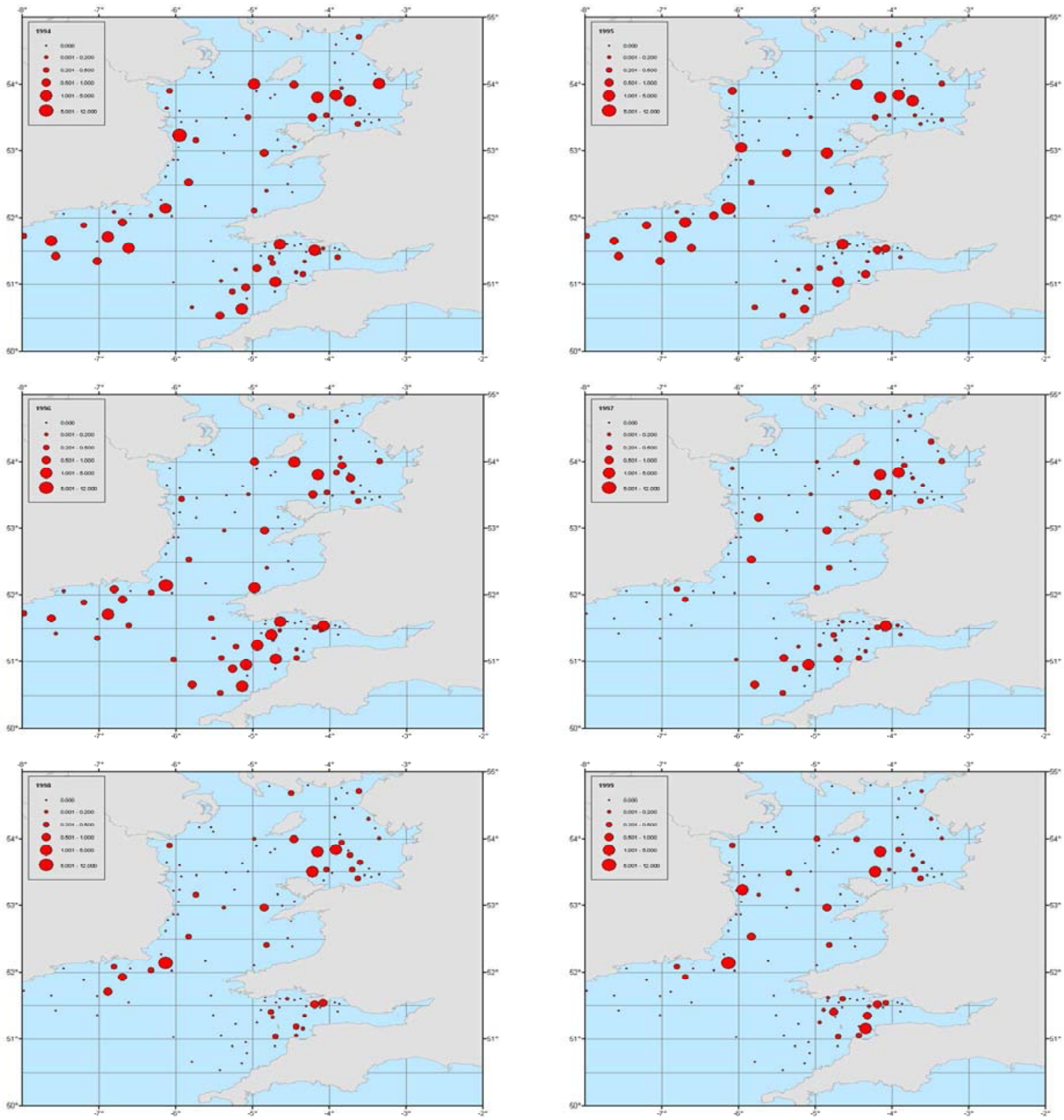


Figure 2.2.8 – Continued.

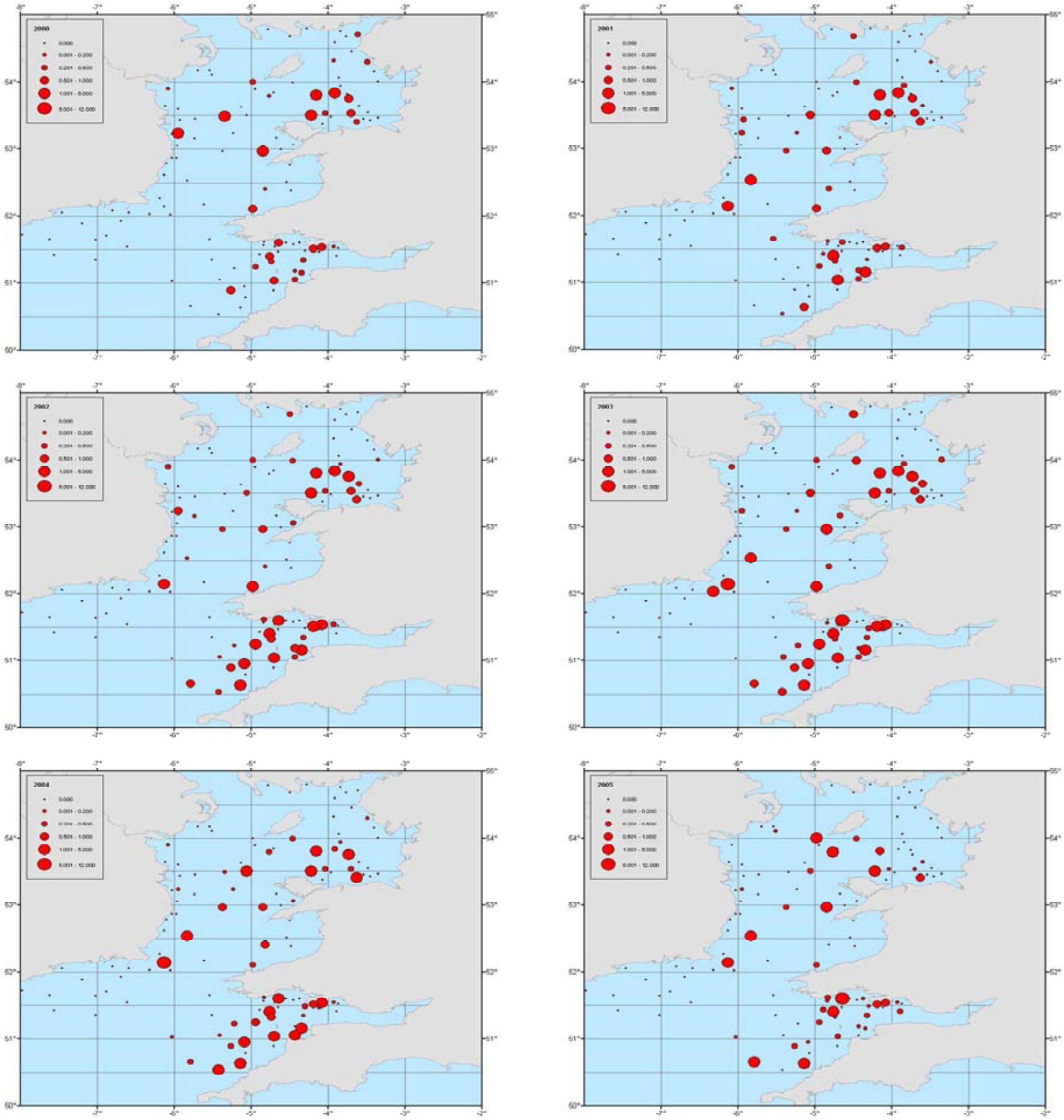
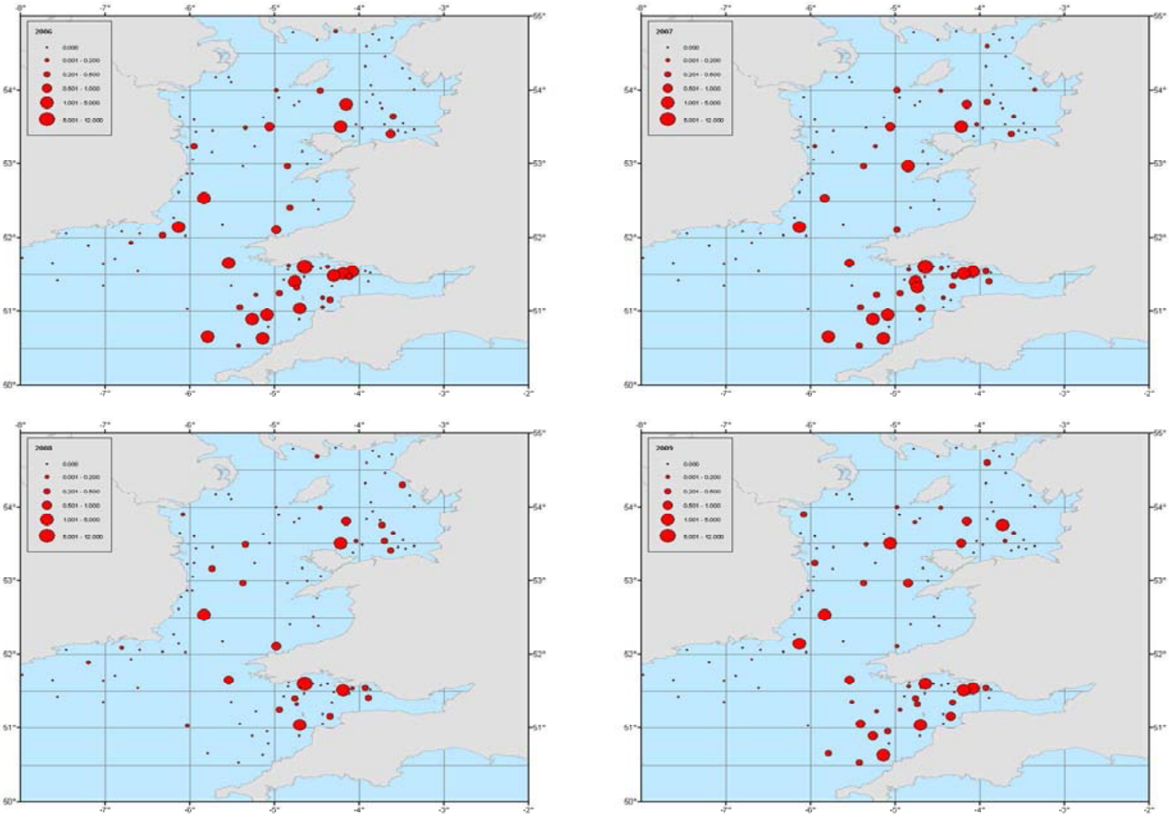


Figure 2.2.8 – Continued.



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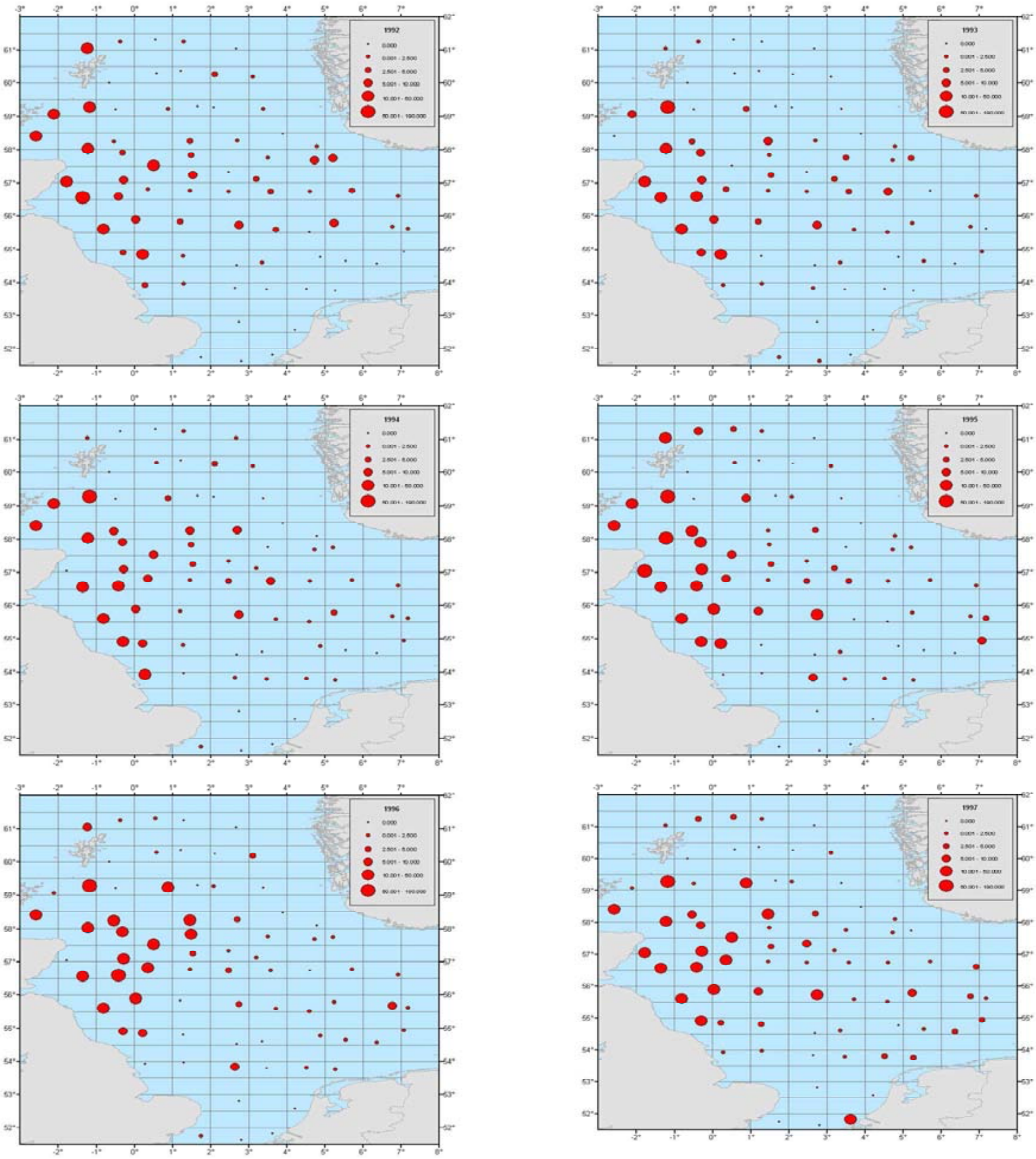
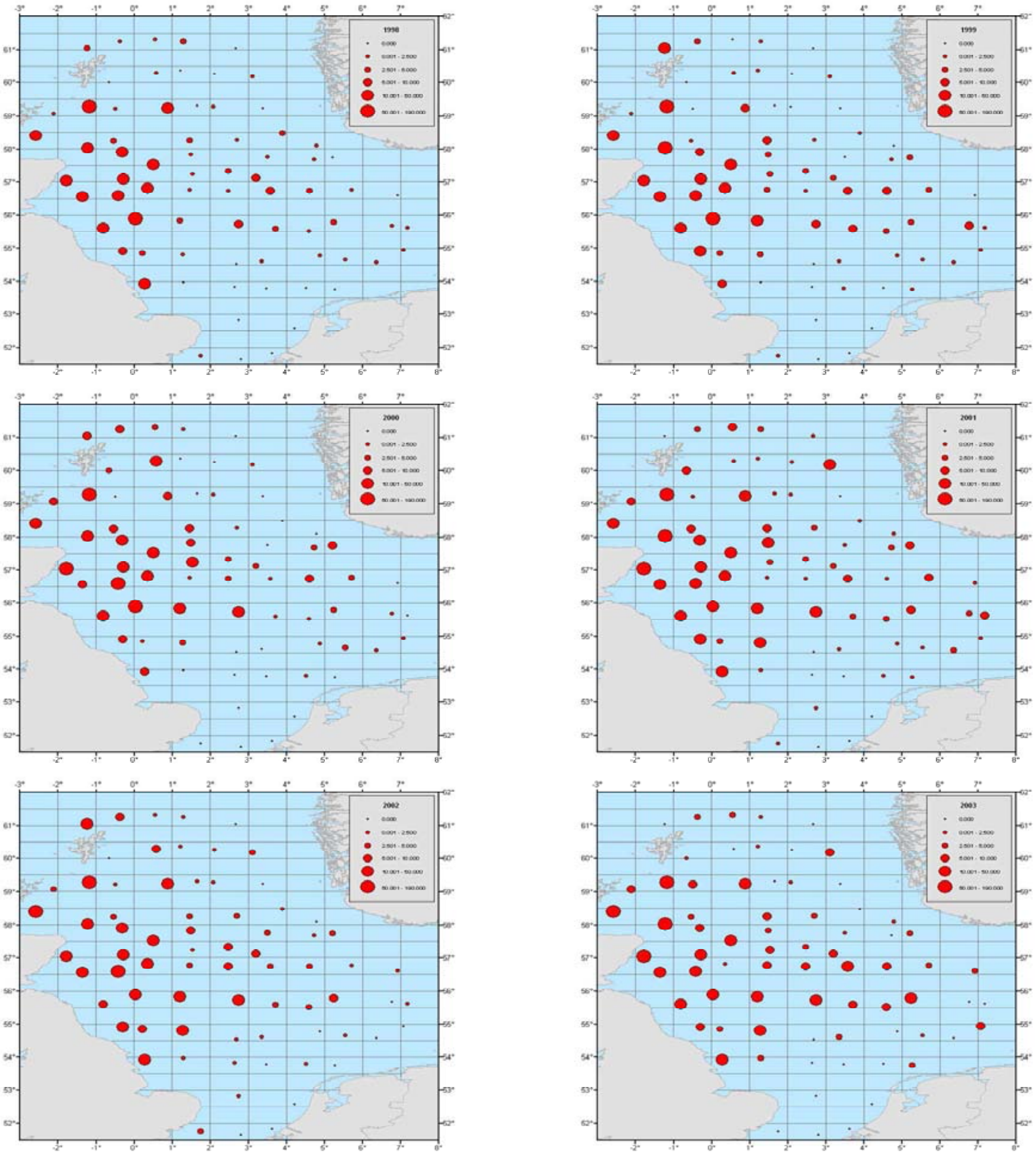


Figure 2.2.9. Abundance (no per nm) of lemon sole caught annually in the North Sea survey, by fishing station, between 1992 and 2009.



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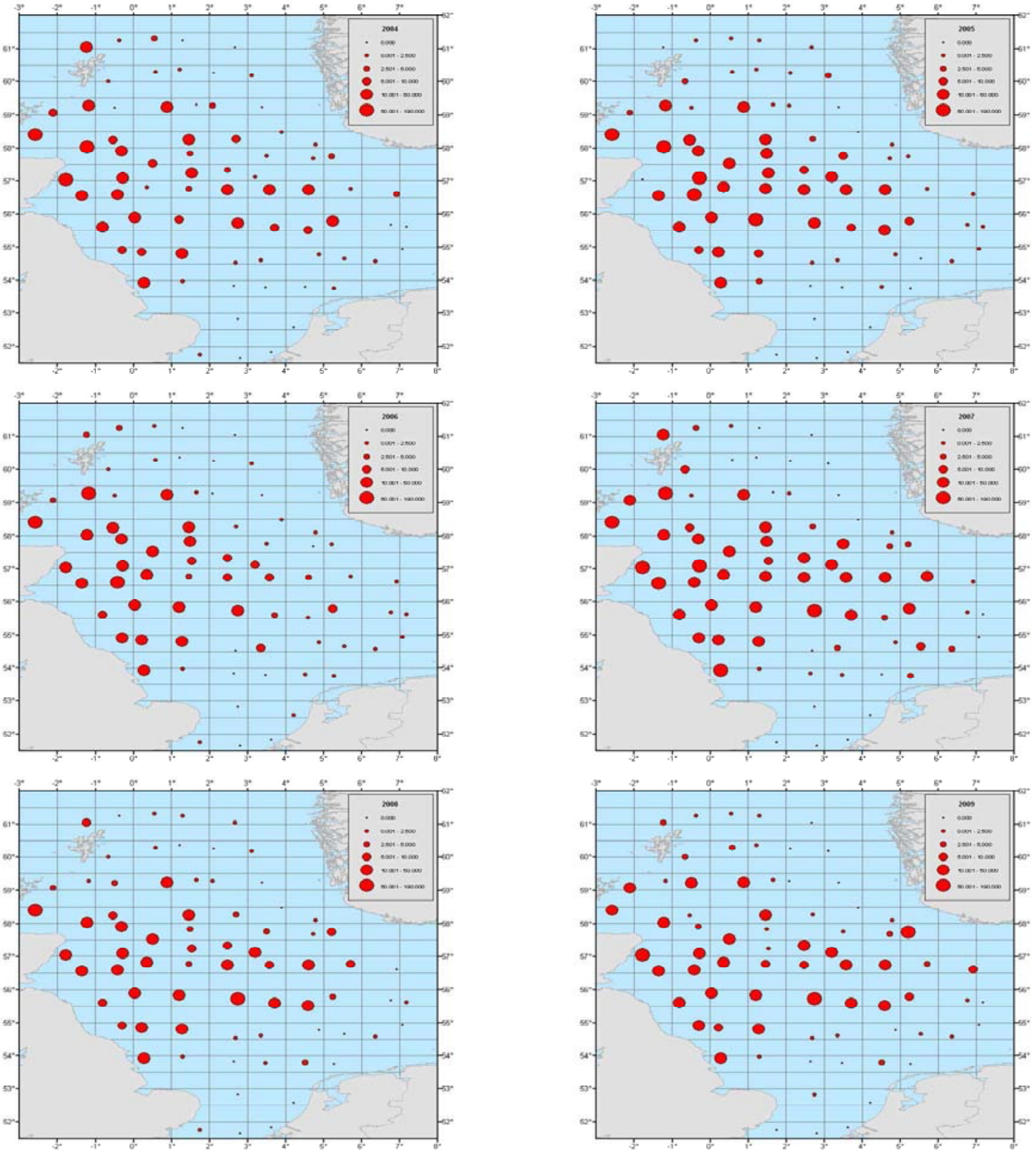

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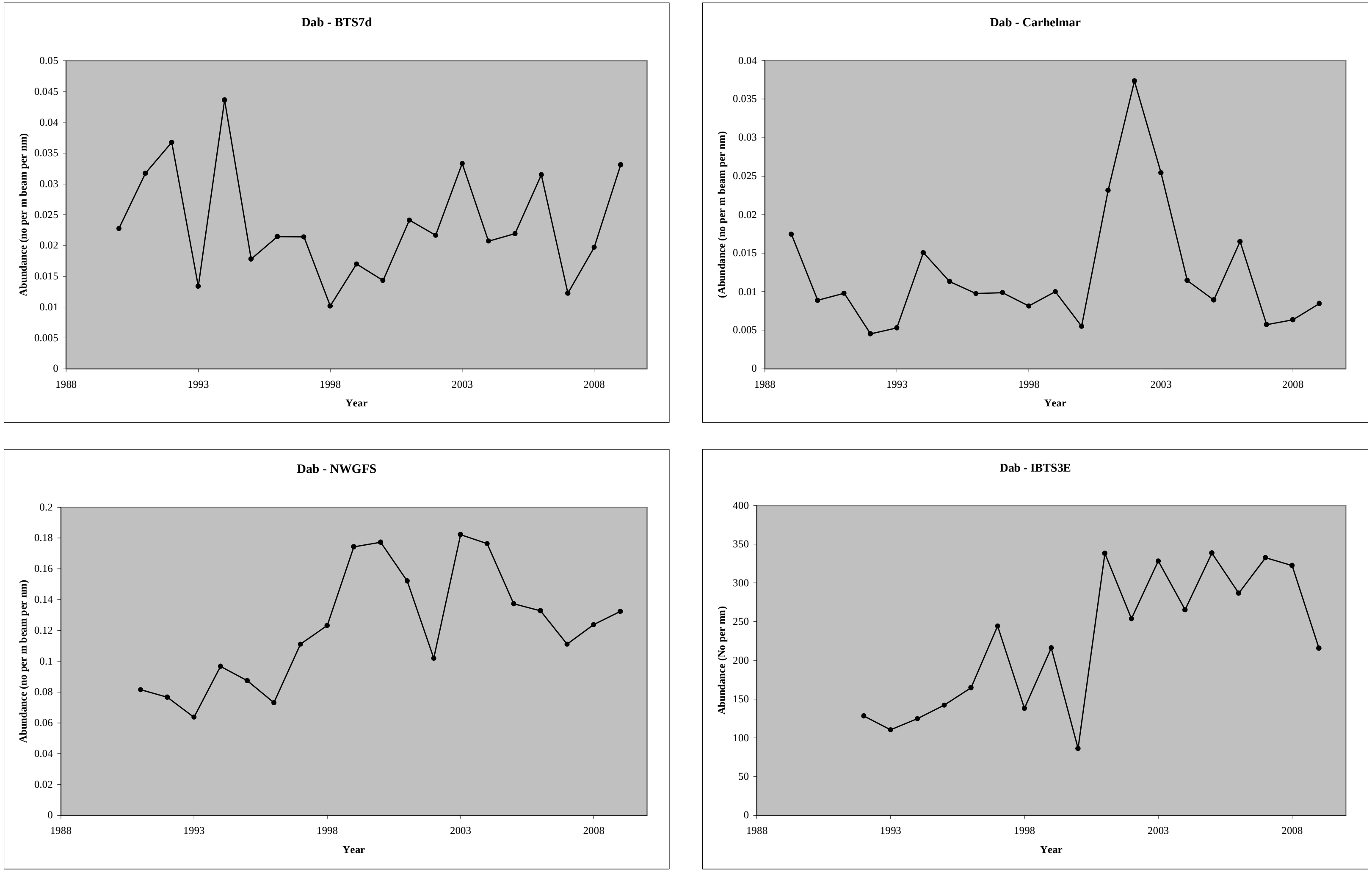


Figure 2.2.10 - Indices of abundance of dab caught in 4 Cefas surveys: the eastern Channel Beam Trawl survey (BTS7d), the western Channel (VIIe) (Carhelmar) Beam Trawl survey, the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl survey (NWGFS) and the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E). 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.

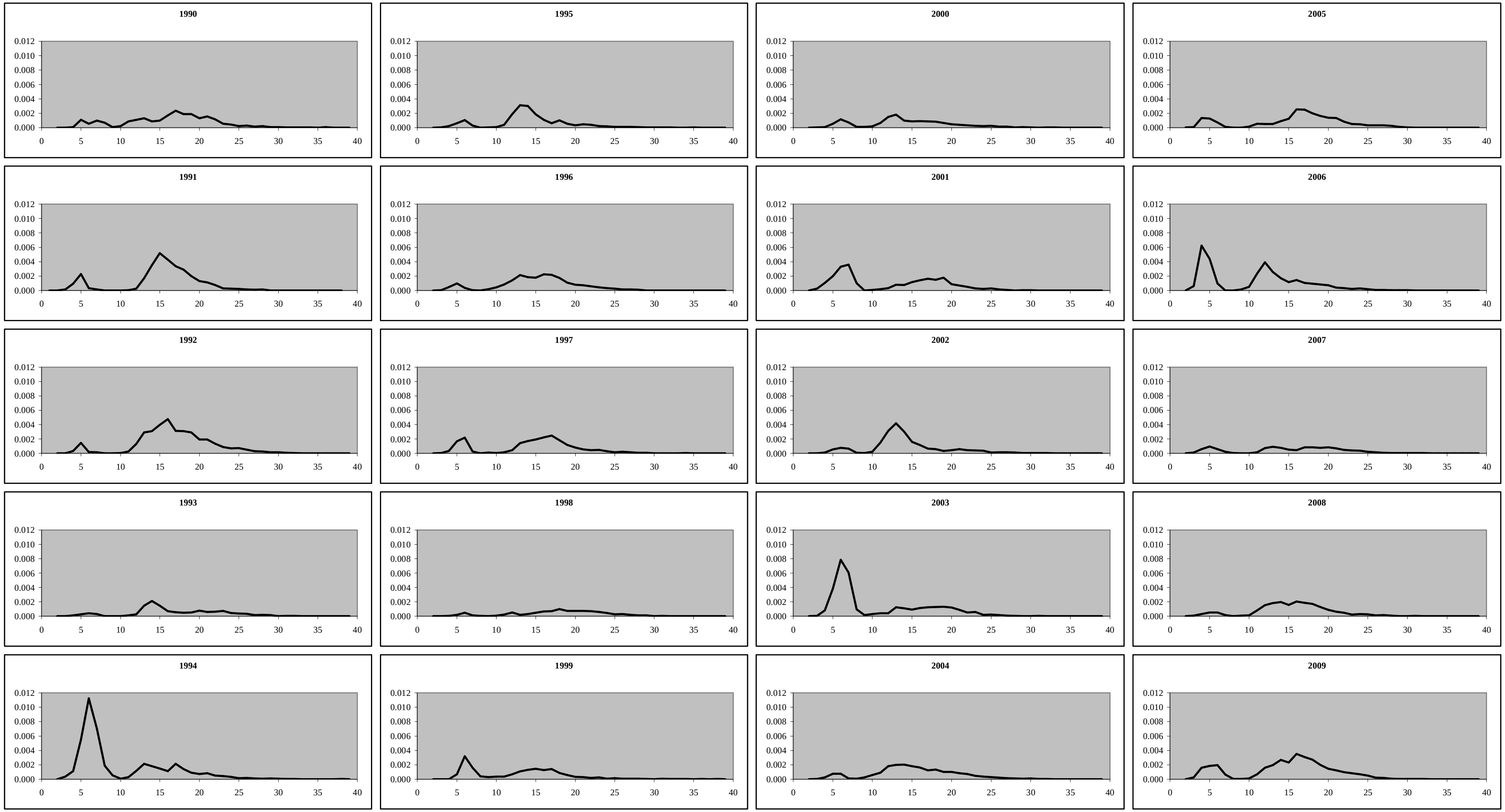


Figure 2.2.11 - Abundance (no per m beam per nm) by length (cm) of dab caught annually in the eastern Channel beam trawl survey, between 1990 and 2009.

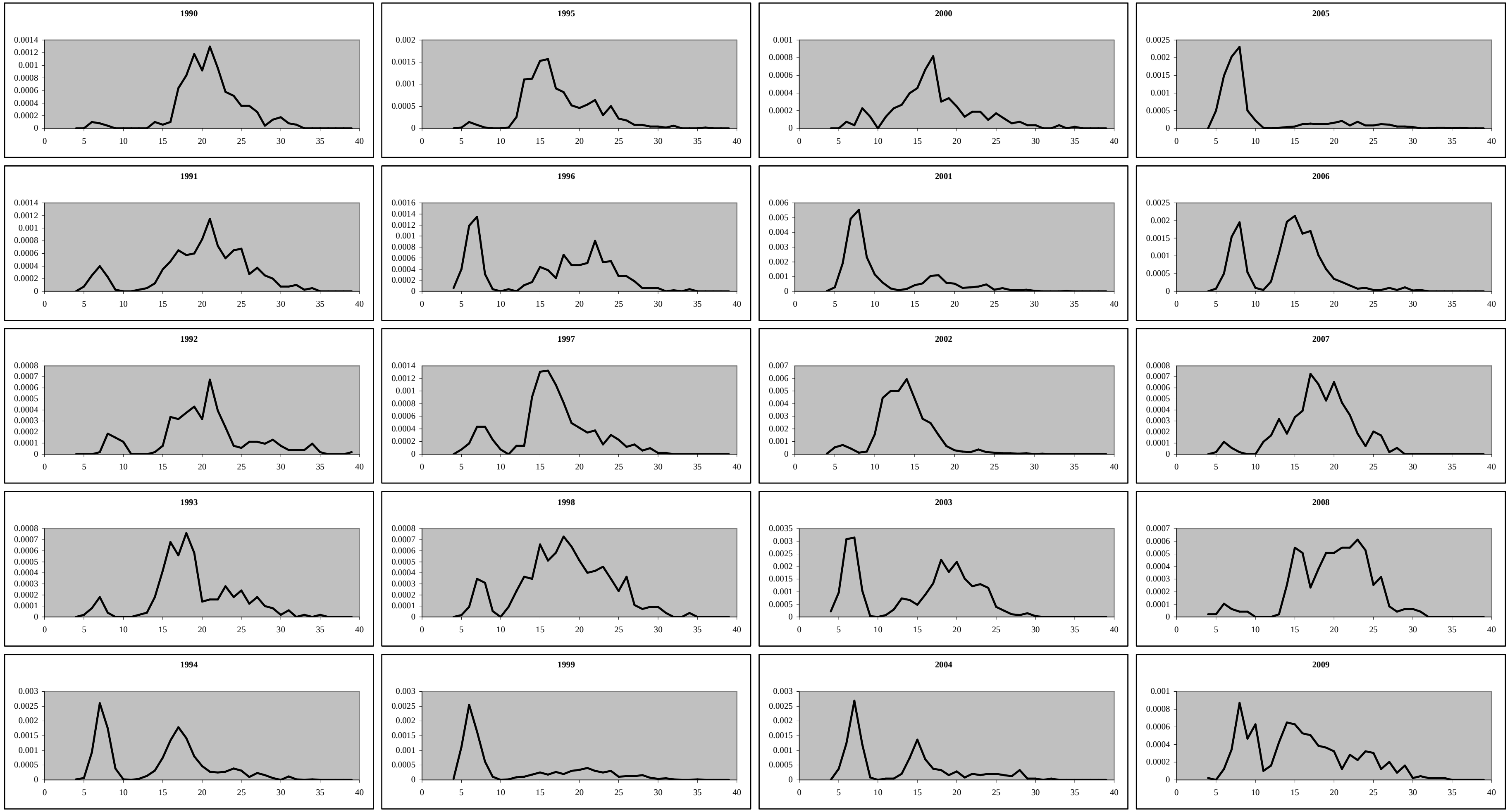


Figure 2.2.12 - Abundance (no per m beam per nm) by length (cm) of dab caught annually in the Carhelmar survey, between 1990 and 2009.

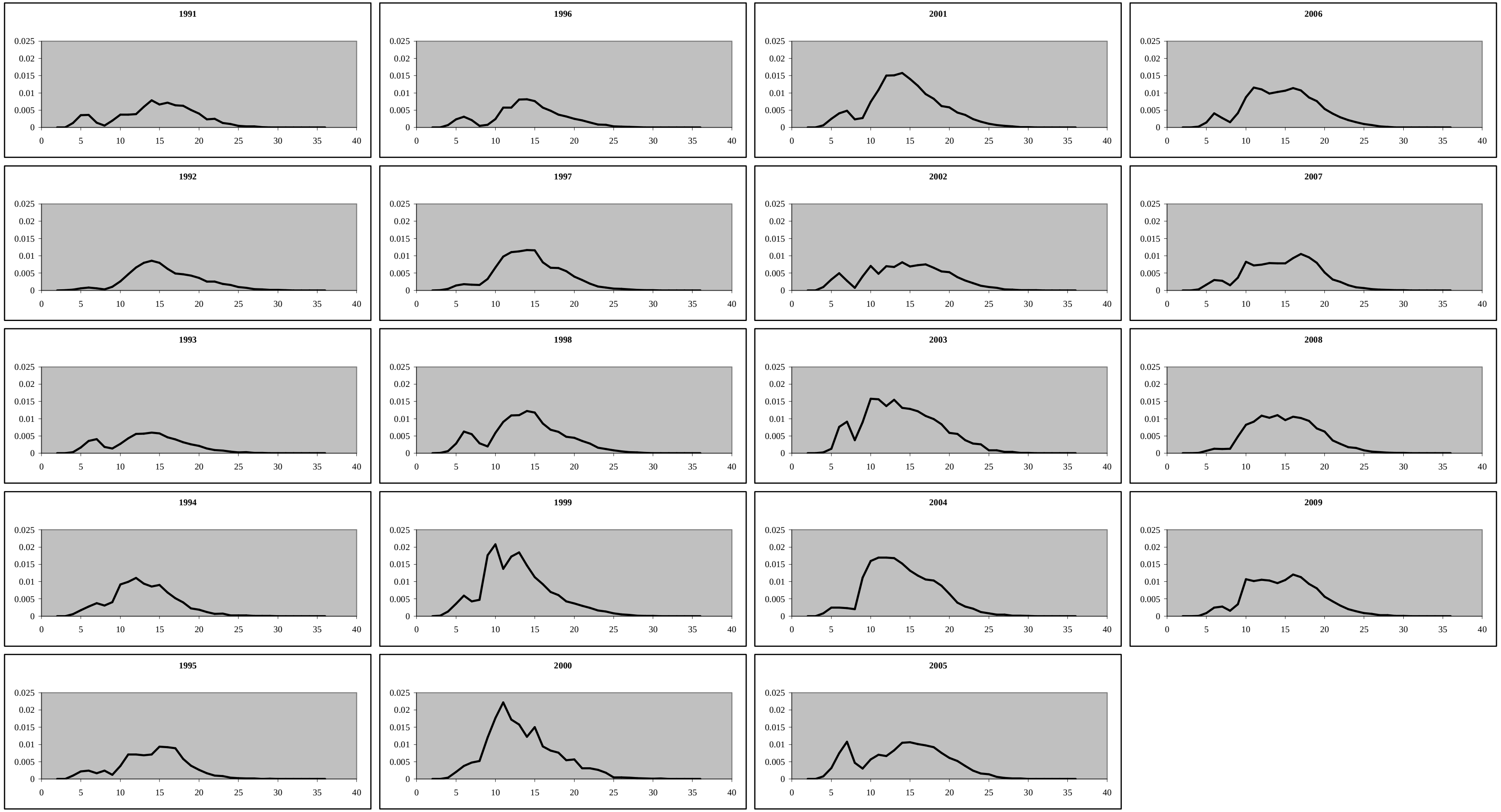


Figure 2.2.13 - Abundance (no per m beam per nm) by length (cm) of dab caught annually in the Irish Sea/Bristol Channel beam trawl survey, between 1991 and 2009.

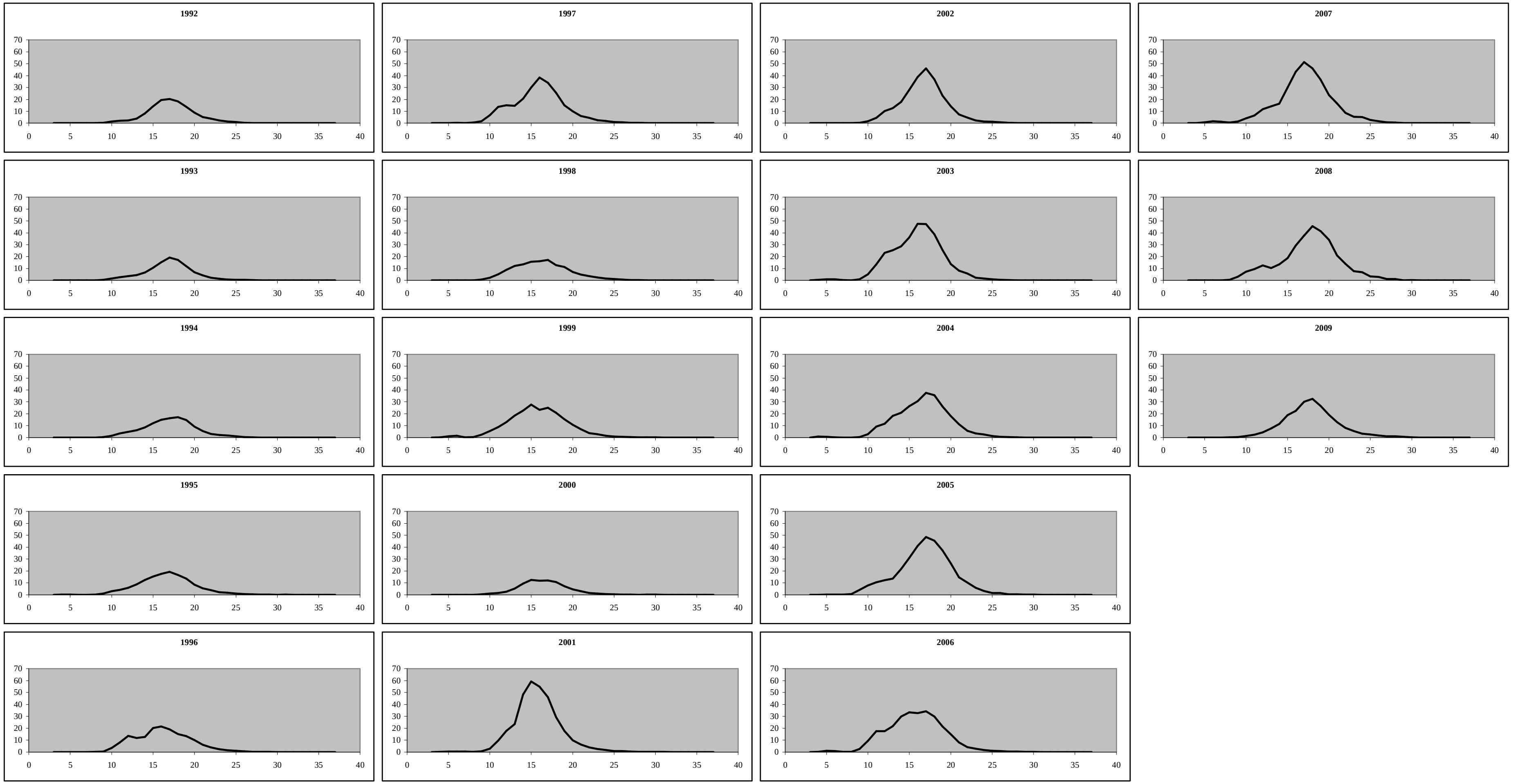


Figure 2.2.14 - Abundance (no per nm) by length (cm) of dab caught annually in the North Sea survey, between 1992 and 2009.

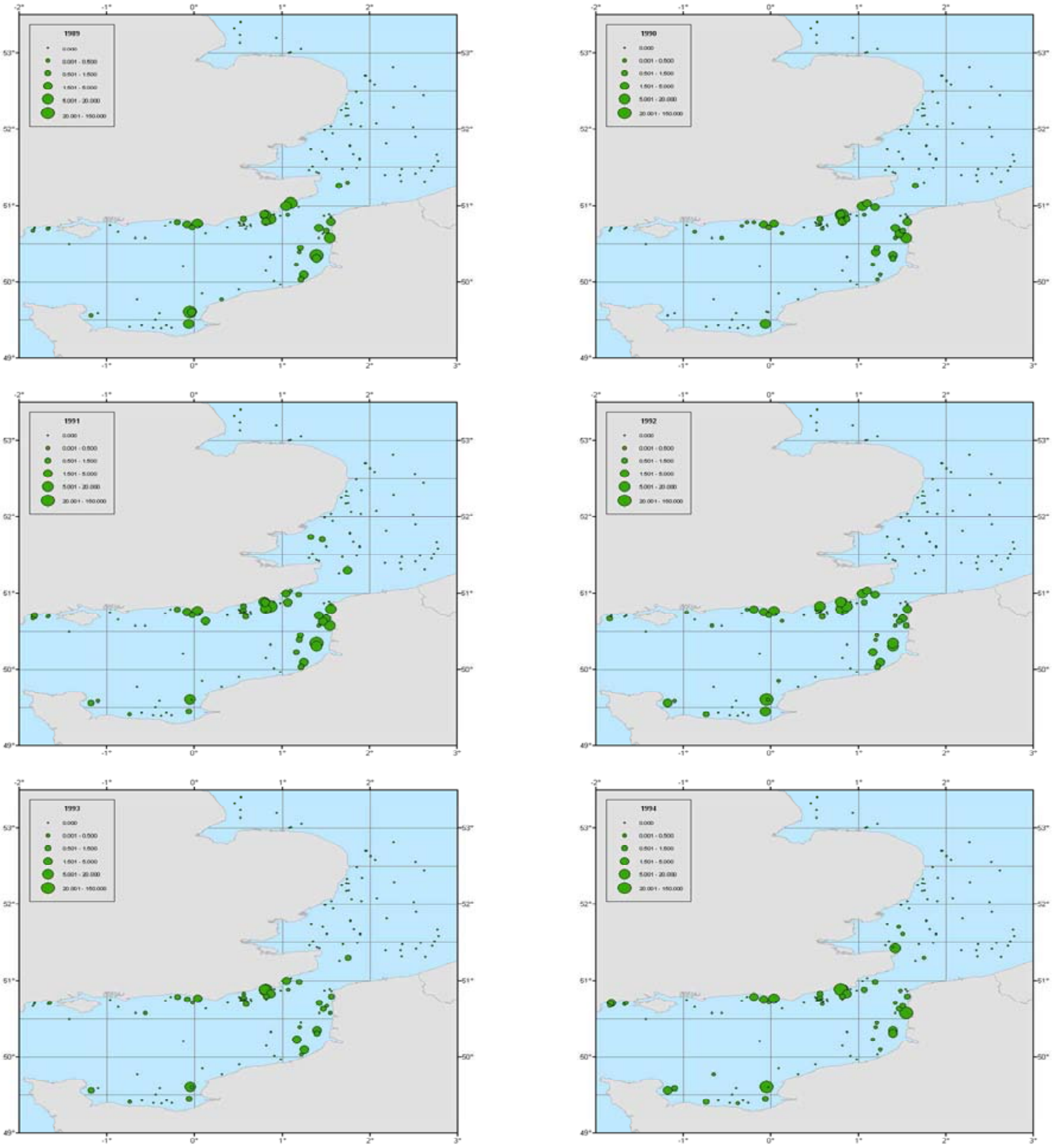
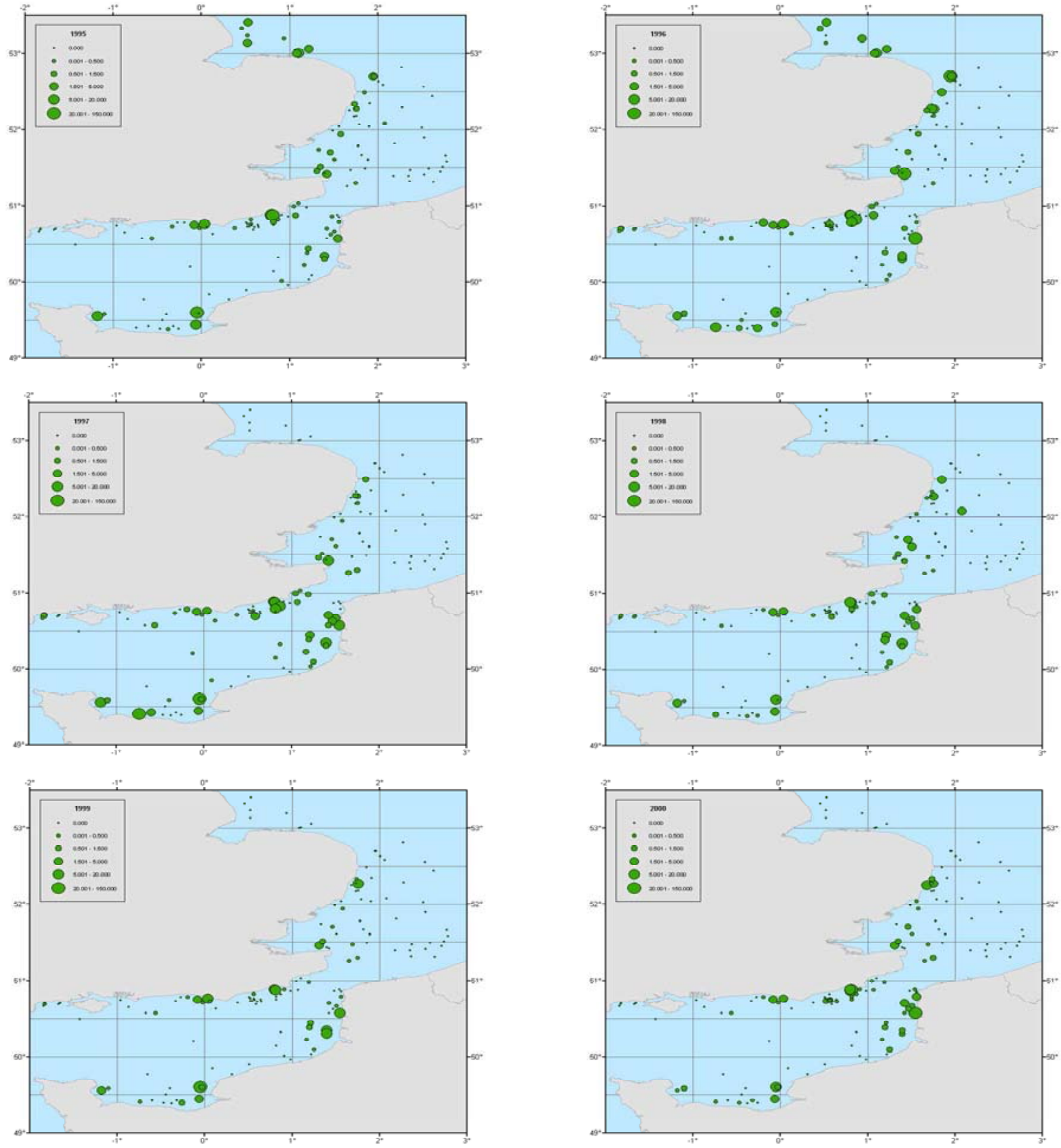


Figure 2.2.15 - Abundance (no per m beam per nm) of dab caught annually in the eastern Channel beam trawl survey, by fishing station, between 1989 and 2009.



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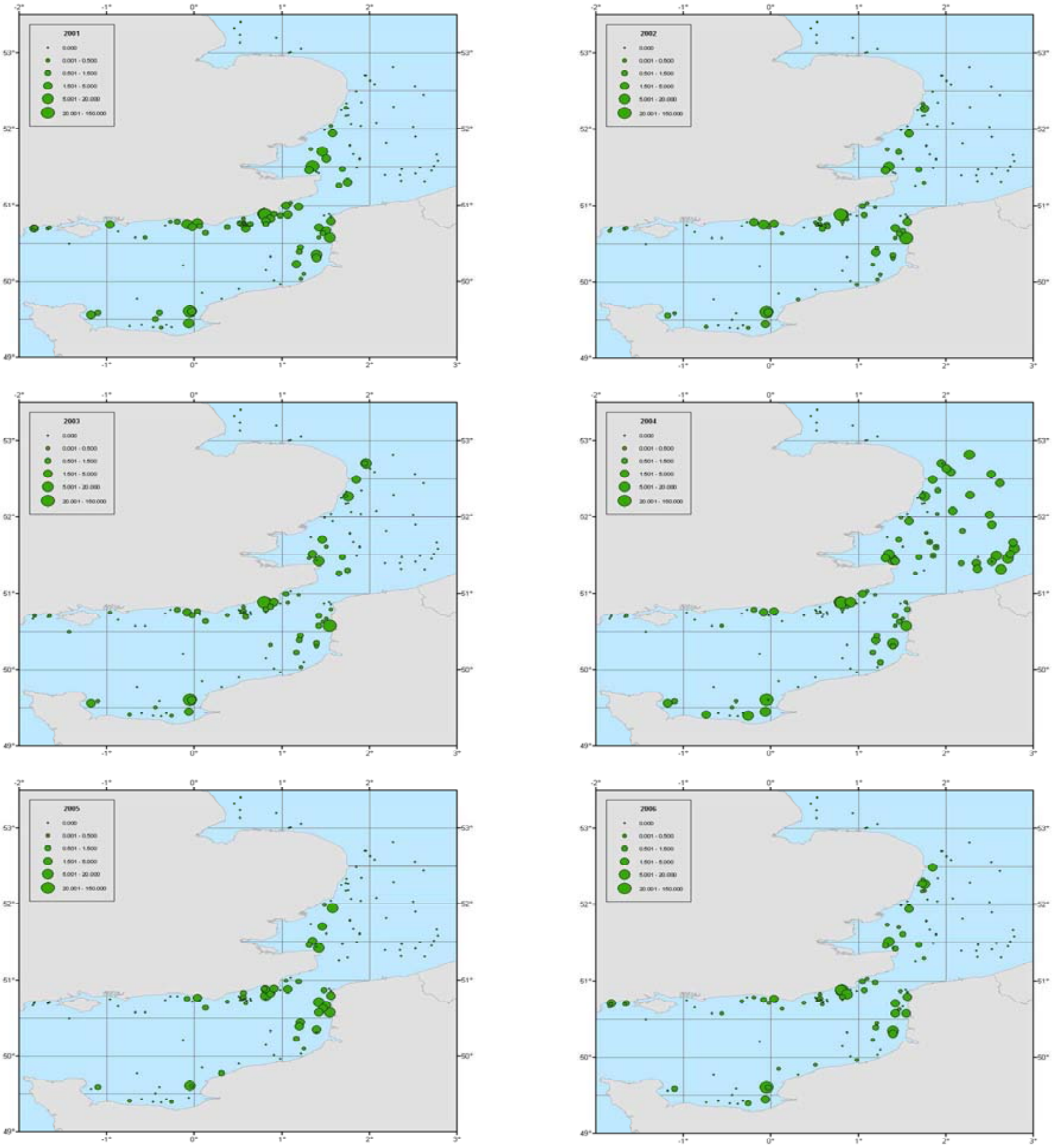

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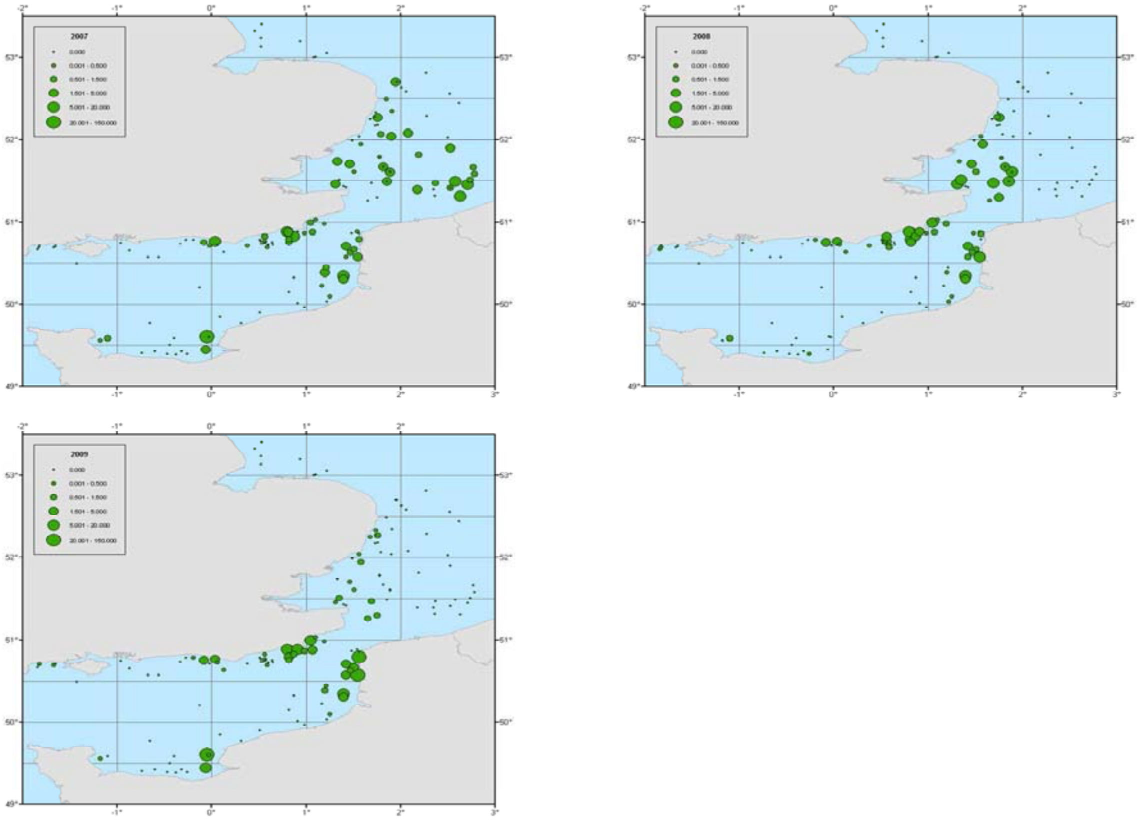

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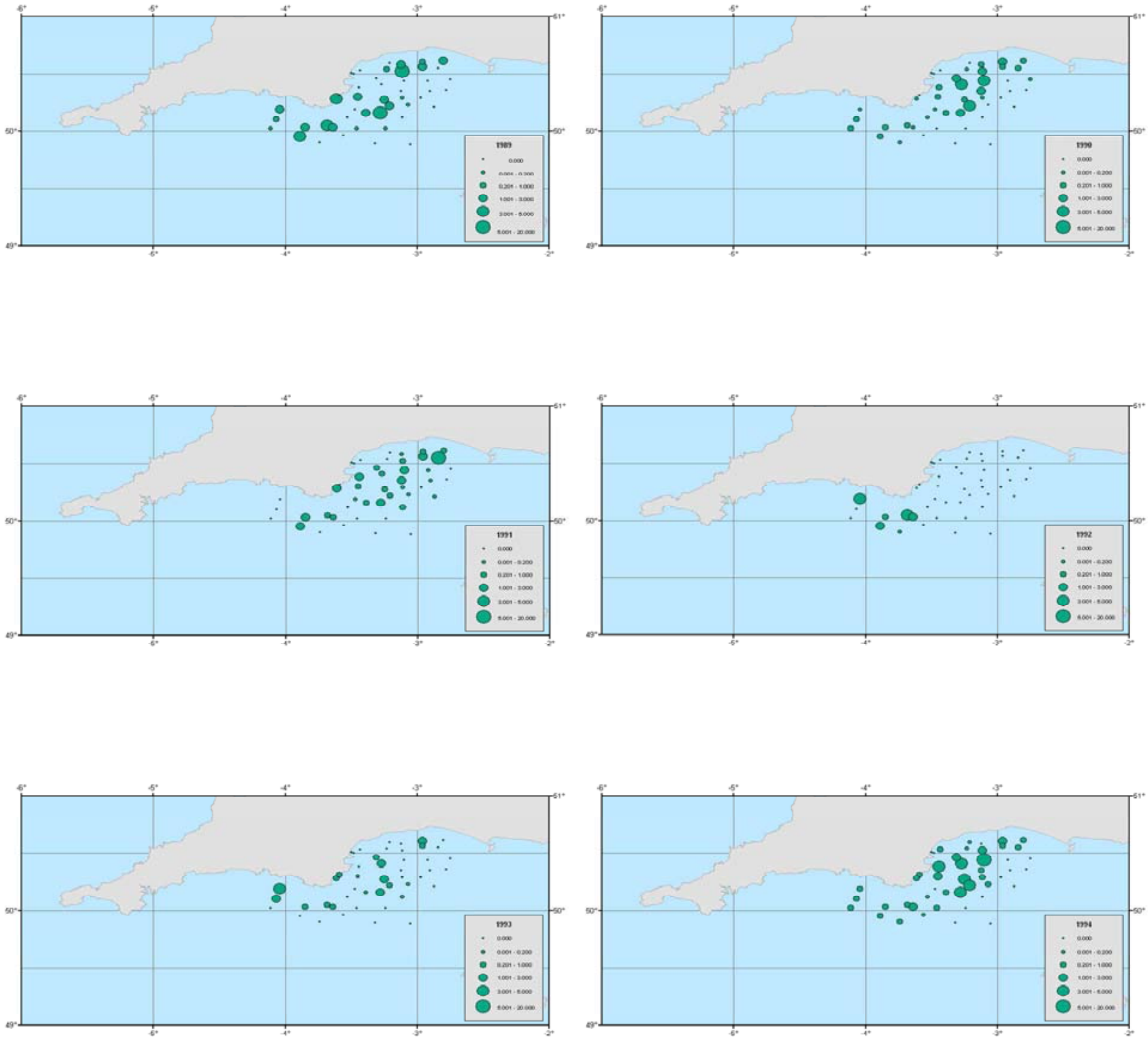
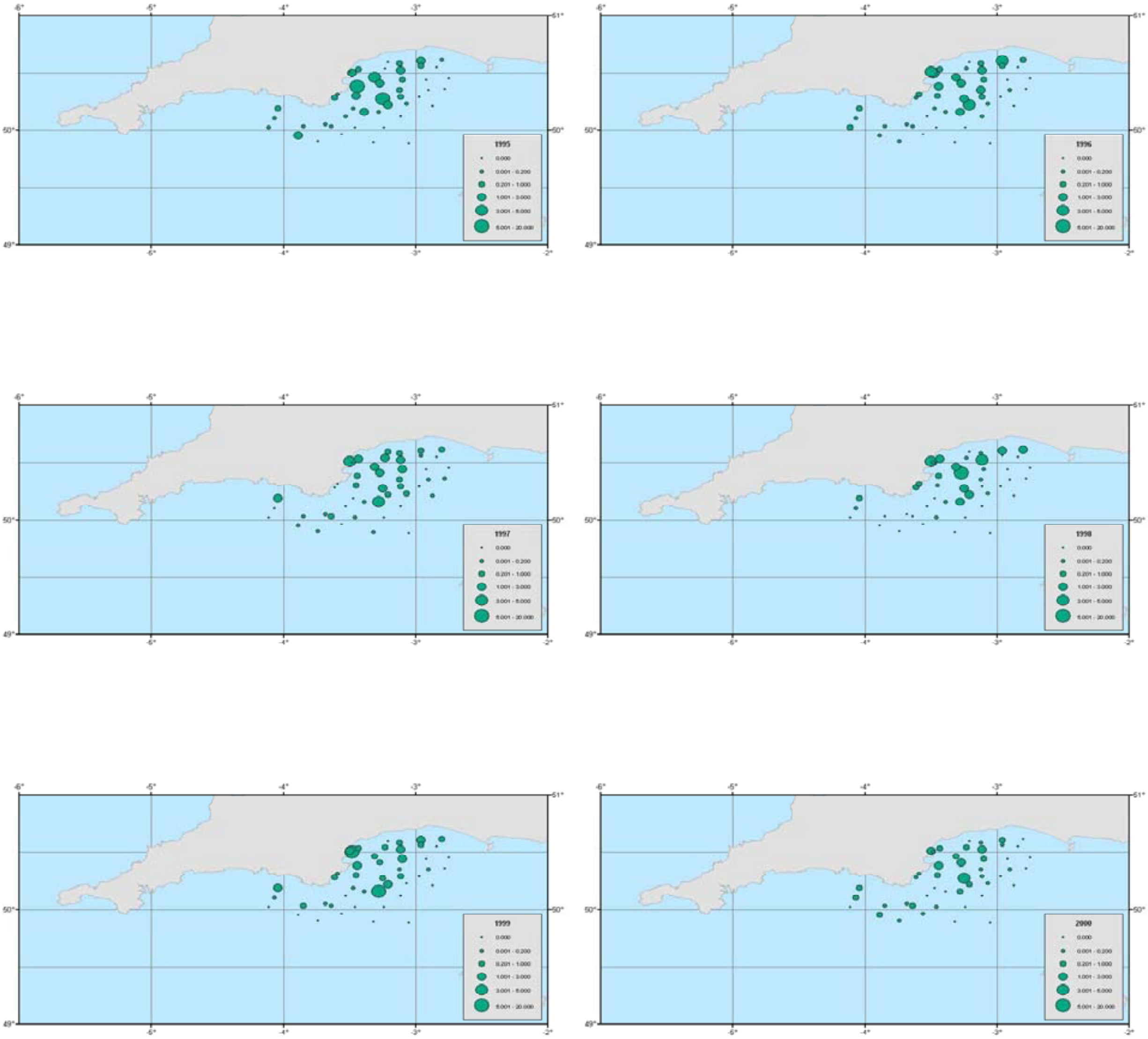


Figure 2.2.16 - Abundance (no per m beam per nm) of dab caught annually in the Carhelmar survey, by fishing station, between 1989 and 2009.



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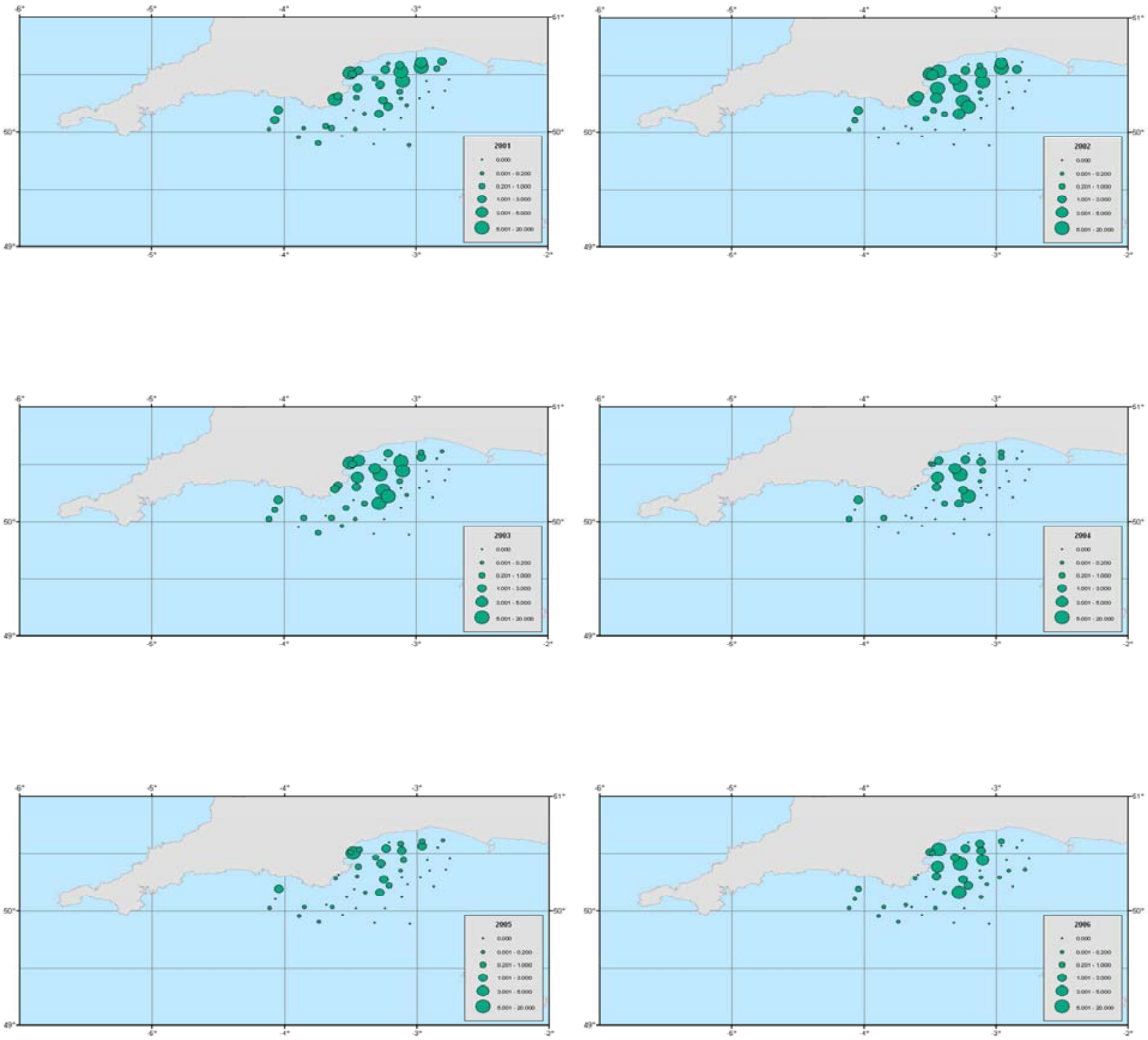

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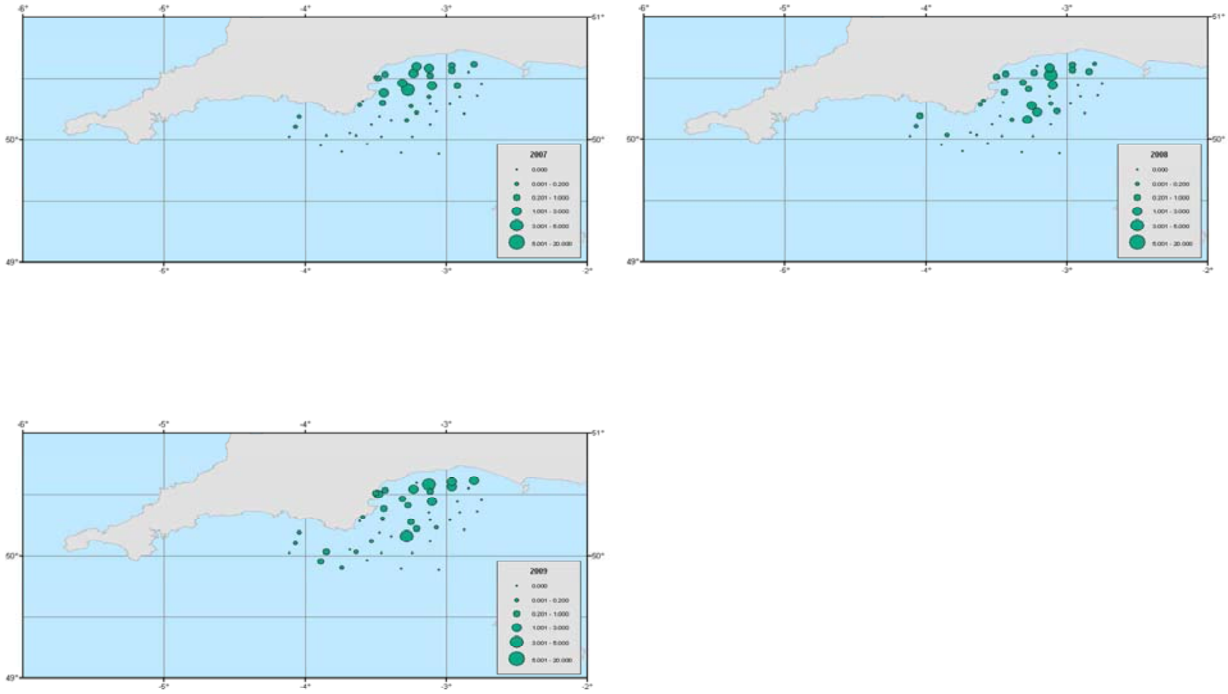

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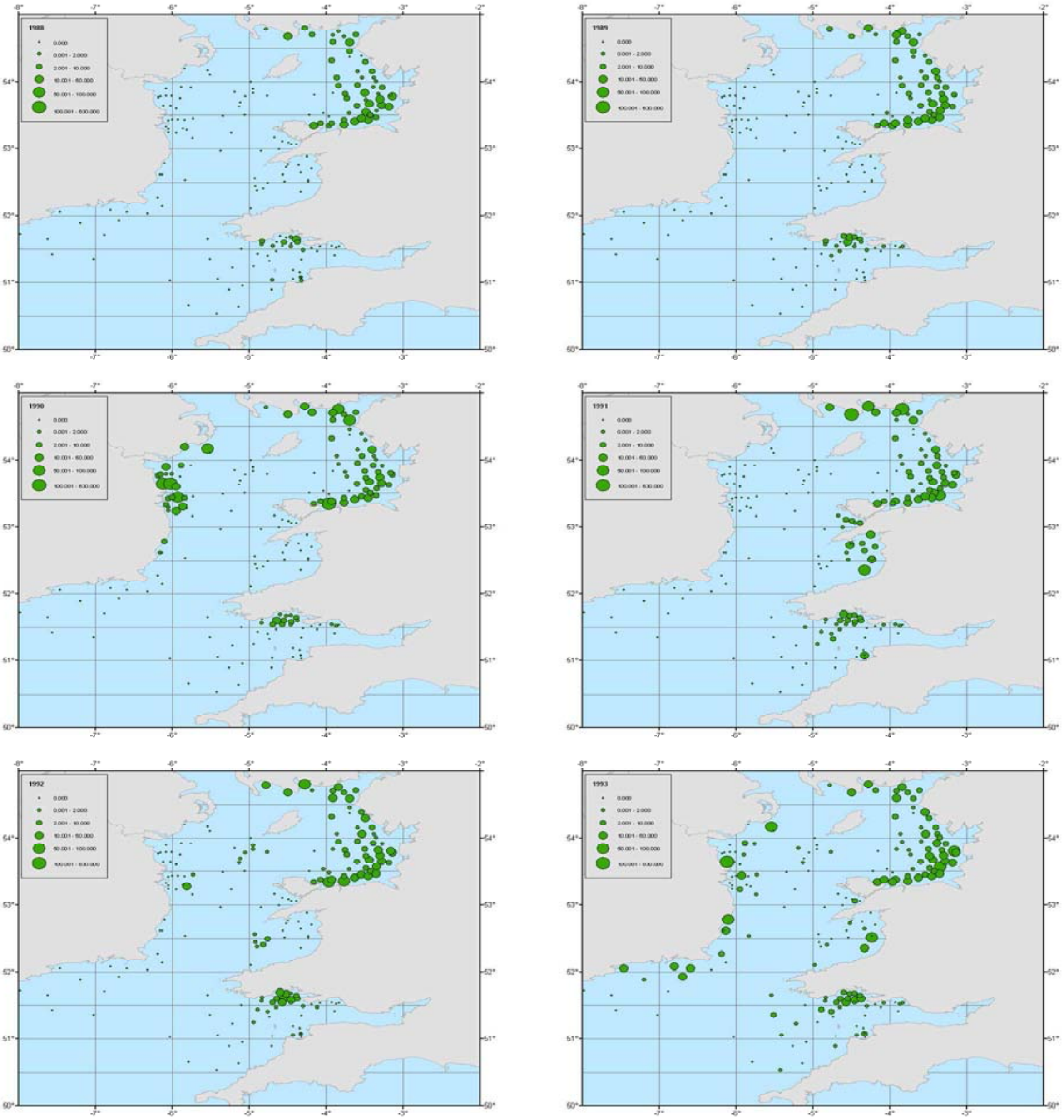
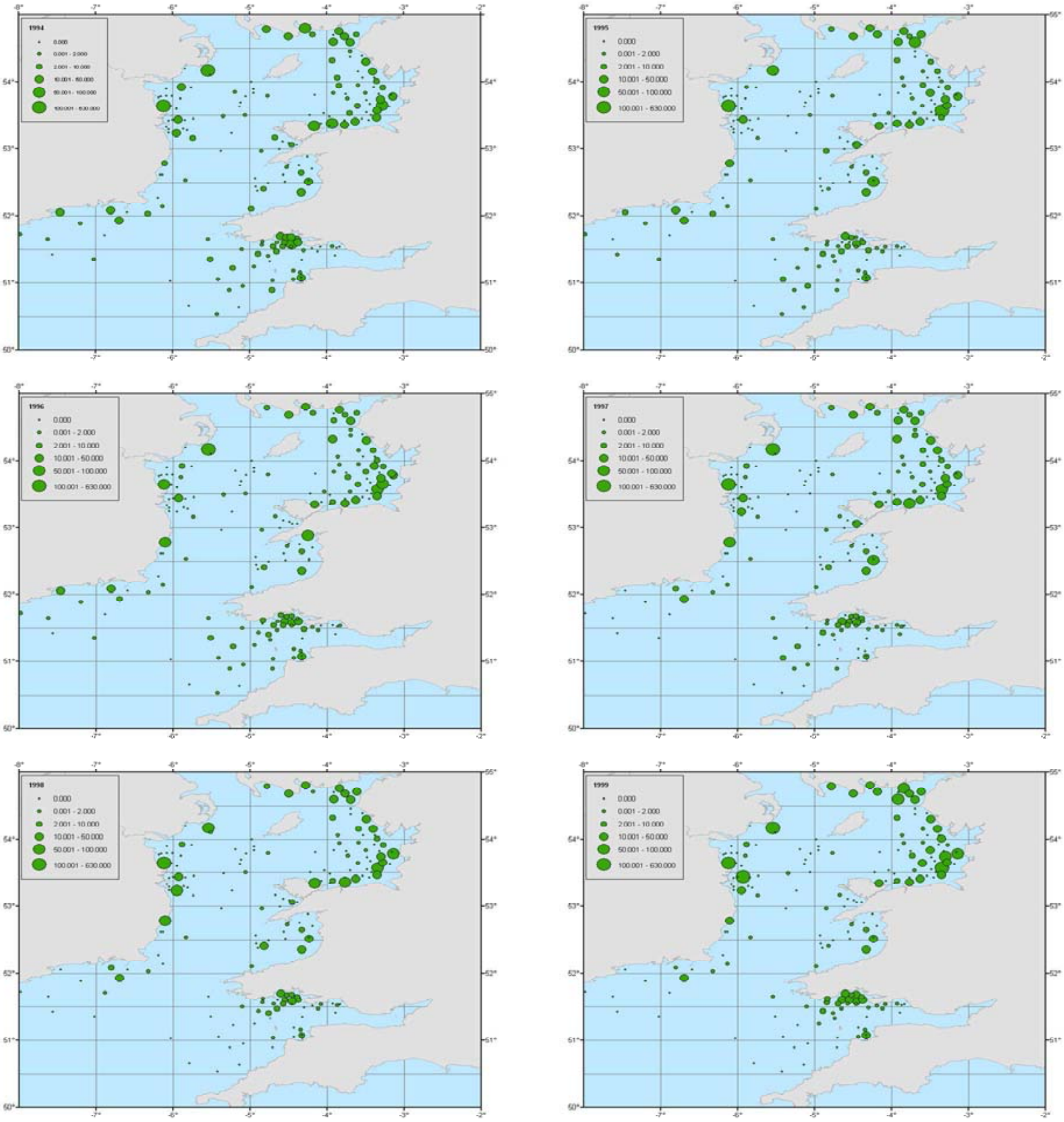


Figure 2.2.17 - Abundance (no per m beam per nm) of dab caught annually in the Irish Sea/Bristol Channel beam trawl survey, by fishing station, between 1988 and 2009.



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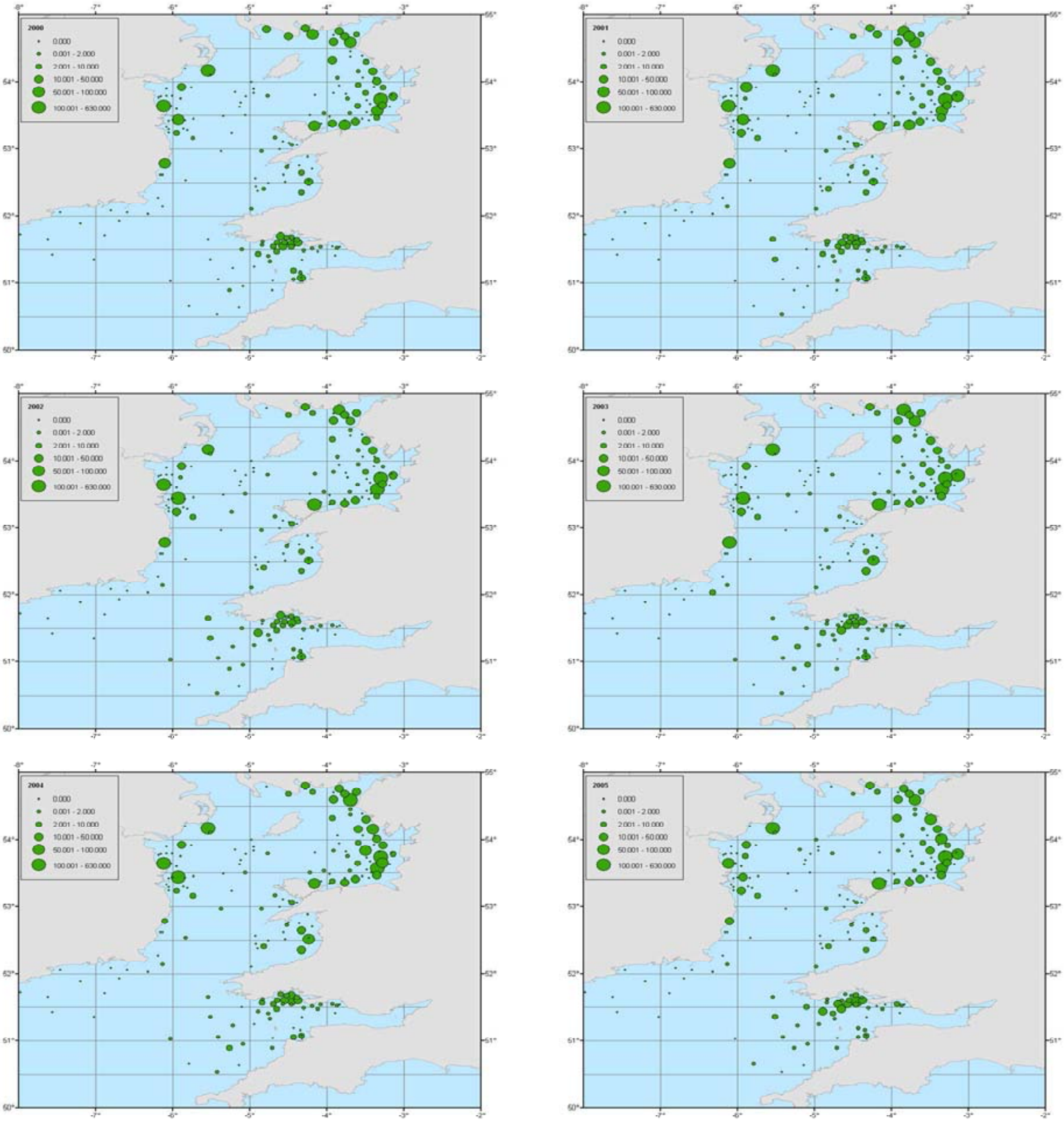

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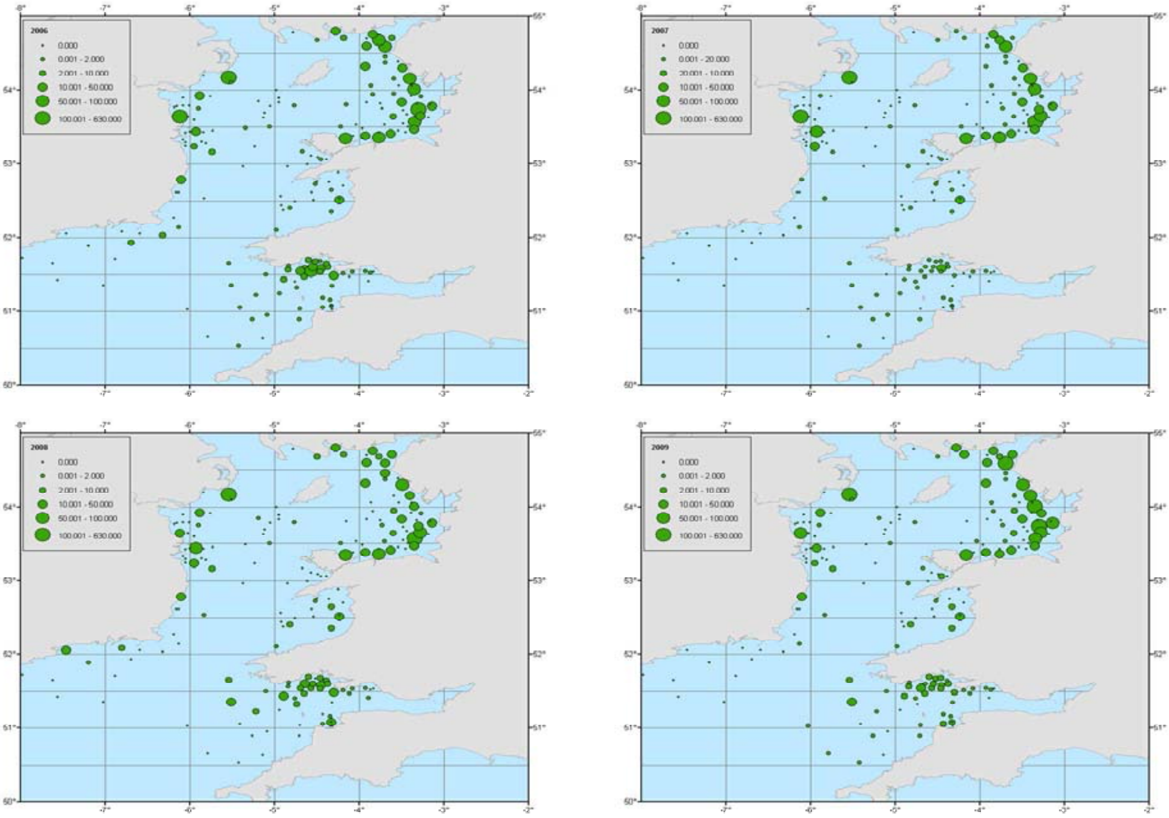

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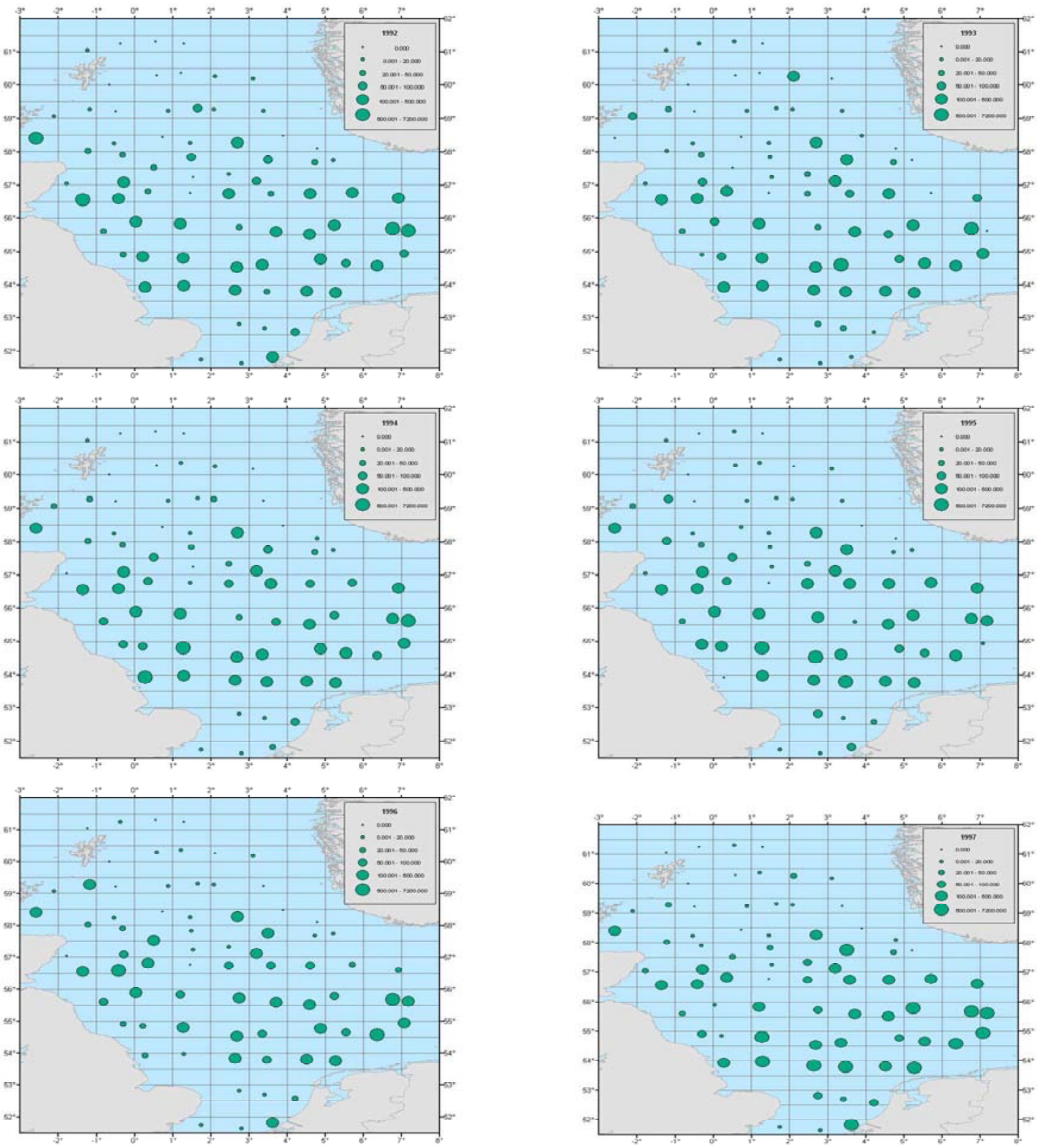
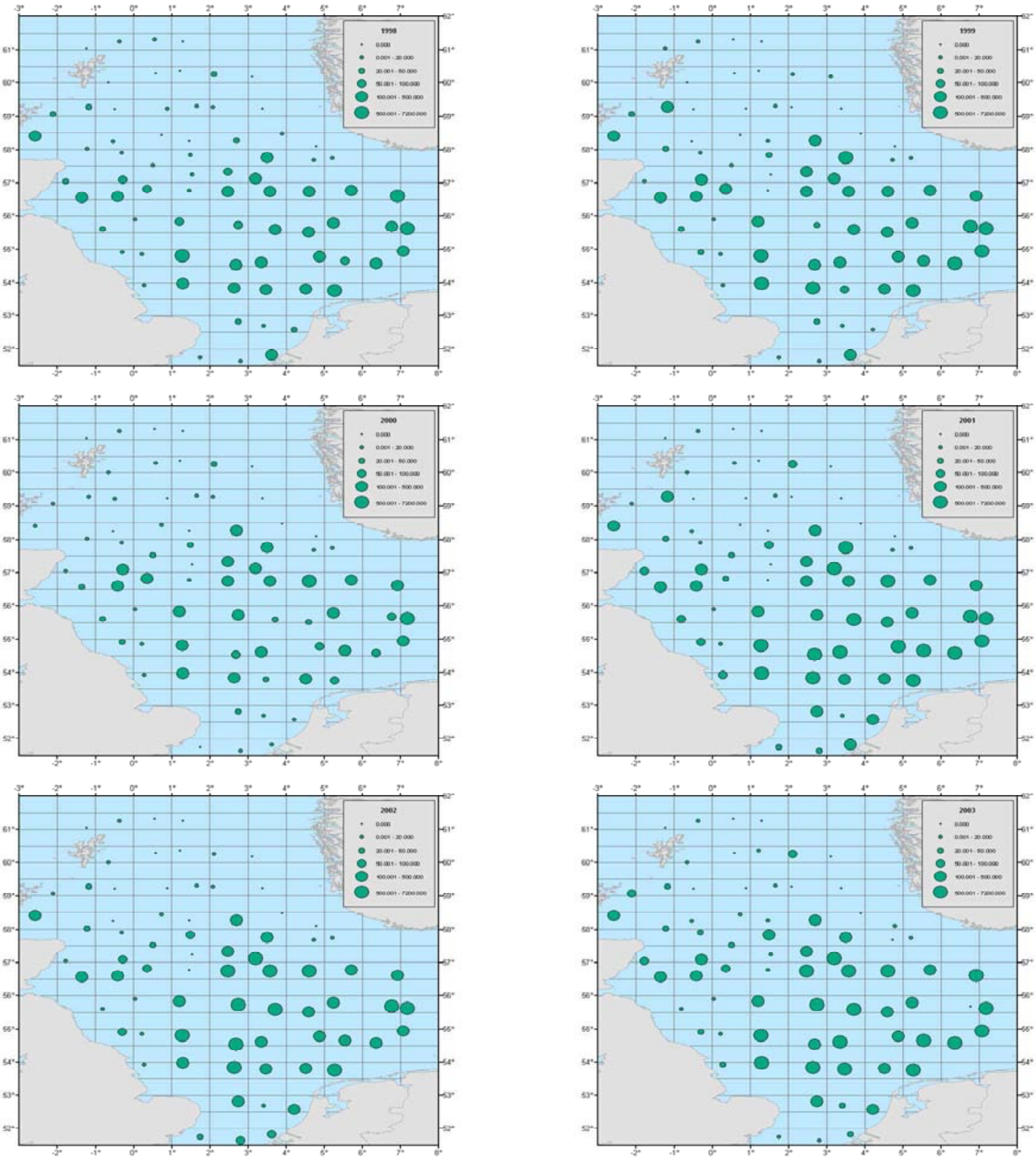


Figure 2.2.18 - Abundance (no per nm) of dab caught annually in the North Sea survey, by fishing station, between 1992 and 2009.



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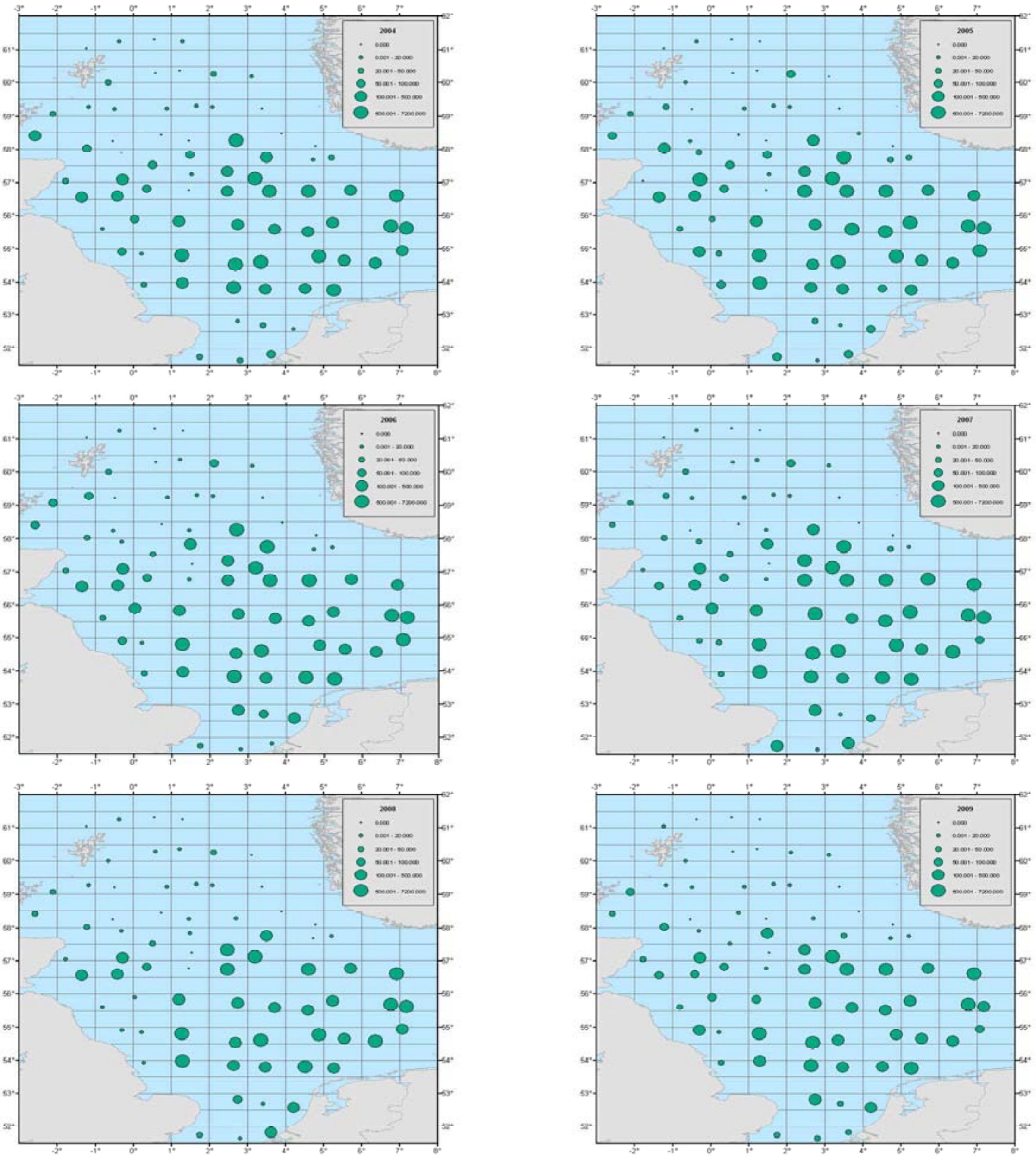

Figure 2.2.18 – Continued.

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.

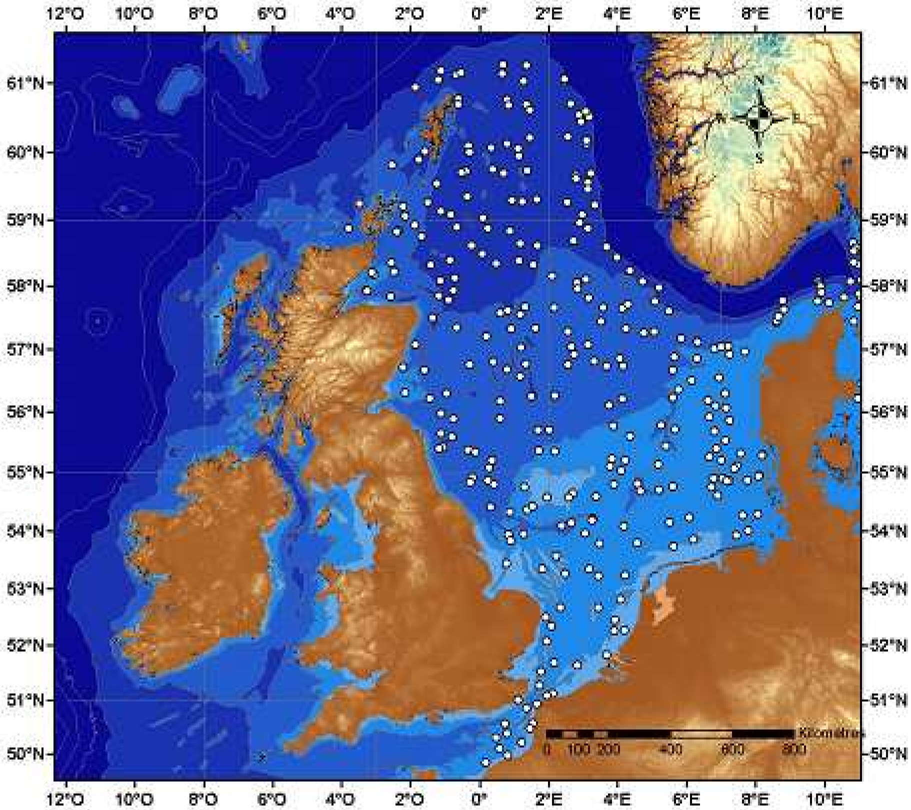

Figure 2.3.1 - Station map of the IBTS in the North Sea in 2009, quarter 1.

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.

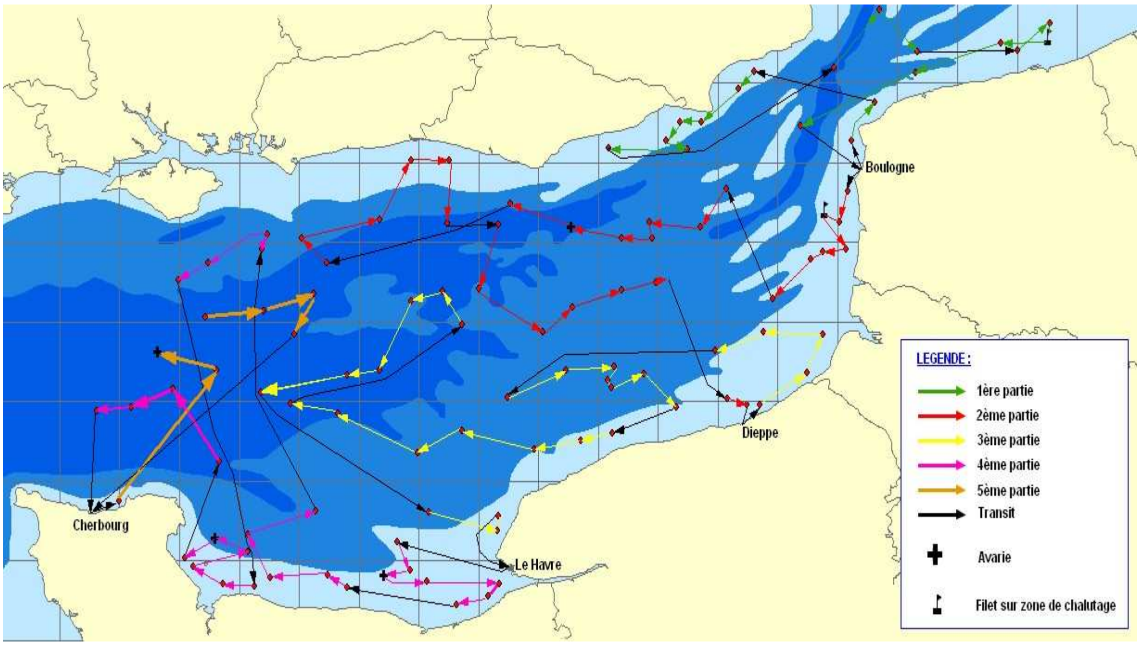

Figure 2.3.2 – Station map of CGFS survey in the eastern Channel.

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.

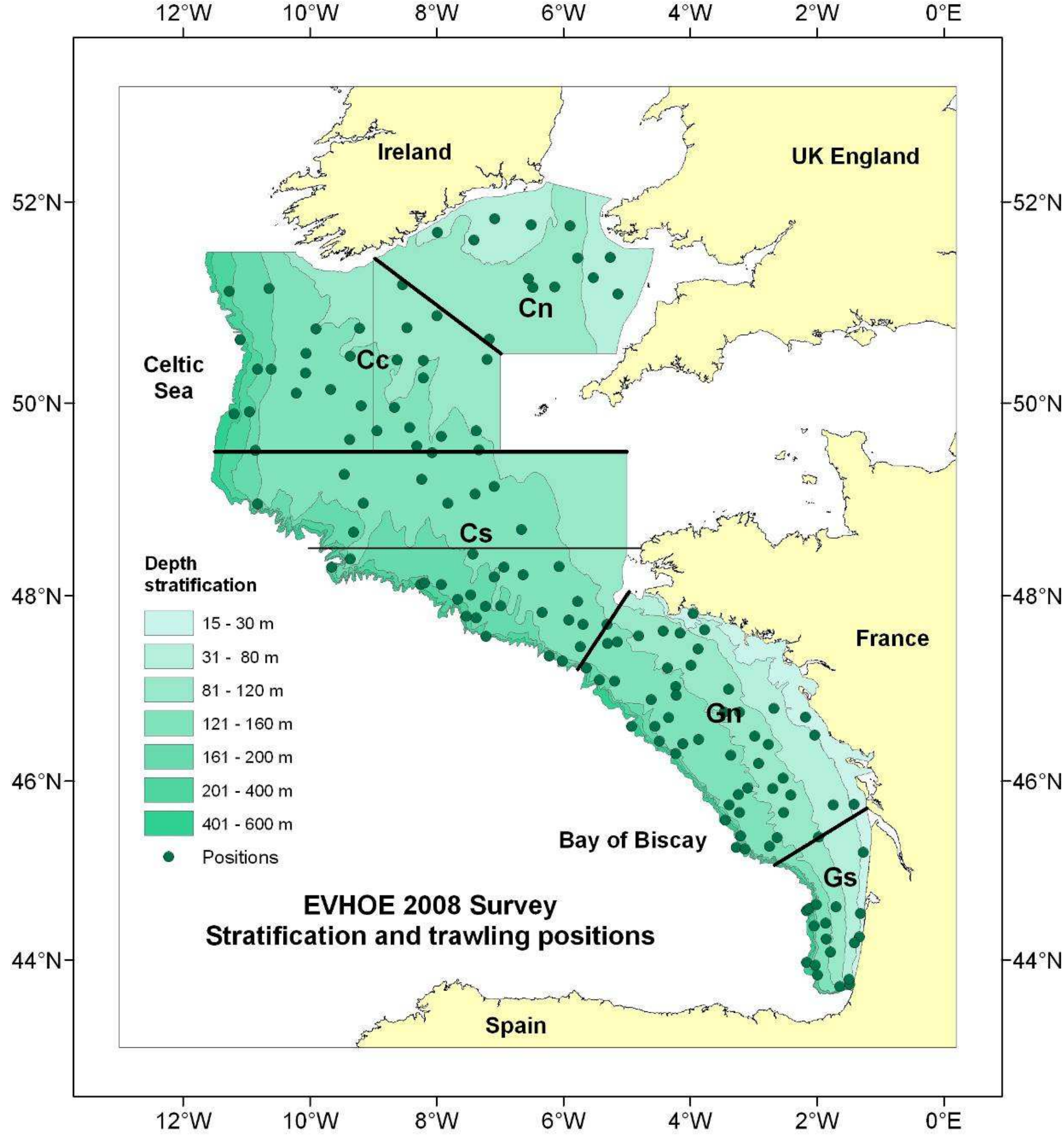

Figure 2.3.3 - Area covered, stratification used and an example of trawling positions in the EVHOE survey.

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.

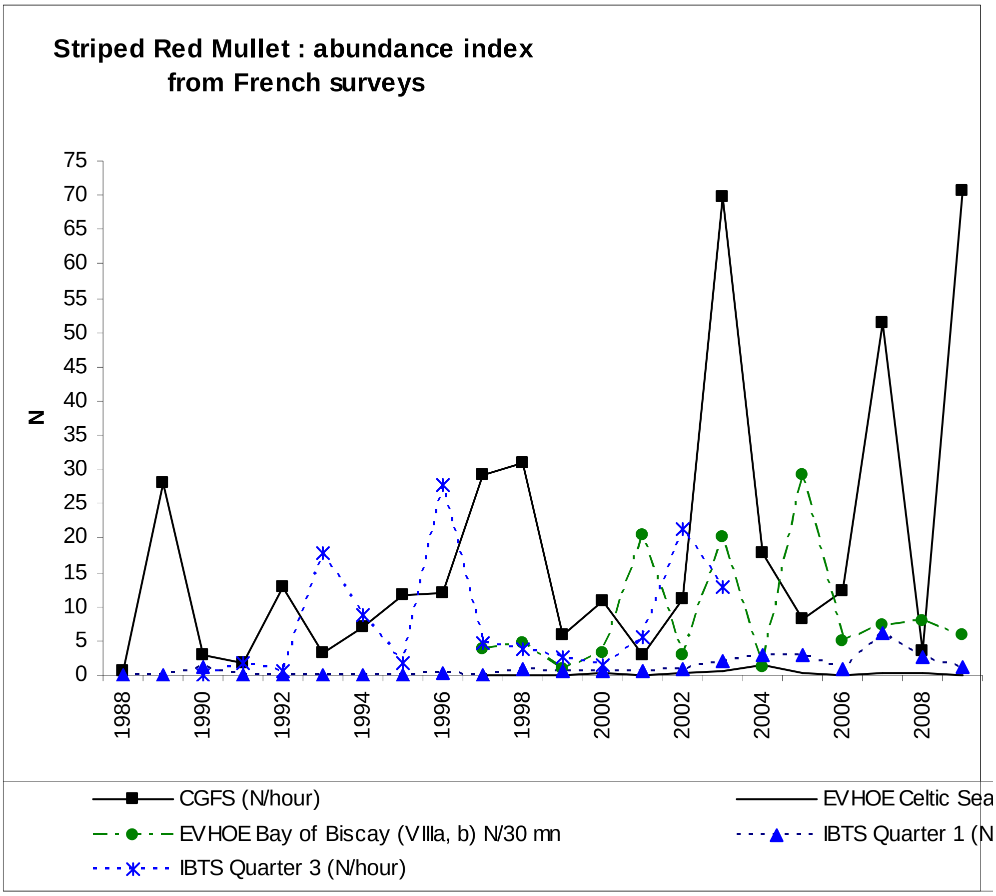

Figure 2.3.4 - Time series of abundance of striped red mullet base on FR-Surveys from 1980 to 2009.

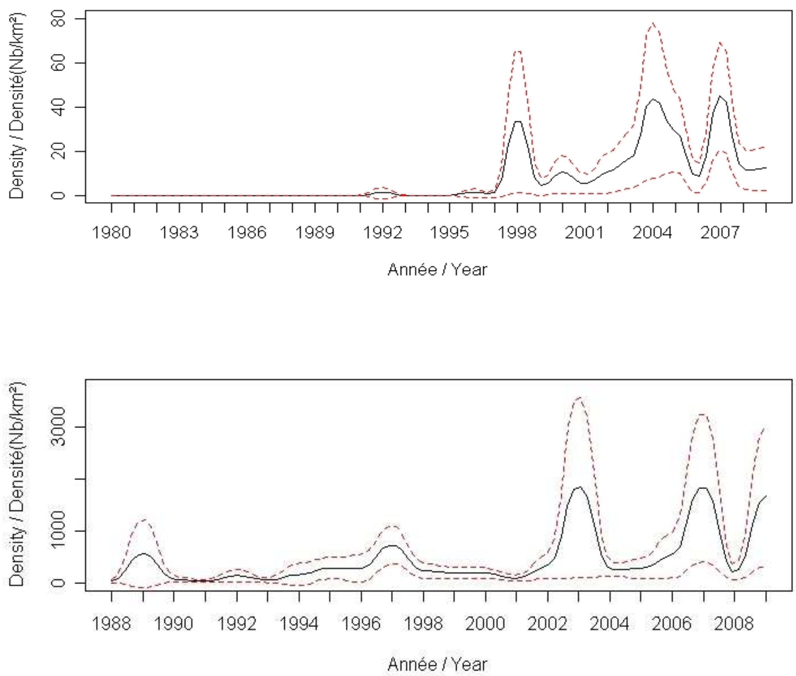

Figure 2.3.5 - Time series of abundance of striped red mullet in the North Sea based on FR-IBTS data (Nb/km²) from 1980 to 2009 (upper panel) and in the eastern Channel based on FR-CGFS data (Nb/km²) from 1988 to 2009 (lower panel). Lines are smoothed, 95% confidence intervals are shown.

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

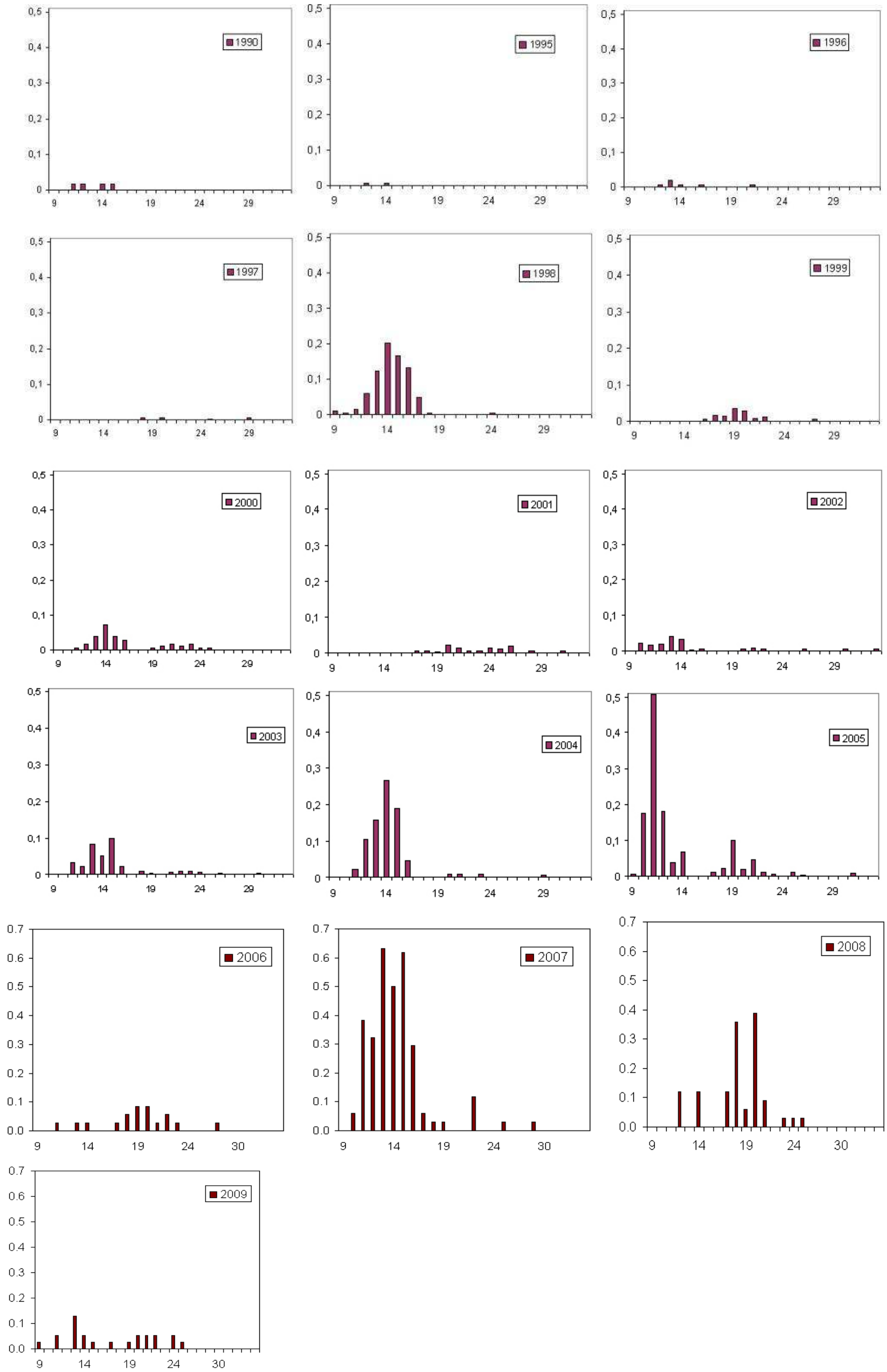

Figure 2.3.6 - Abundance indices (N/30 min) of striped red mullet per size class (length in cm.) during IBTS-Q1, all countries, from 1990 to 2009.

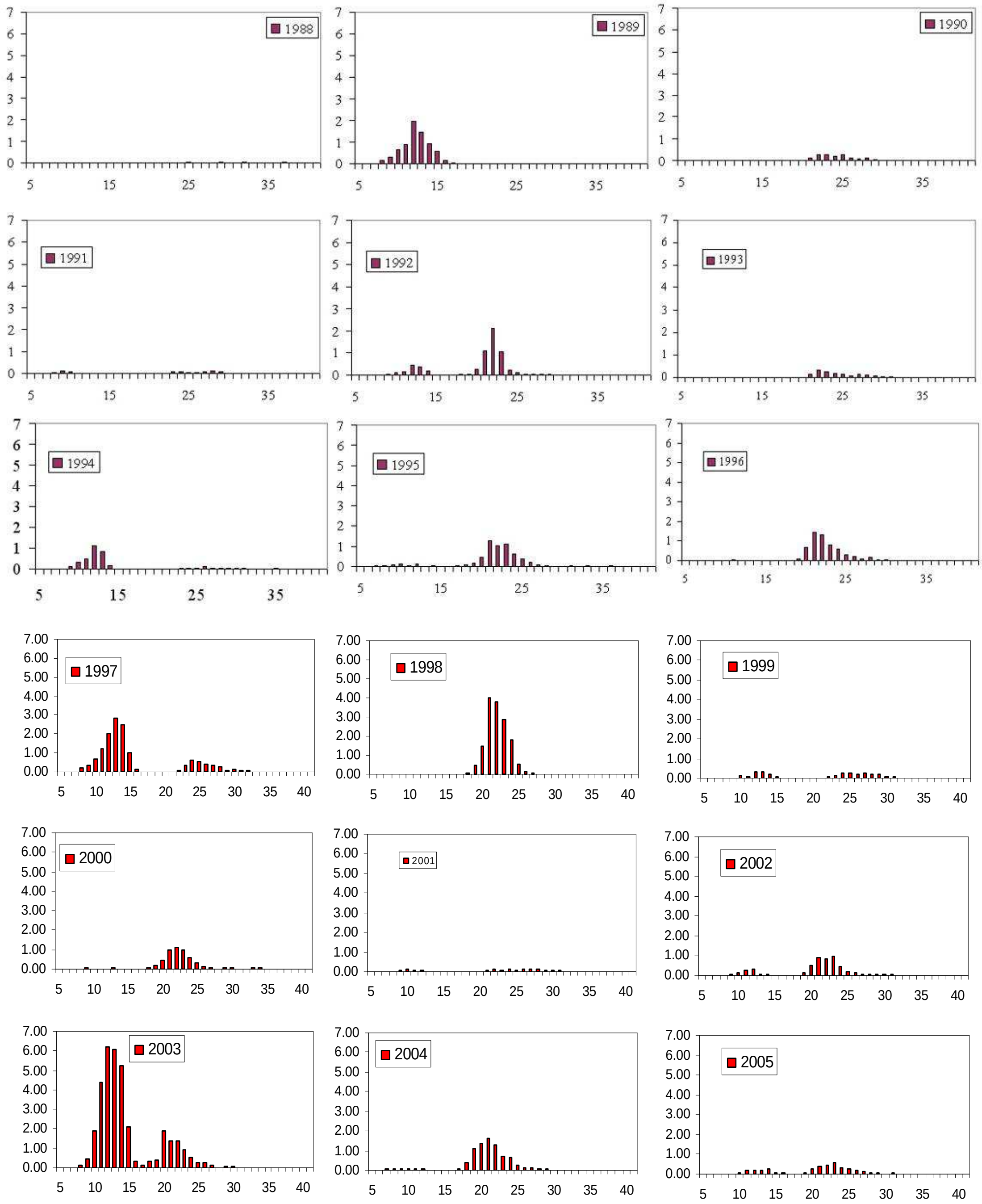

Figure 2.3.7 - Abundance indices (N/30 min) of striped red mullet per size class (length in cm.) during FR-CGFS from 1988 to 2009.

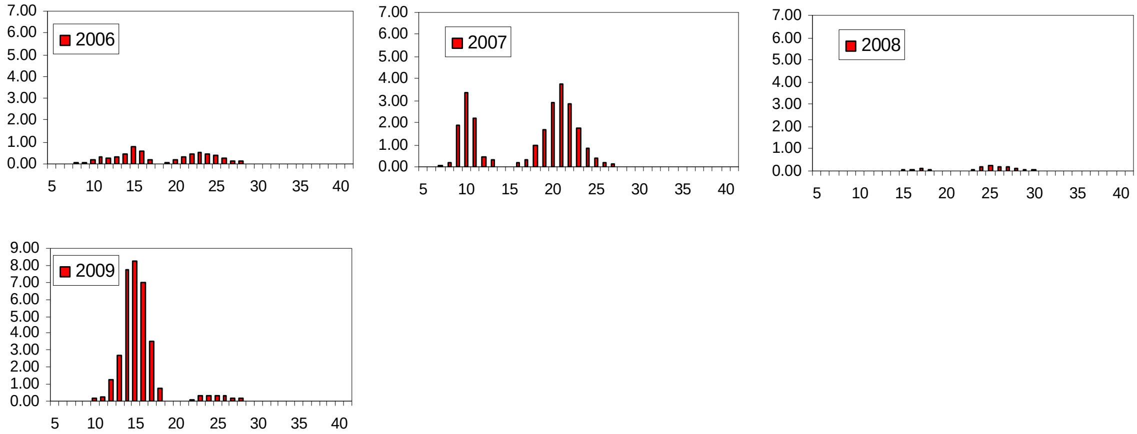

Figure 2.3.7 – Continued

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

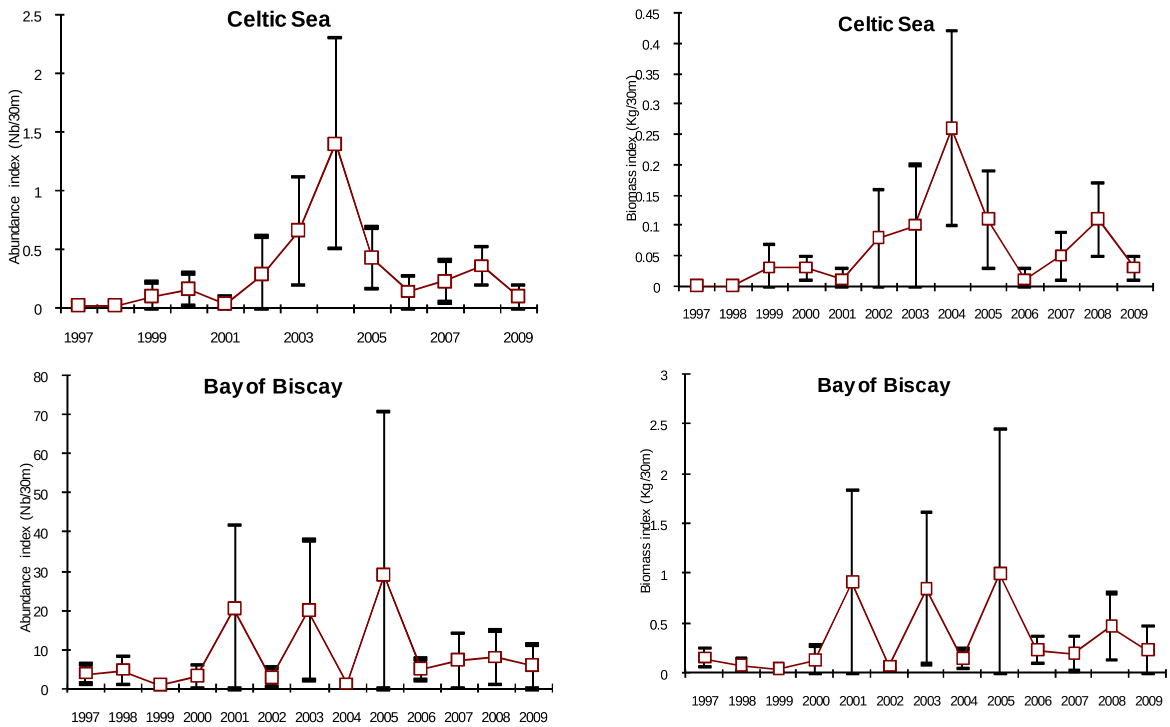

Figure 2.3.8 - Time series of abundance (N) and biomass (kg) per 30 minutes of striped red mullet in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

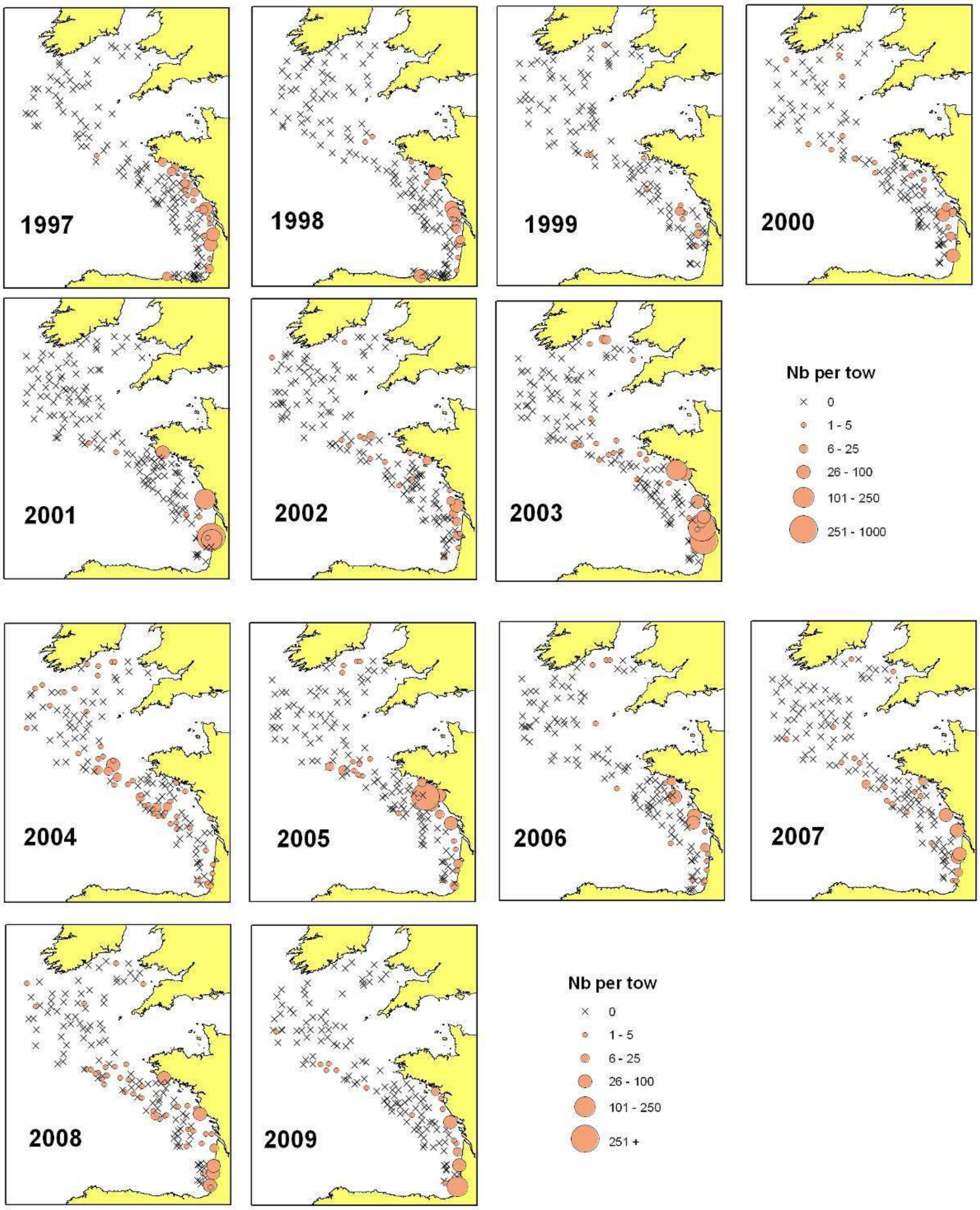

Figure 2.3.9 – Distribution of striped red mullet in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

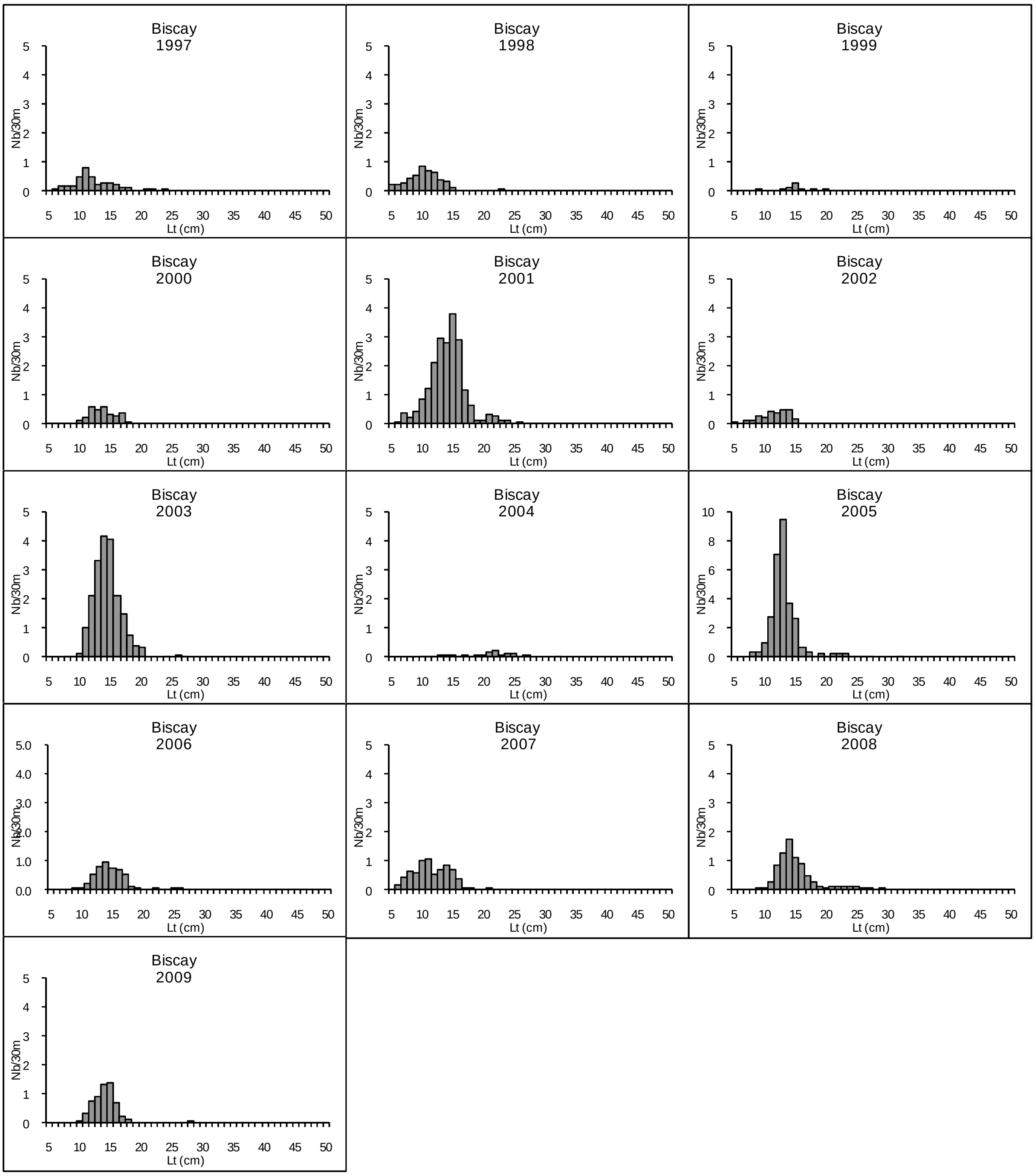

Figure 2.3.10 - Abundance indices (N/30 min) of striped red mullet per size class (length in cm) during FR-EVHOE (Bay of Biscay) from 1997 to 2009.

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).

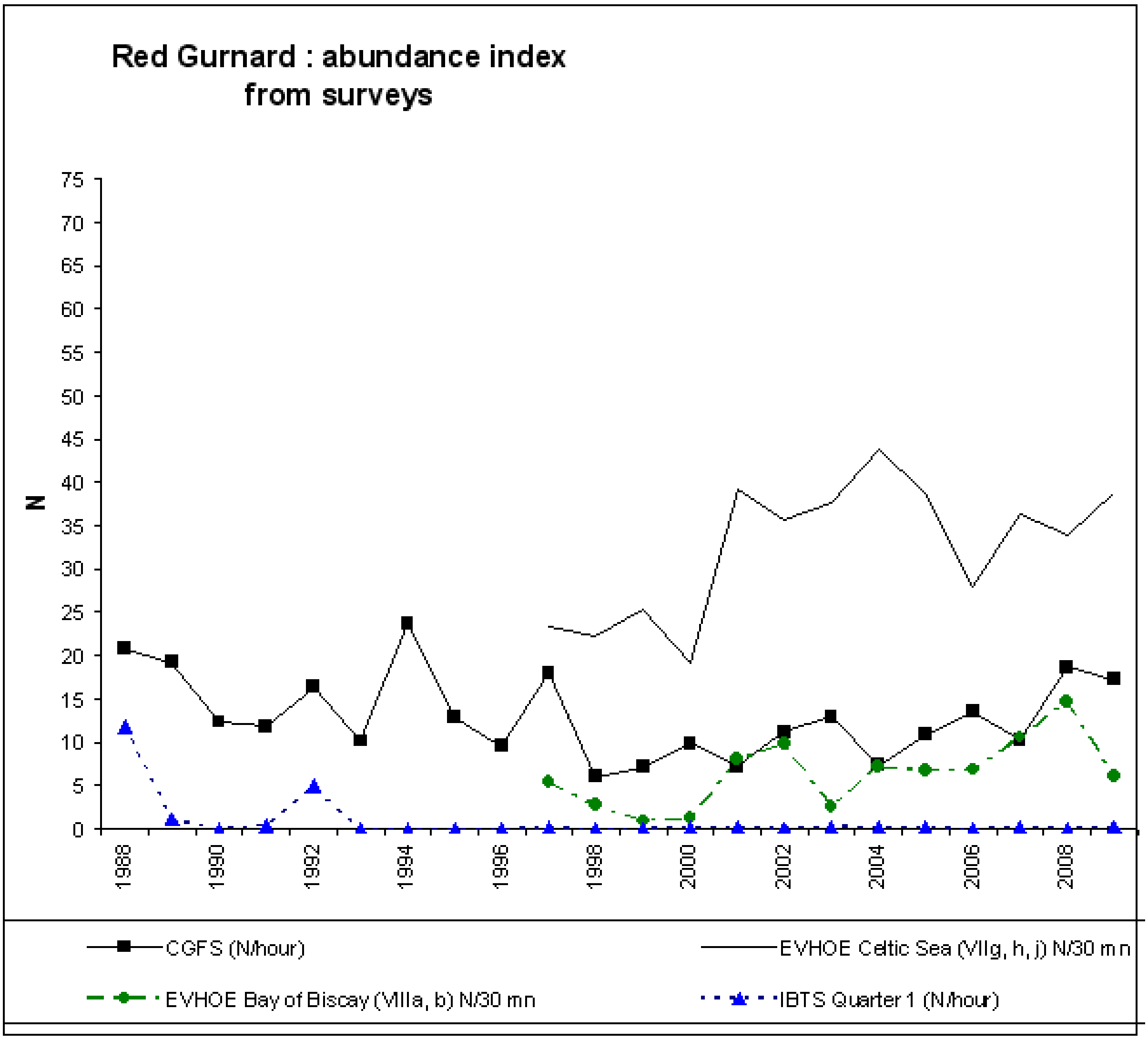

Figure 2.3.11 - Time series of abundance of red gurnard base on FR-Surveys from 1980 to 2009.

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

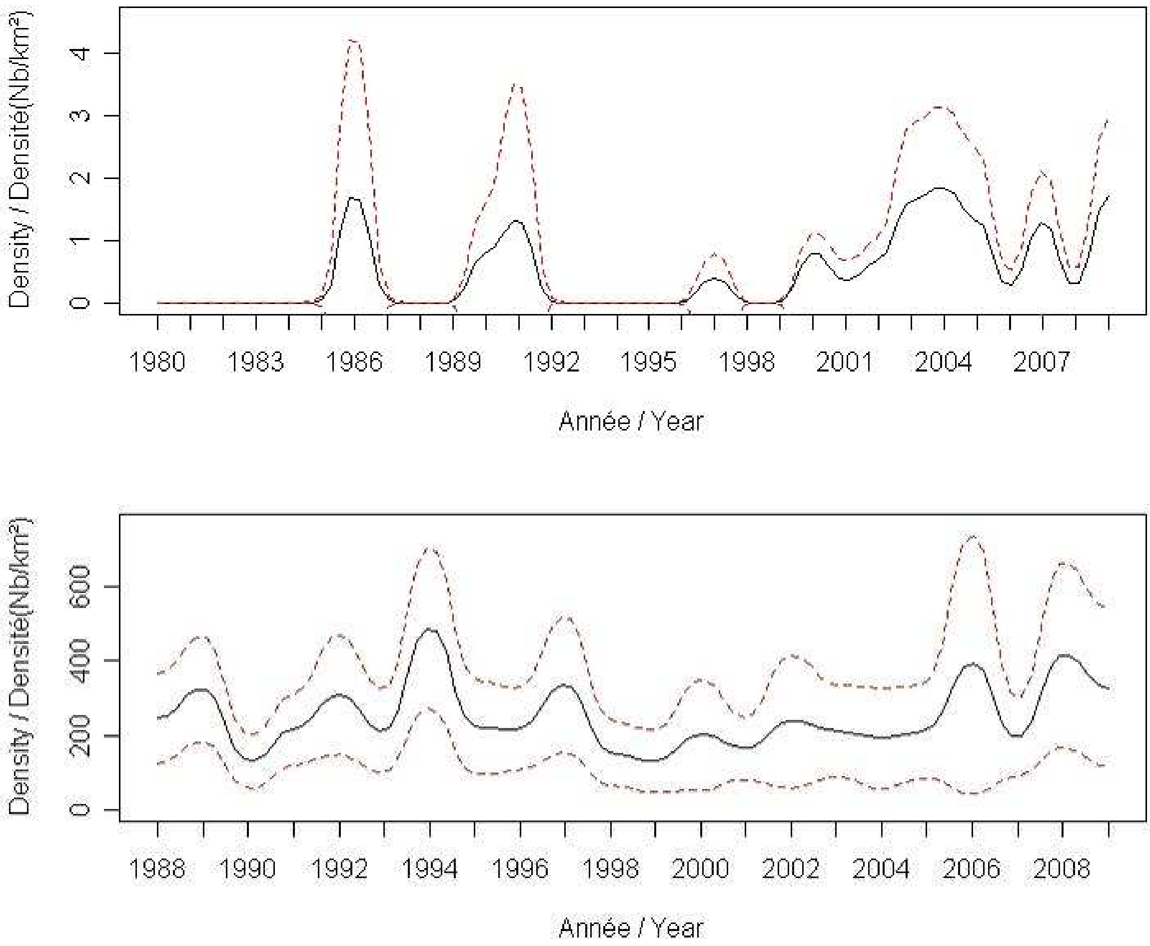

Figure 2.3.12 - Time series of abundance of red gurnard in the North Sea based on IBTS data (N/km²) from 1980 to 2009 (upper panel) and in the eastern Channel based on FR-CGFS data (N/km²) from 1988 to 2009 (lower panel). Lines are smoothed, 95% confidence intervals are shown.

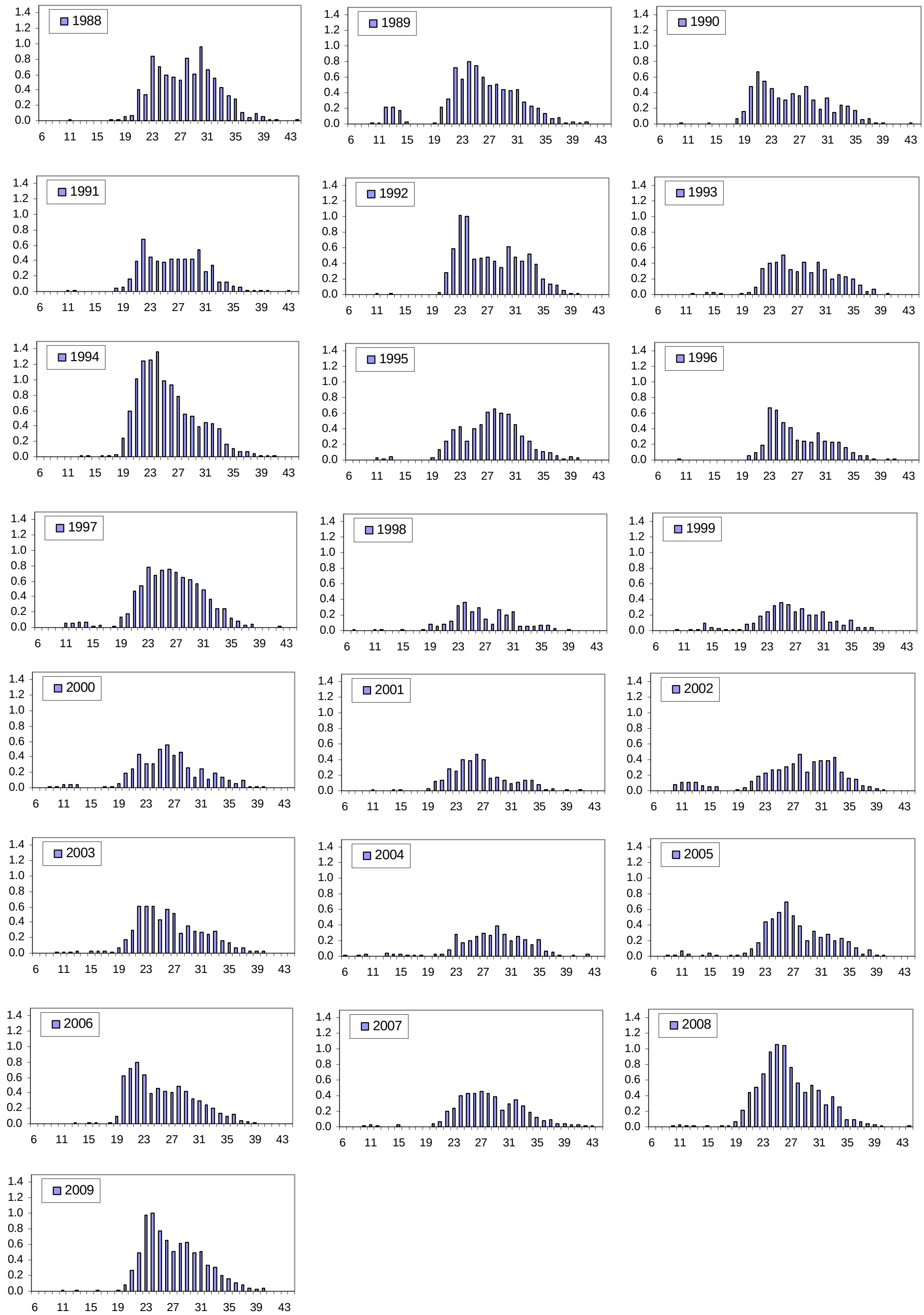

Figure 2.3.13 – Abundance index at length of red gurnard in the Eastern Channel from FR-CGFS surveys.

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

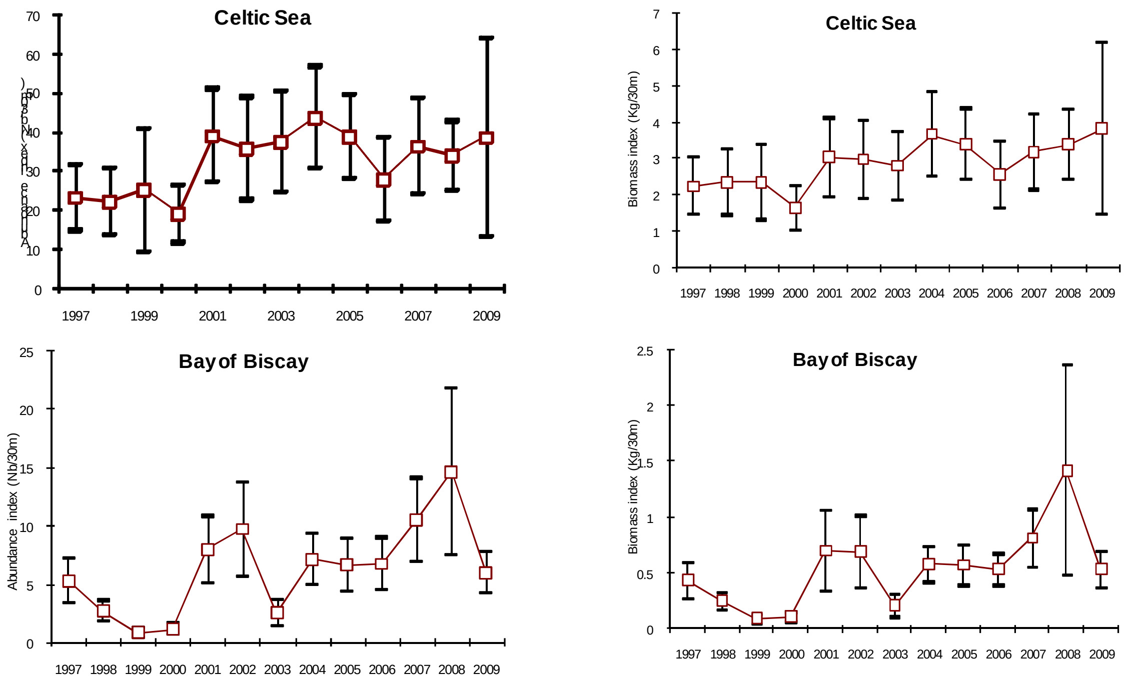

Figure 2.3.14 – Time series of abundance (N and W(kg)/30 min) of red gurnard in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

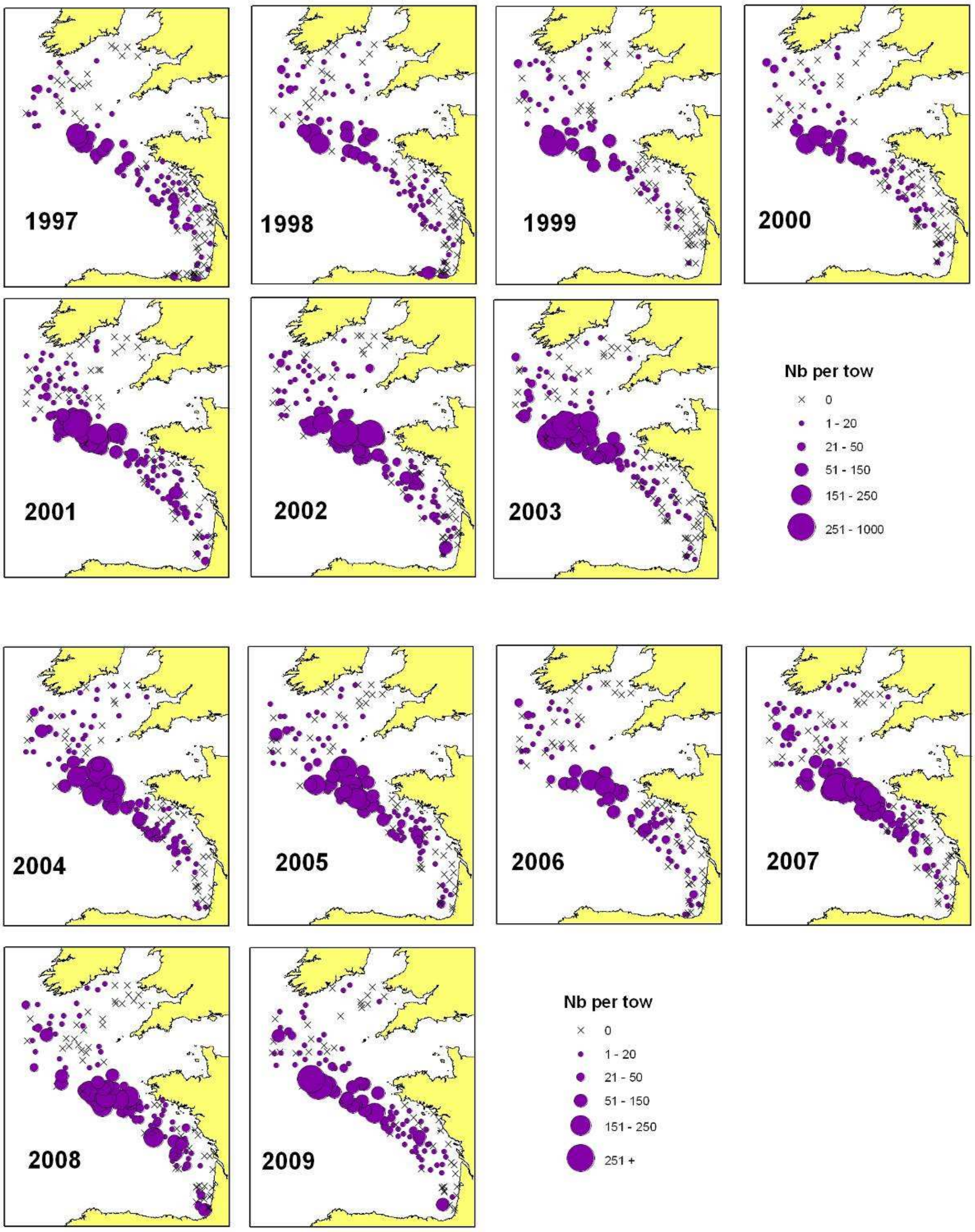

Figure 2.3.15 – Distribution of red gurnard in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

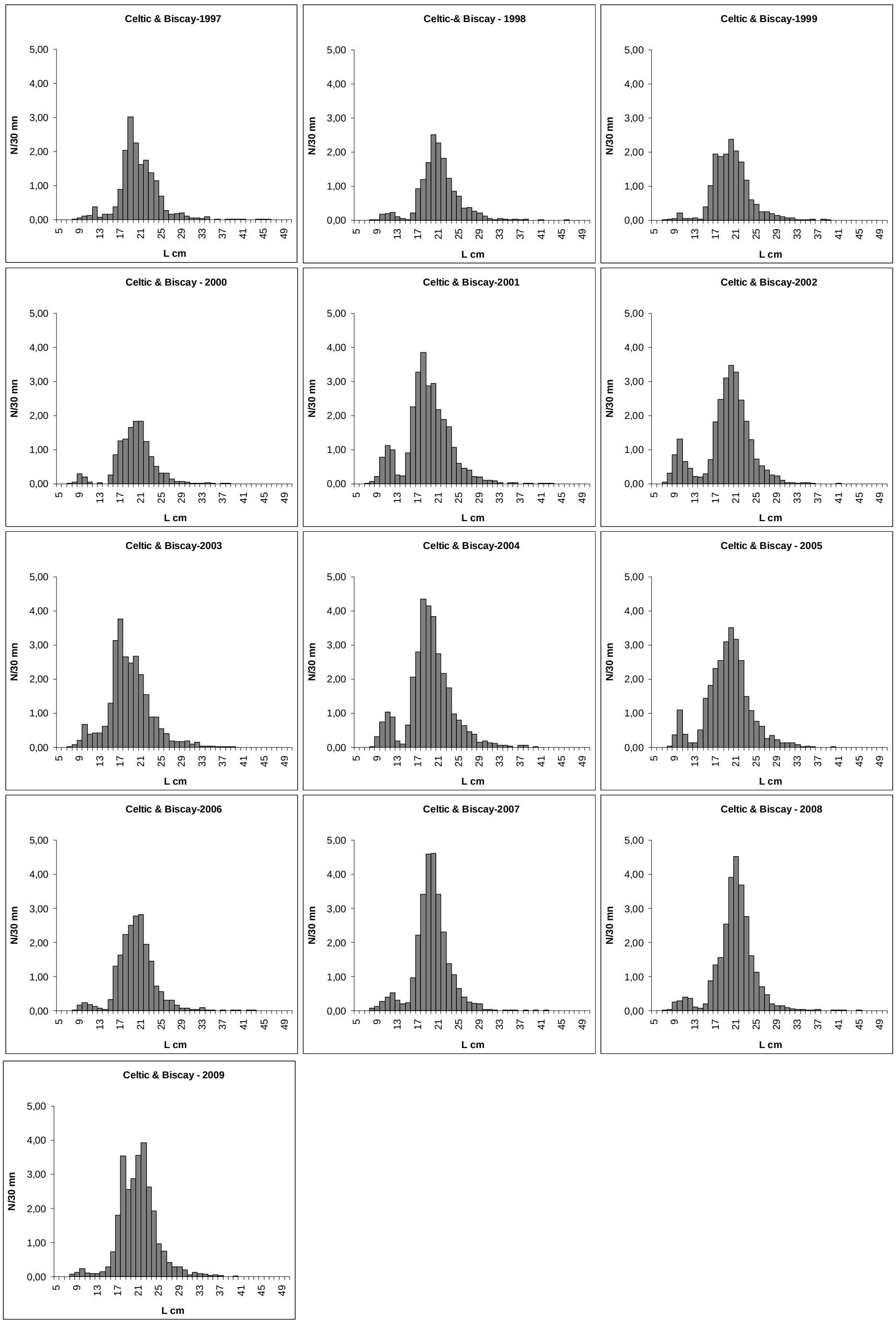

Figure 2.3.16 - Length abundance index of red gurnard in the combined areas of Celtic Sea and bay of Biscay from FR-EVHOE surveys series.

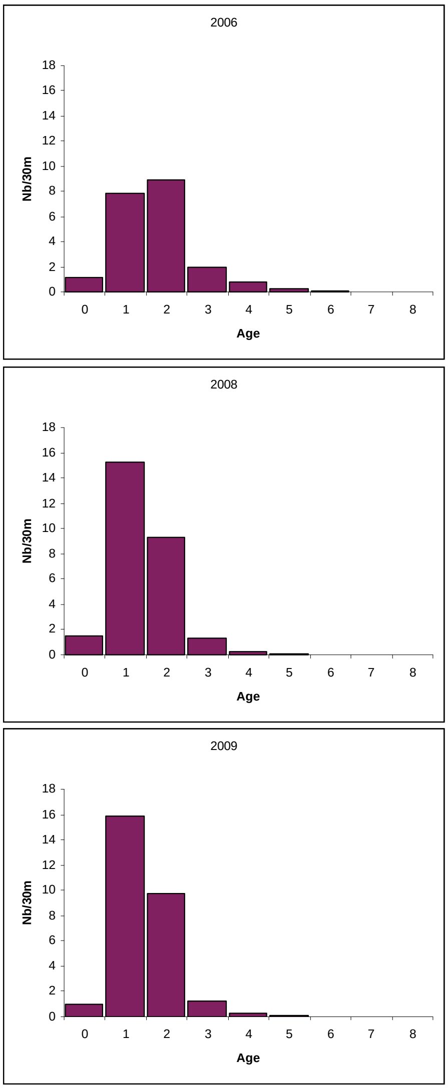

Figure 2.3.17 - Abundance index at age of red gurnard in the combined areas of Celtic Sea and Bay of Biscay from FR-EVHOE surveys series for 2006, 2008 and 2009.

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.

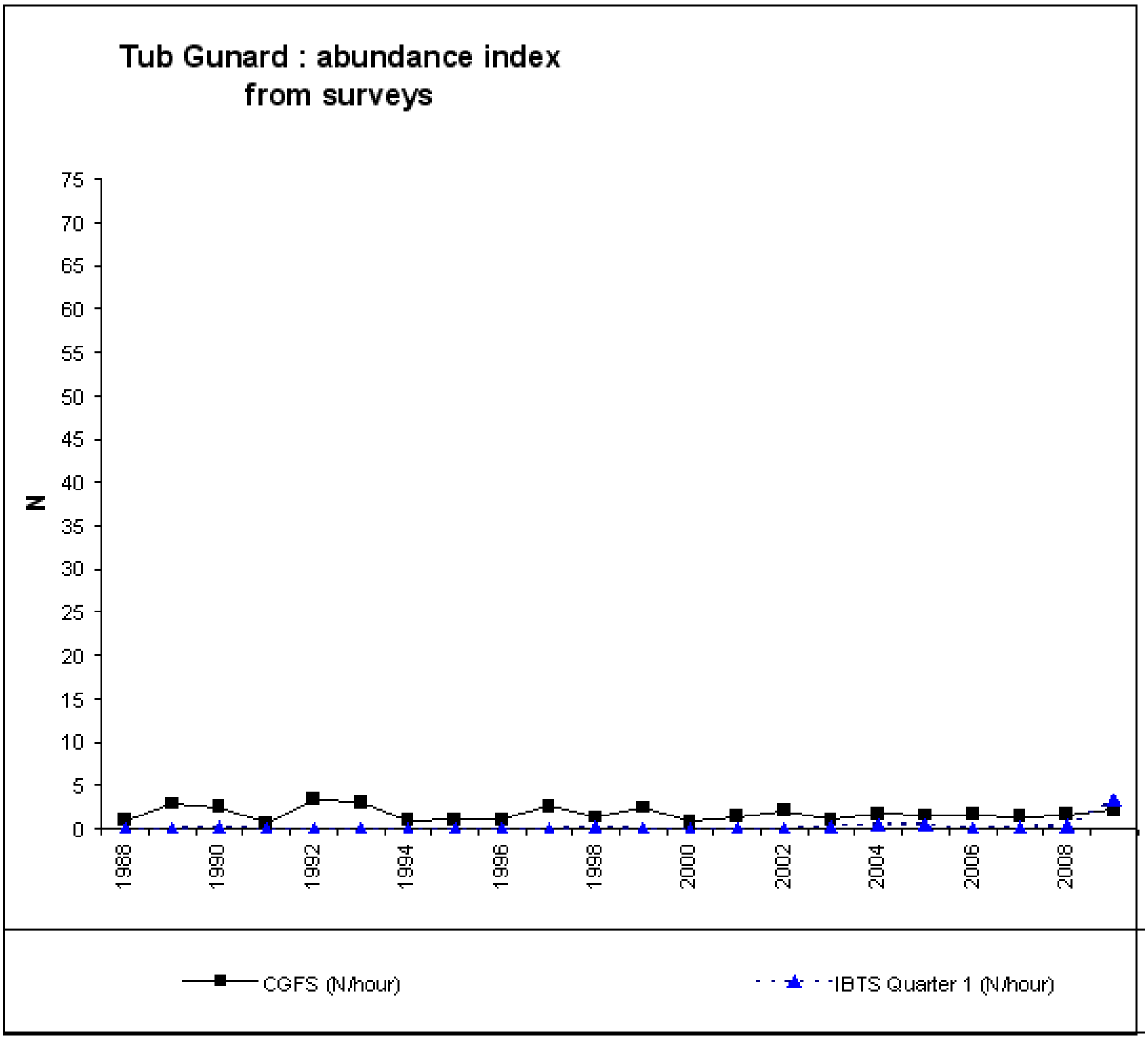

Figure 2.3.18 – Time series of abundance of tub gurnard based on FR-Surveys from 1980 to 2009

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

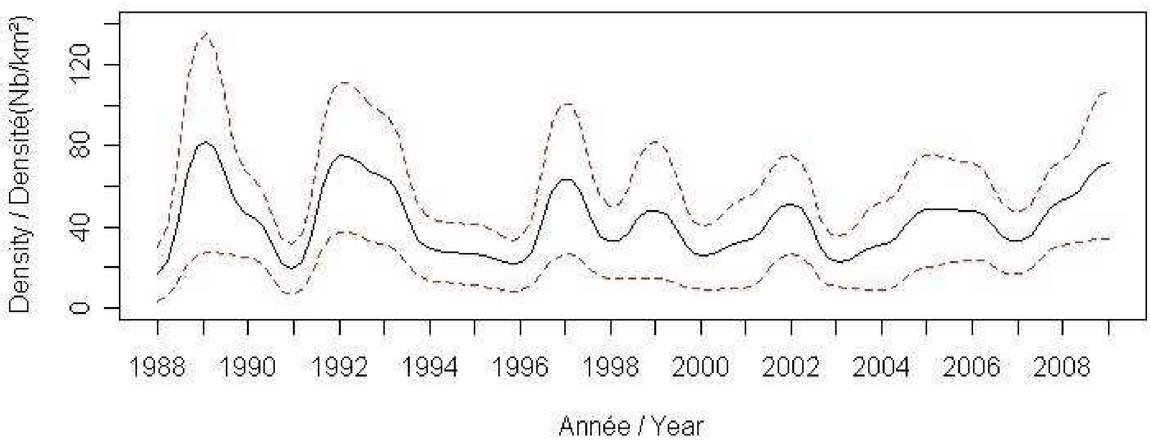

Figure 2.3.19 - Time series of abundance of tub gurnard in the eastern Channel based on FR-CGFS data (N/km²) from 1988 to 2009. Line is smoothed, 95% confidence intervals are shown.

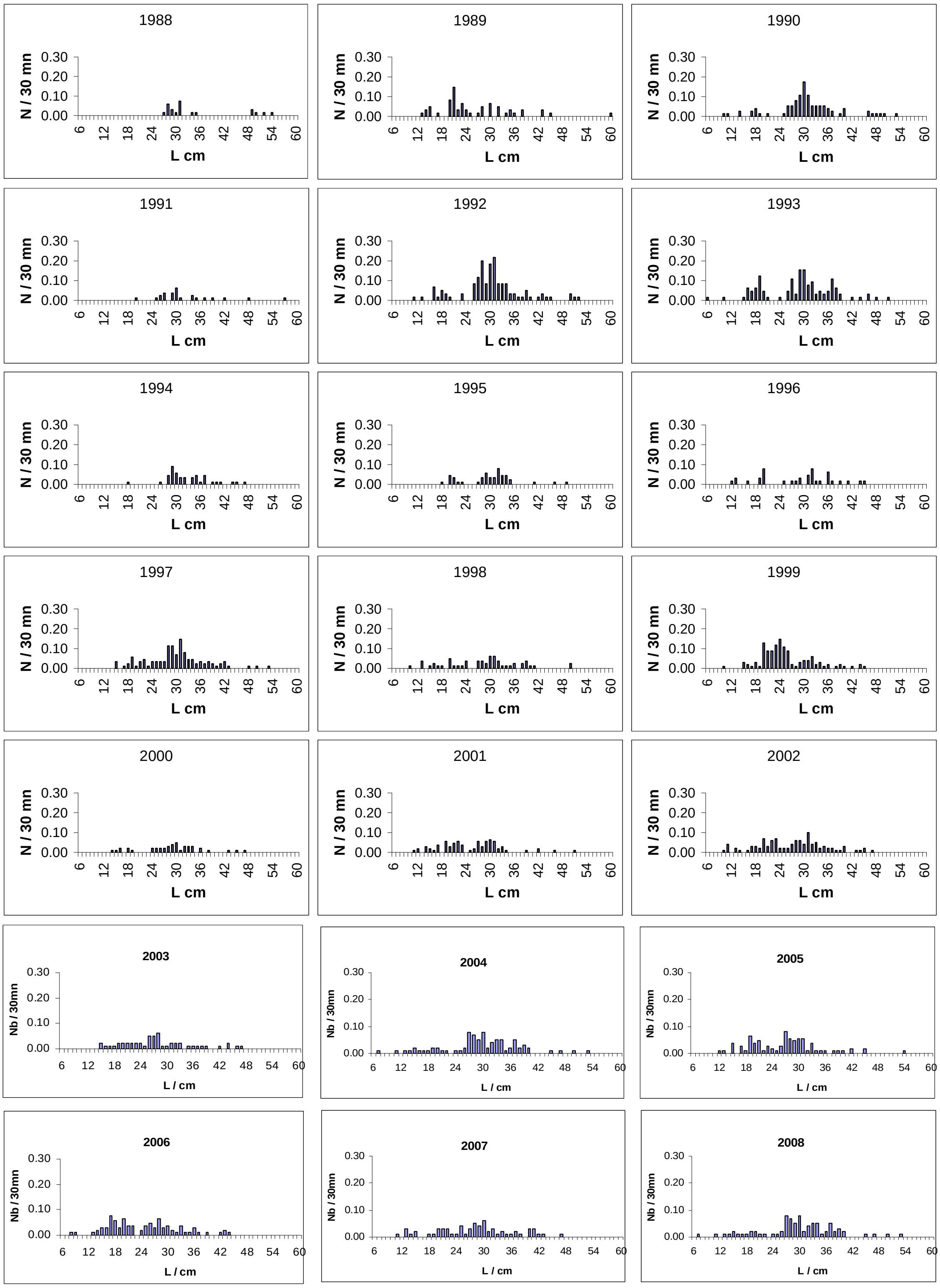

Figure 2.3.20 - Length abundance indices of tub gurnard from FR-CGFS surveys in VIId.

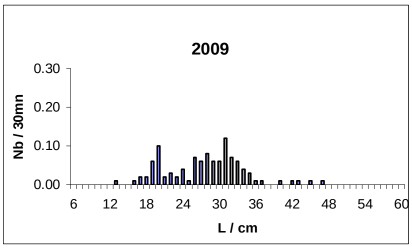

Figure 2.3.20 – Continued

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.

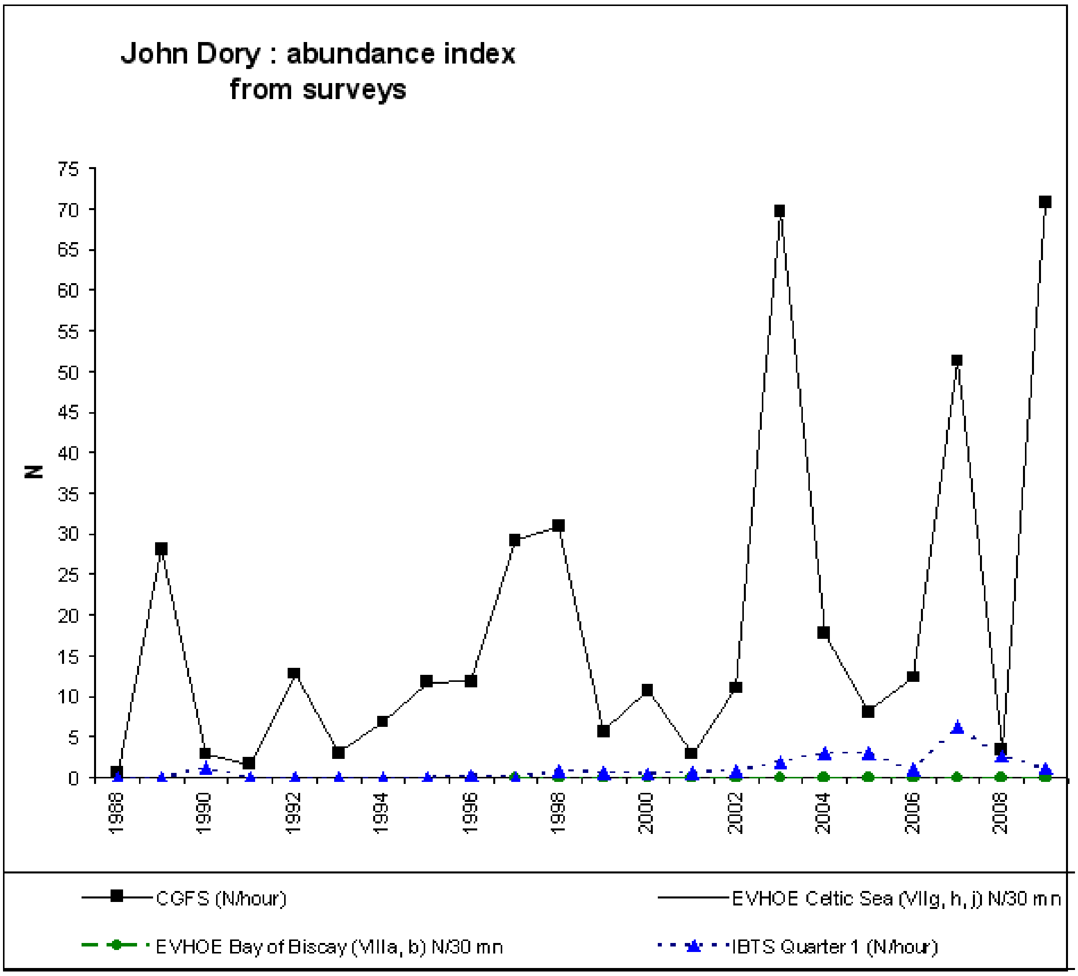

Figure 2.3.21 - Time series of abundance of john dory based on FR-Surveys from 1980 to 2009.

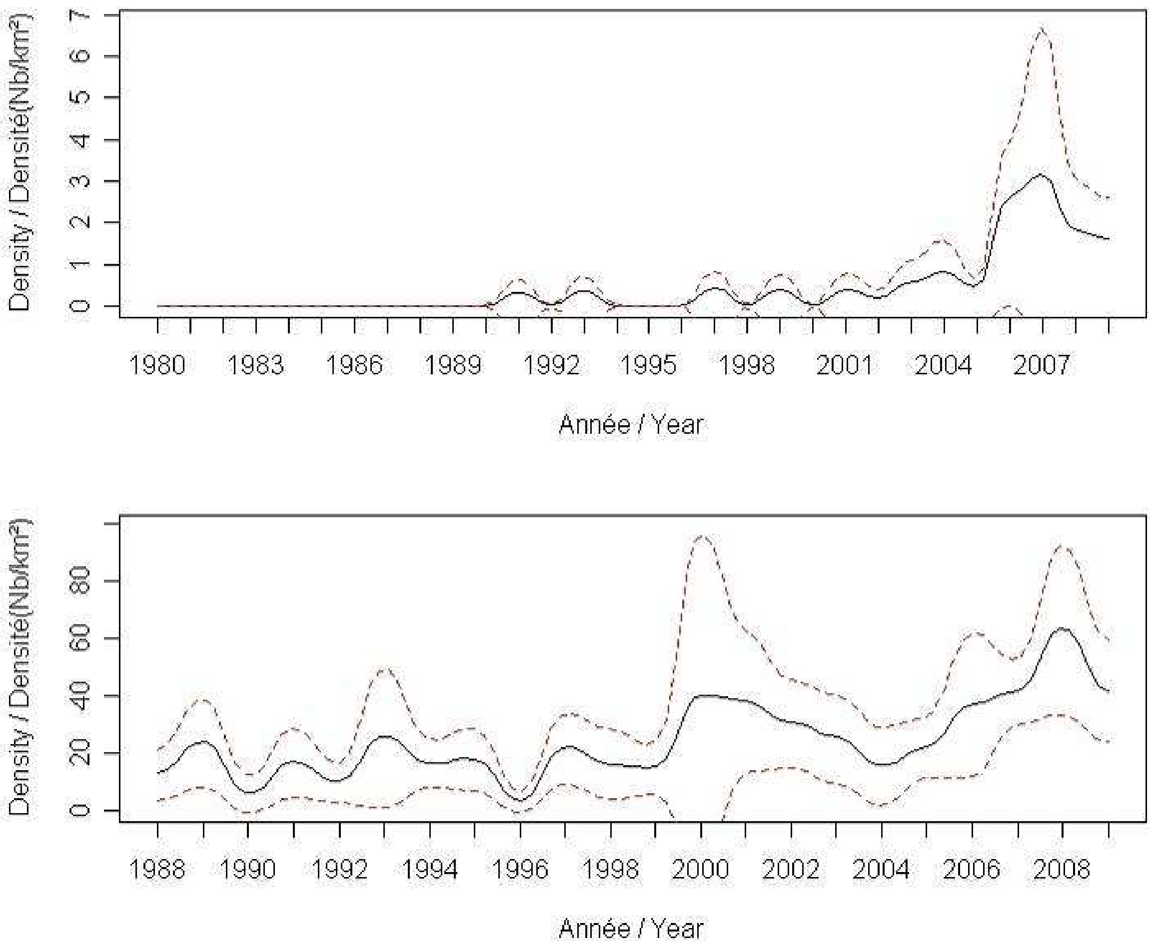

Figure 2.3.22 - Time series of abundance of John dory in the North Sea base don IBTS data (N/km²) from 1980 to 2009 (upper panel) and in the eastern Channel base on FR-CGFS data (N/km²) from 1988 to 2009 (lower panel). Lines are smoothed, 95% confidence intervals are shown.

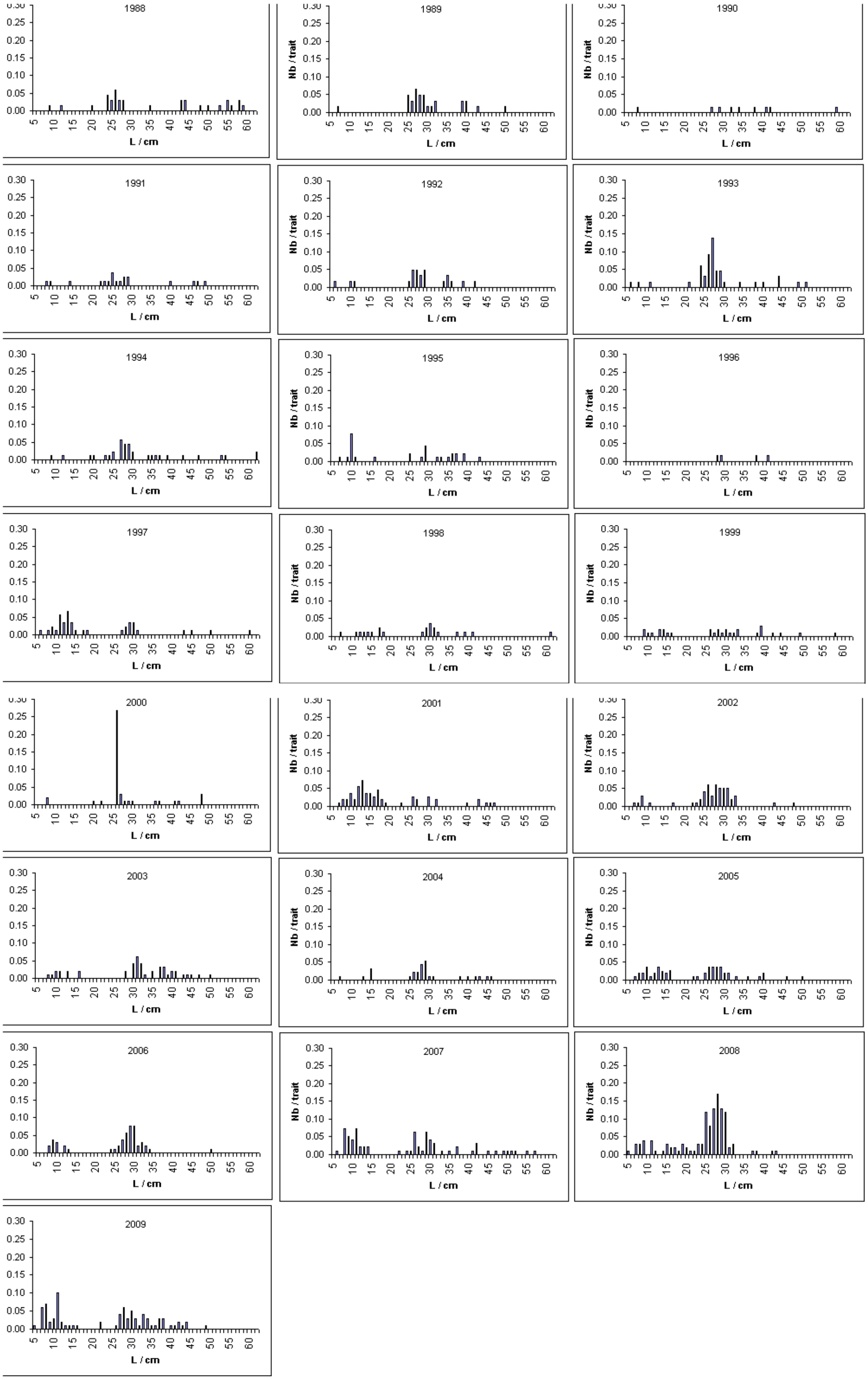

Figure 2.3.23 - Length abundance indices of john dory from FR-CGFS surveys in VIId.

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

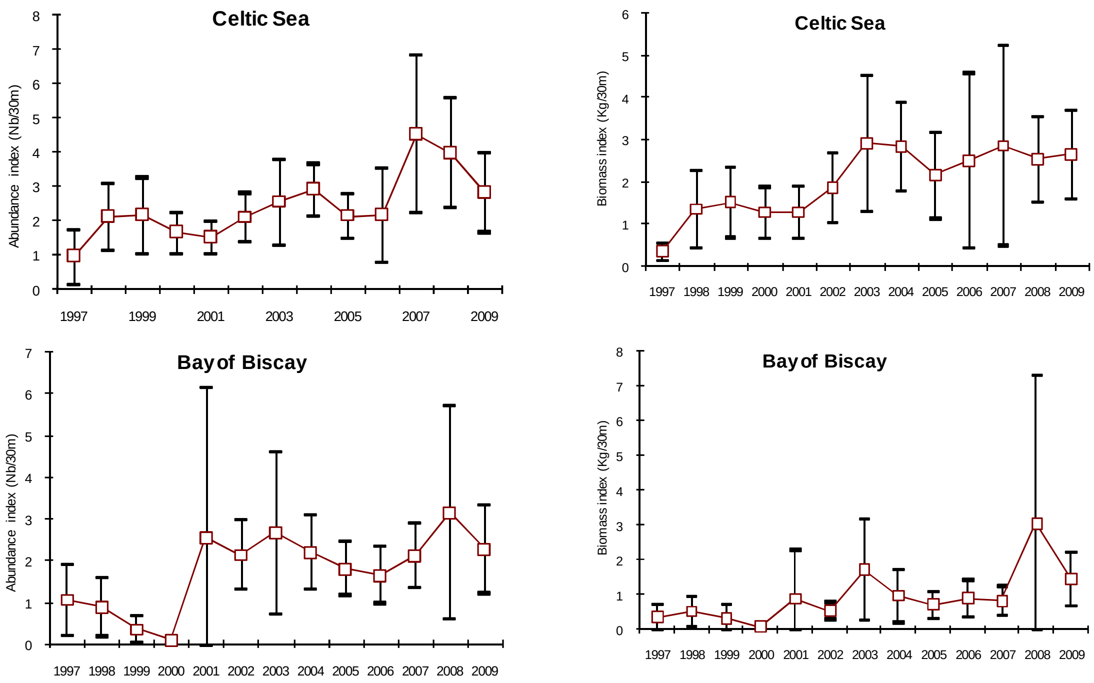

Figure 2.3.24 – Time series of abundance (N and W(kg)/30 min) of John dory in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

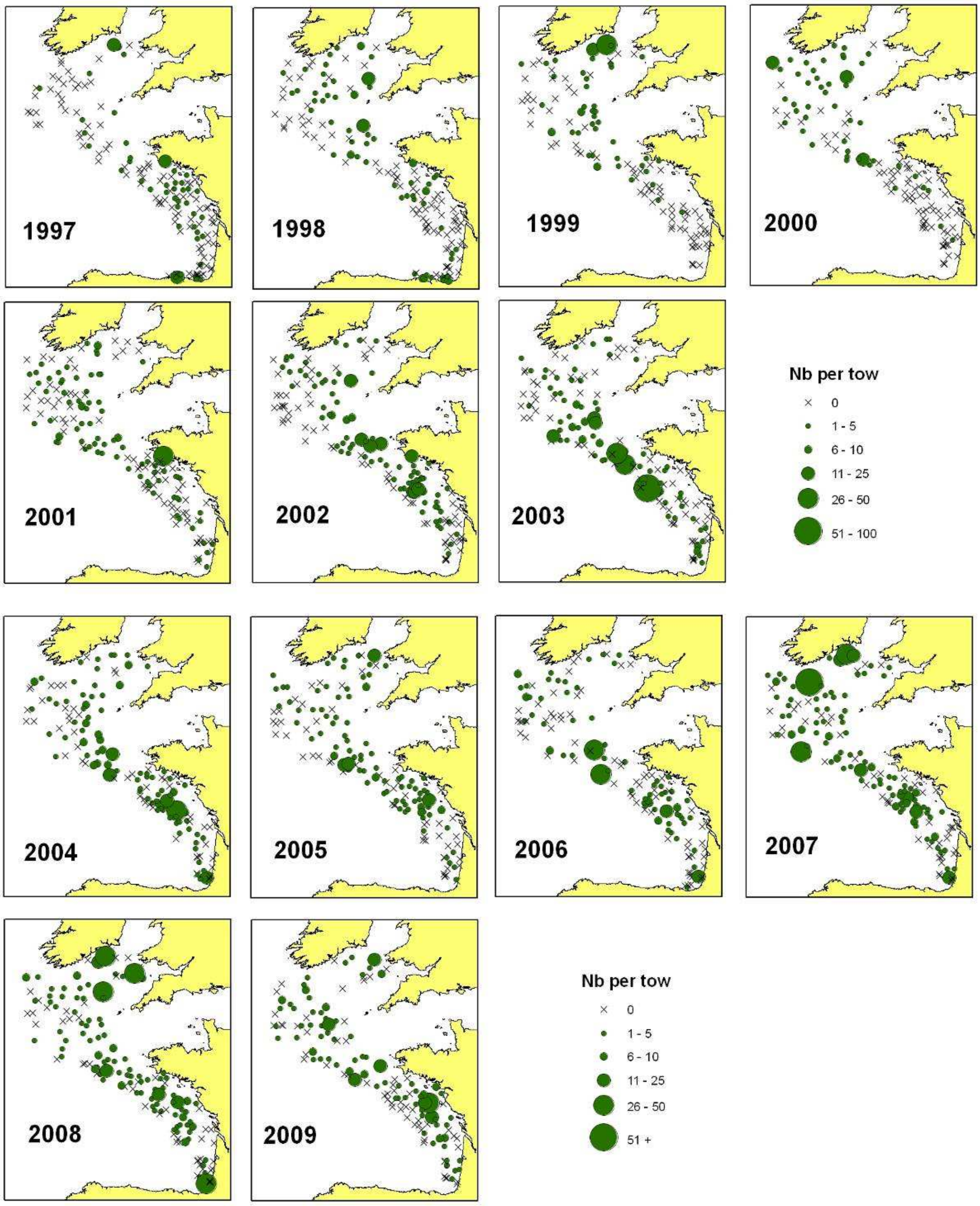

Figure 2.3.25 – Distribution of John dory in the Celtic Sea and in the Bay of Biscay during FR-EVHOE from 1997 to 2009.

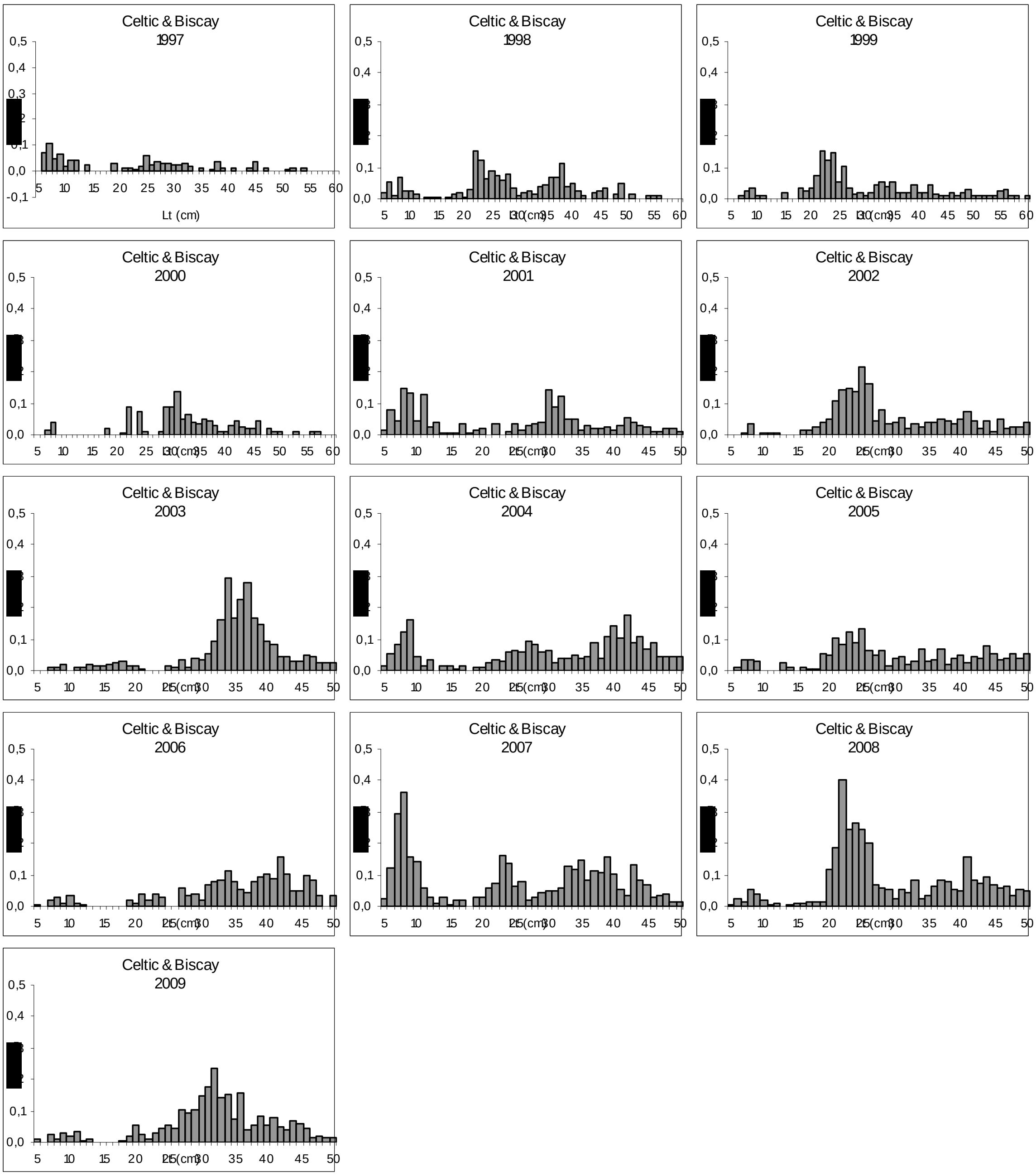

Figure 2.3.26 – Length abundance index of John Dory in Celtic Sea and Bay of Biscay from FR-EVHOE surveys series.

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.

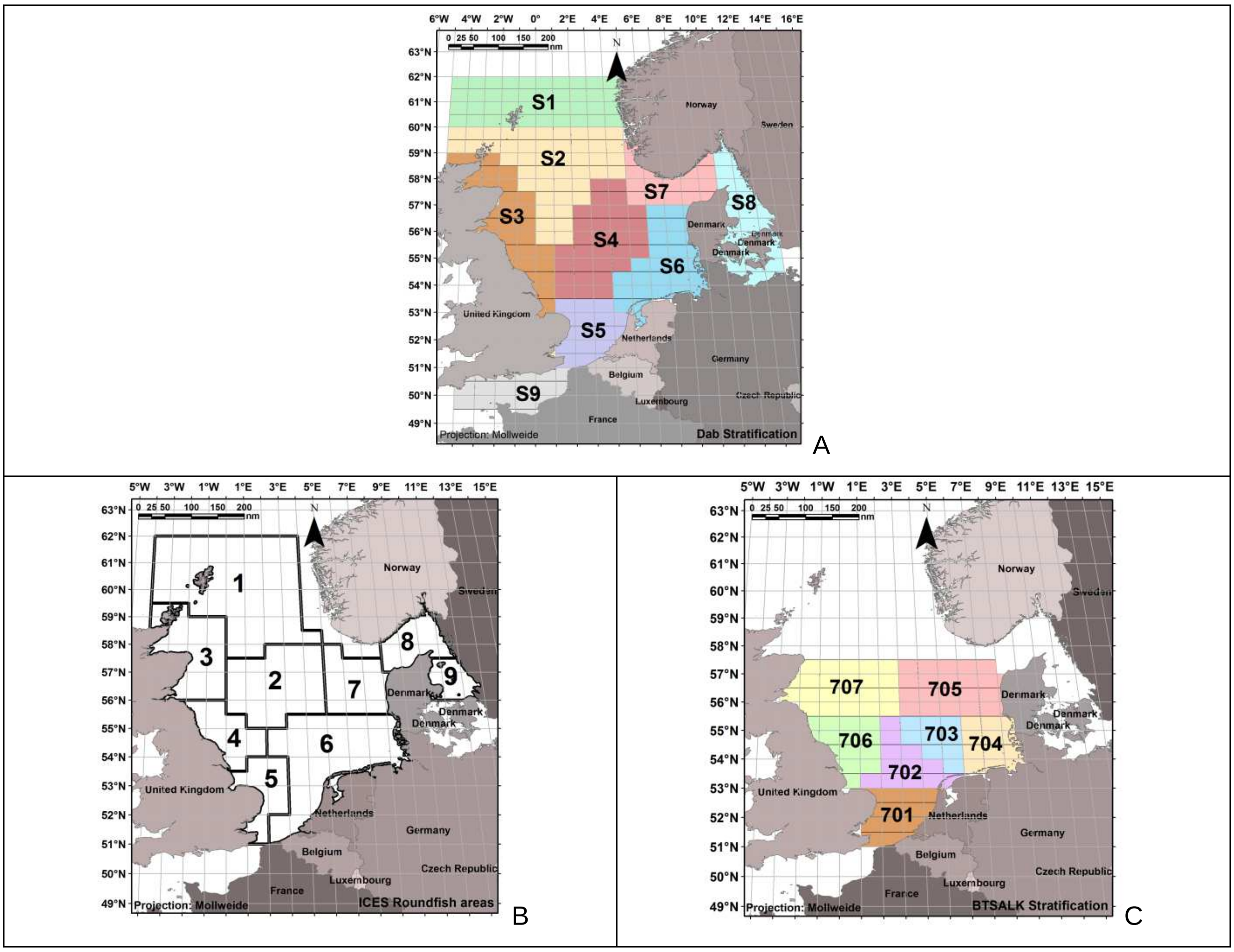

Figure 2.4.1 – Stratification schemes tested for the analysis of dab. Dab stratification (A), ICES roundfish stratification (B) areas and PS stratification (C) according to van Keeken *et al.* (2005).

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.

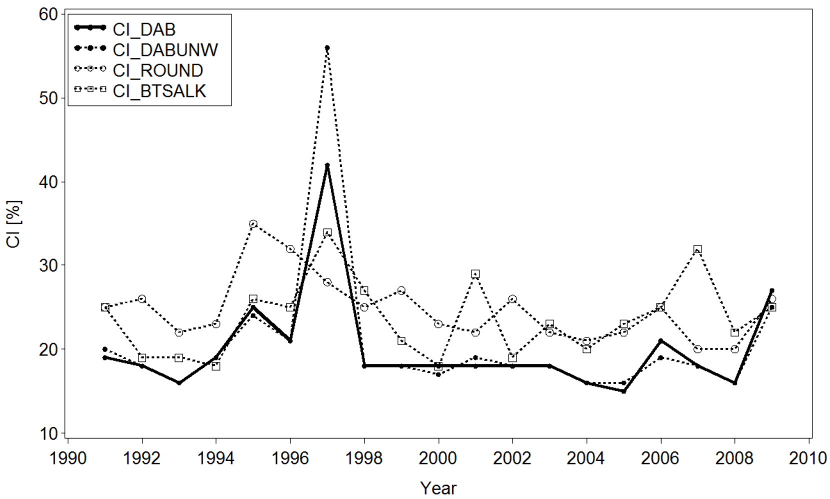

Figure 2.4.2 – Confidence intervals of the survey mean [%] of the dab stratification (CI_DAB), unstratified (CI_DABUNW), roundfish stratification (CI_ROUND) and PS stratification according to age-length-key stratification from IMARES (CI_BTSALK). Confidence intervals (CI) were set at the 95% level of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

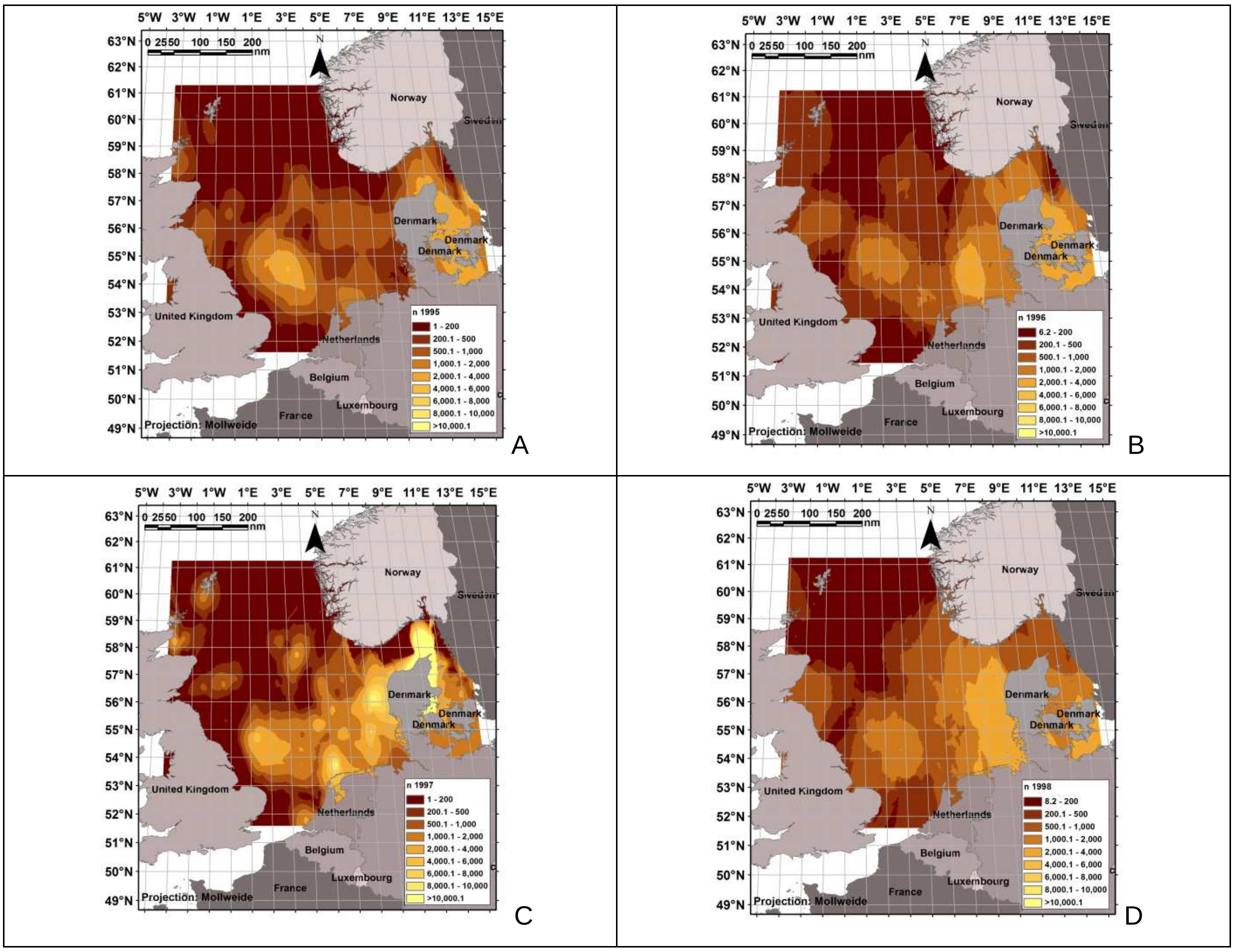

Figure 2.4.3 – Kriging of dab abundance for IBTS Q3, 1995-1998. In 1997 (C), one outlier in the Skaggerrak area (light yellow) caused considerable leverage and a correspondingly high survey CI. Dark shading – low abundance, light shading – high abundance.

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).

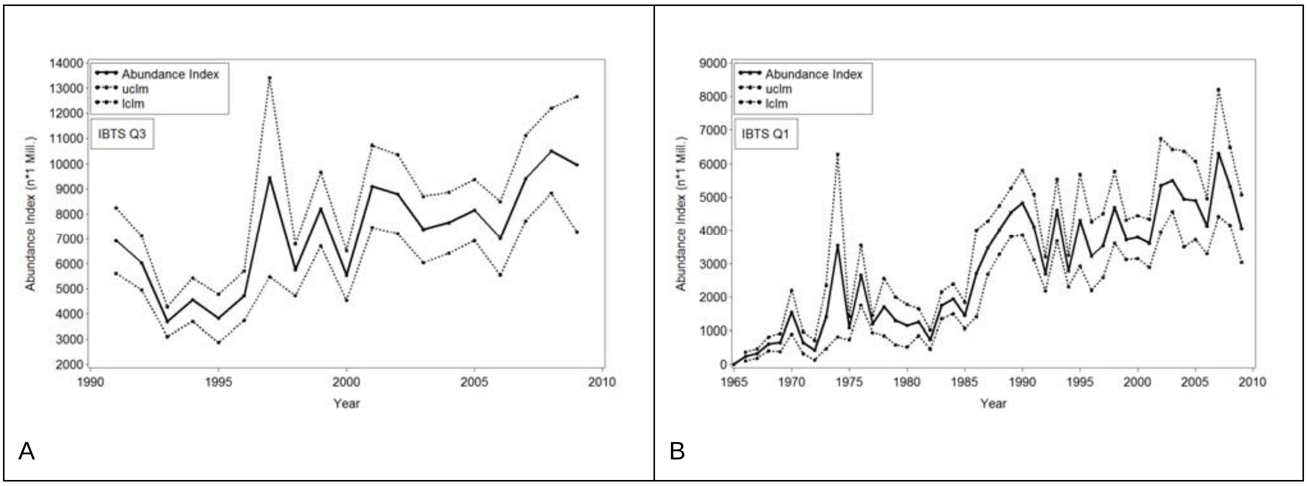

Figure 2.4.4a – Dab abundance indices (n*1 Mill) for IBTS Q3 (A) and IBTS Q1 (B). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

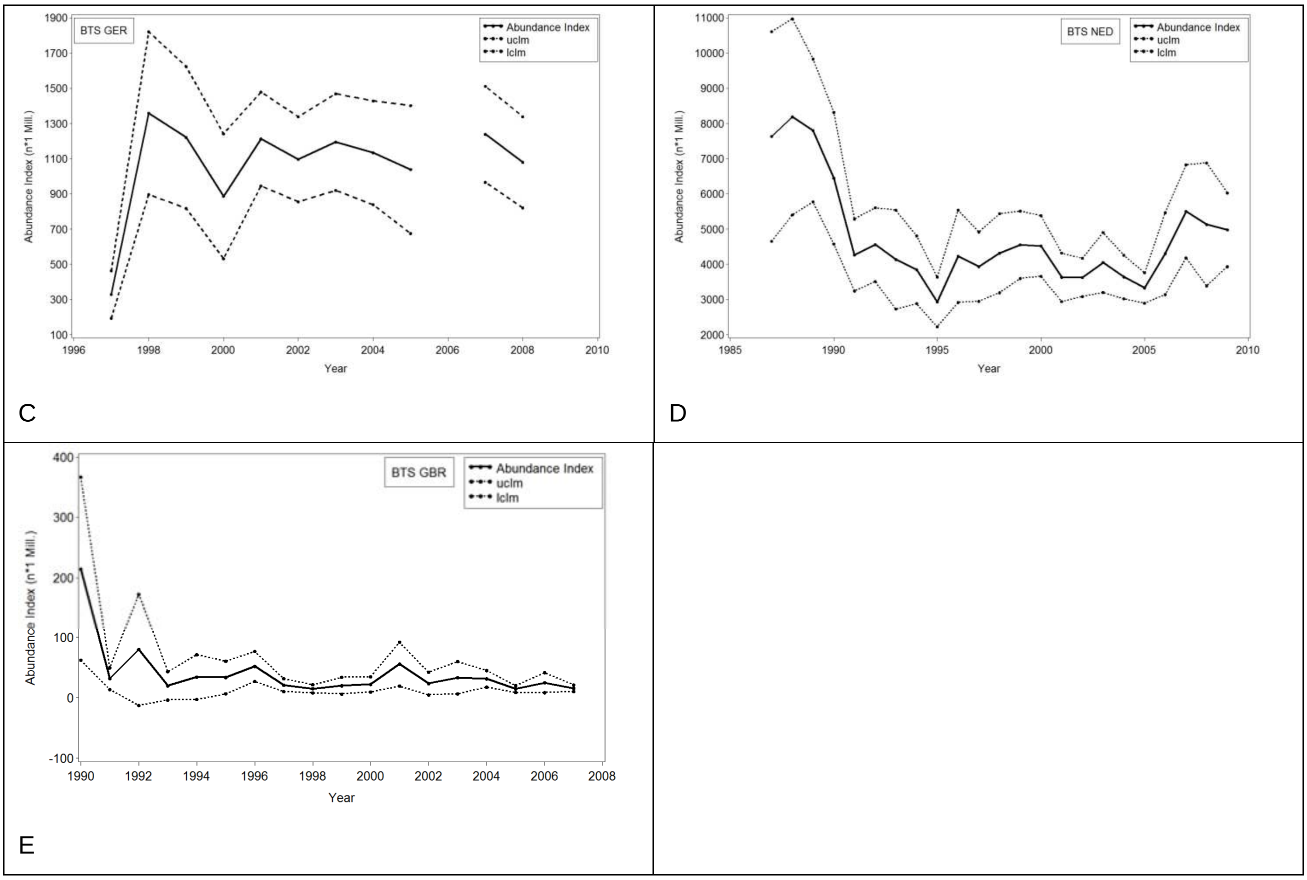

Figure 2.4.4b – Dab abundance indices (n*1 Mill) for German (C), Dutch (D) and English BTS (E). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

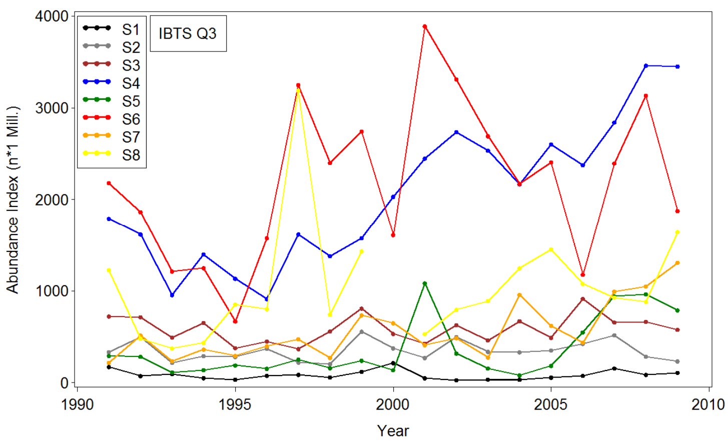

Figure 2.4.5 – IBTS Q3 Dab abundance indices (n*1 Mill.) by stratum for North Sea, 1991-2009.

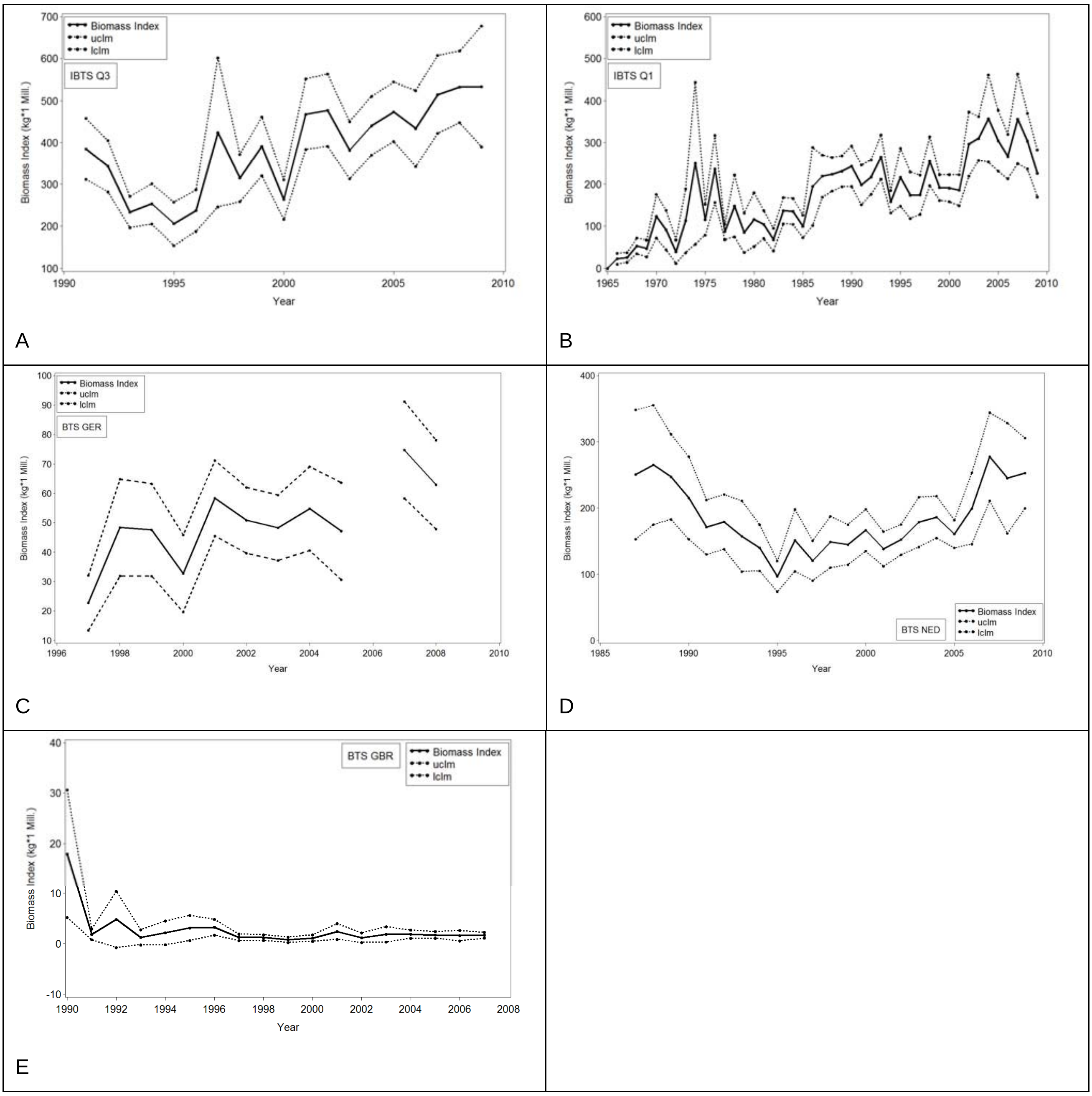

Figure 2.4.6 – Dab biomass indices (kg*1Mill) for IBTS Q3 (A), IBTS Q1 (B) German (C), Dutch (D) and English BTS (E). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

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.

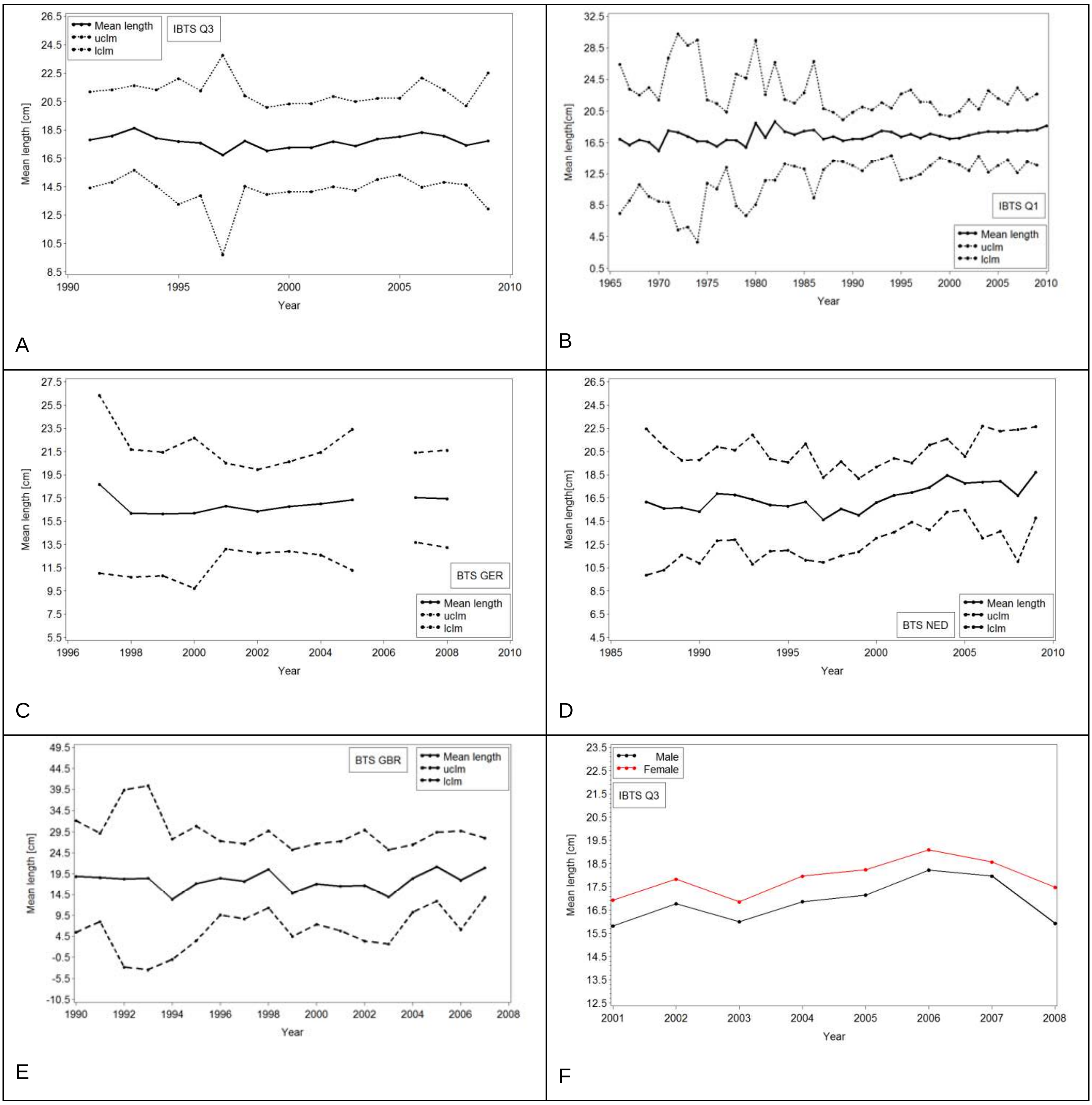

Figure 2.4.7 – Dab mean length [cm] for IBTS Q3 (A), IBTS Q1 (B) German (C), Dutch (D) and English BTS (E). Mean length by sex for IBTS Q3 (F). Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

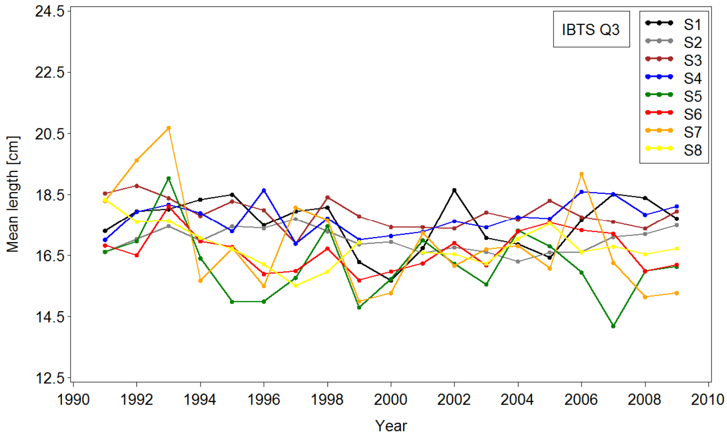

Figure 2.4.8 – IBTS Q3 Dab mean length [cm] by stratum for the North Sea, 1991-2009.

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.

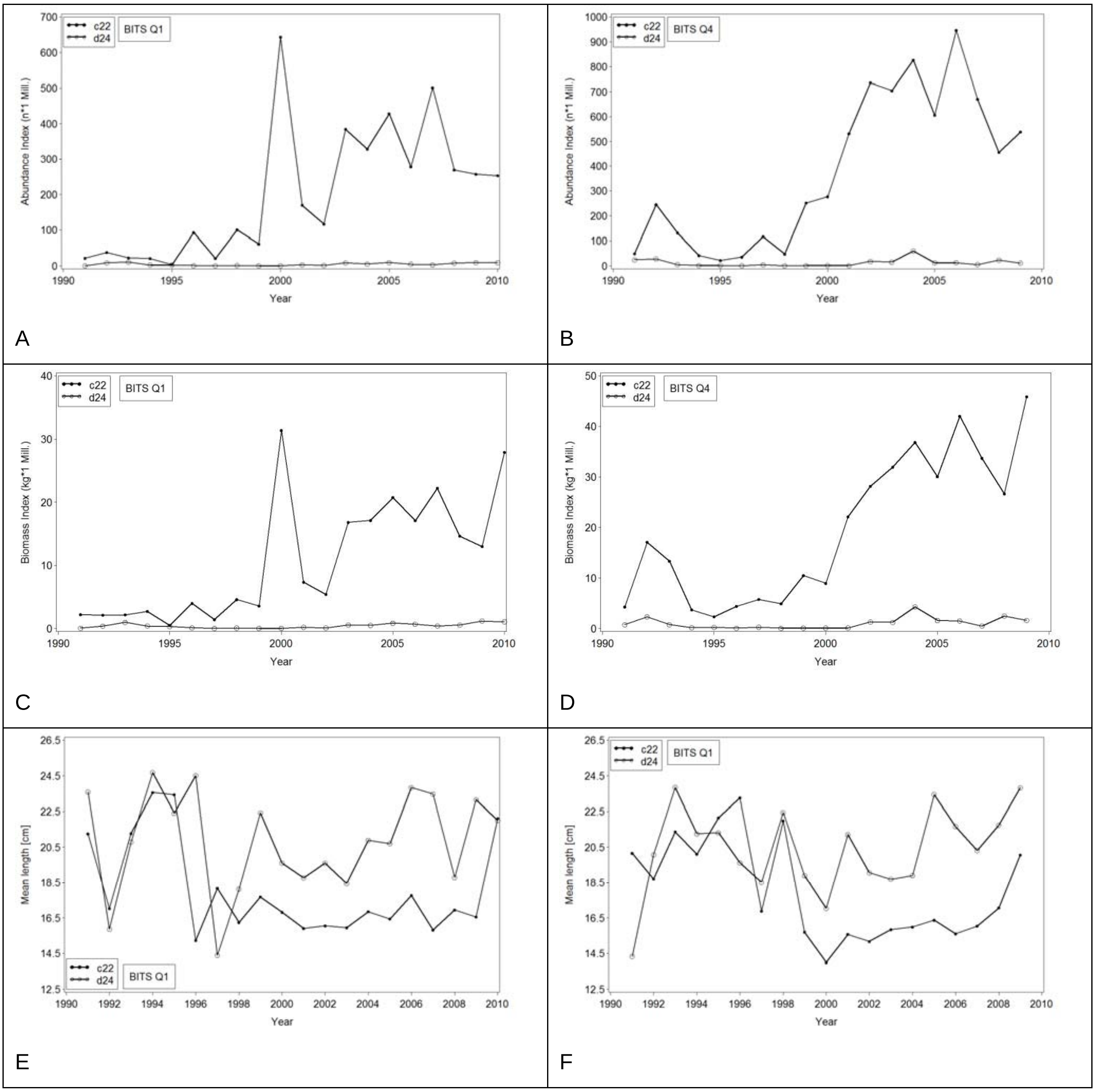

Figure 2.4.9 – Dab abundance indices (n*1 Mill) (A, B), biomass indices (kg*1 Mill) (C, D) and mean length [cm] (E, F) by ICES fishing areas c22 and d24 for BITS Q1 and Q4.

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).

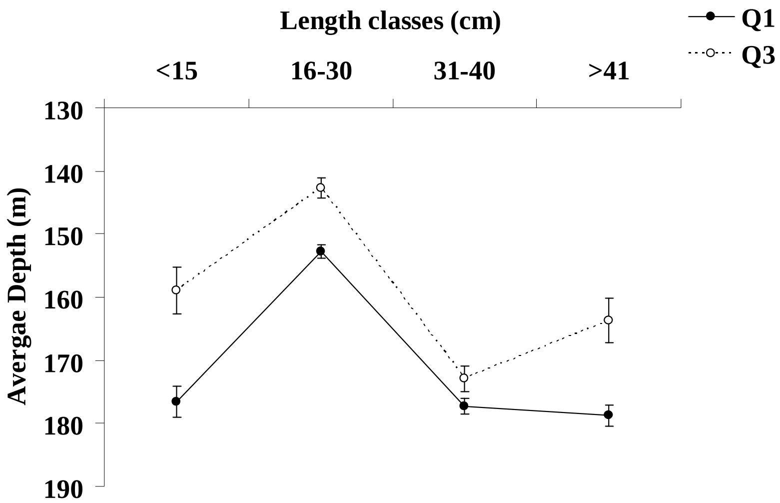

Figure 2.6.1 – Occurrence of different length classes at different depths. Bars represent standard errors.

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

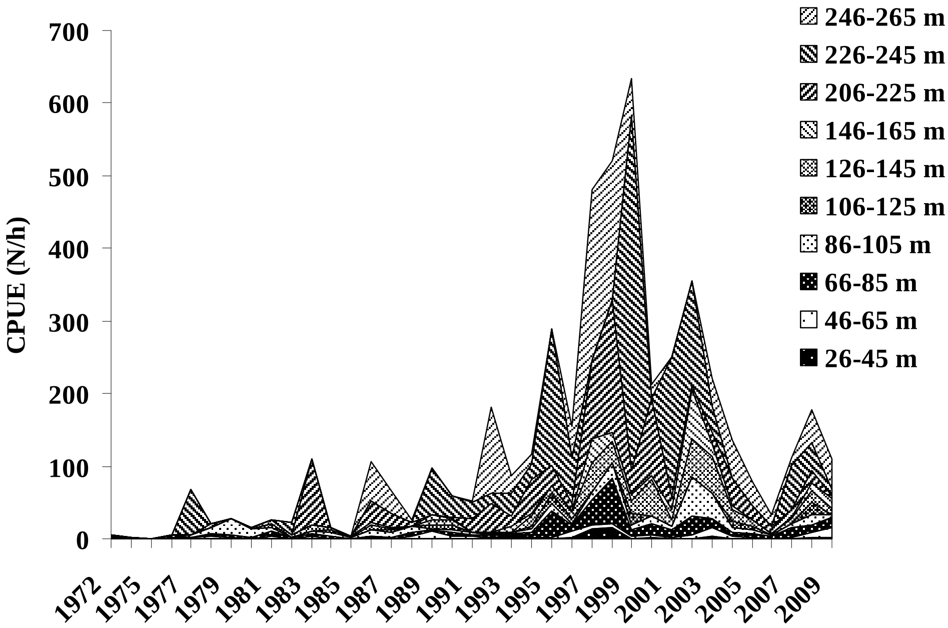

Figure 2.6.2 – Time series of CPUE at different depth strata in quarter 1.

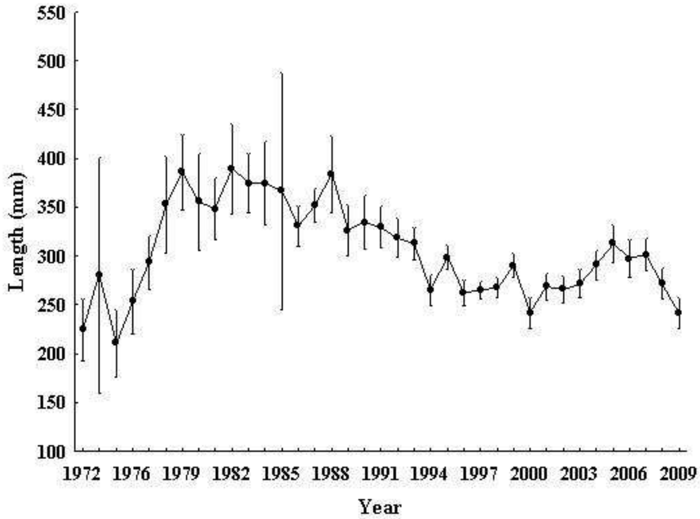

Figure 2.6.3 – Time series of average length distribution. Vertical bars denote 0.95 confidence intervals.

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.

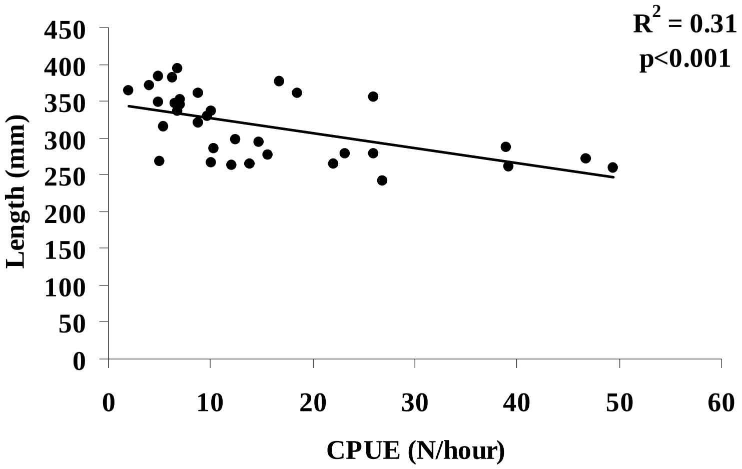

Figure 2.6.4 – Regression between yearly CPUE and average length.

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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

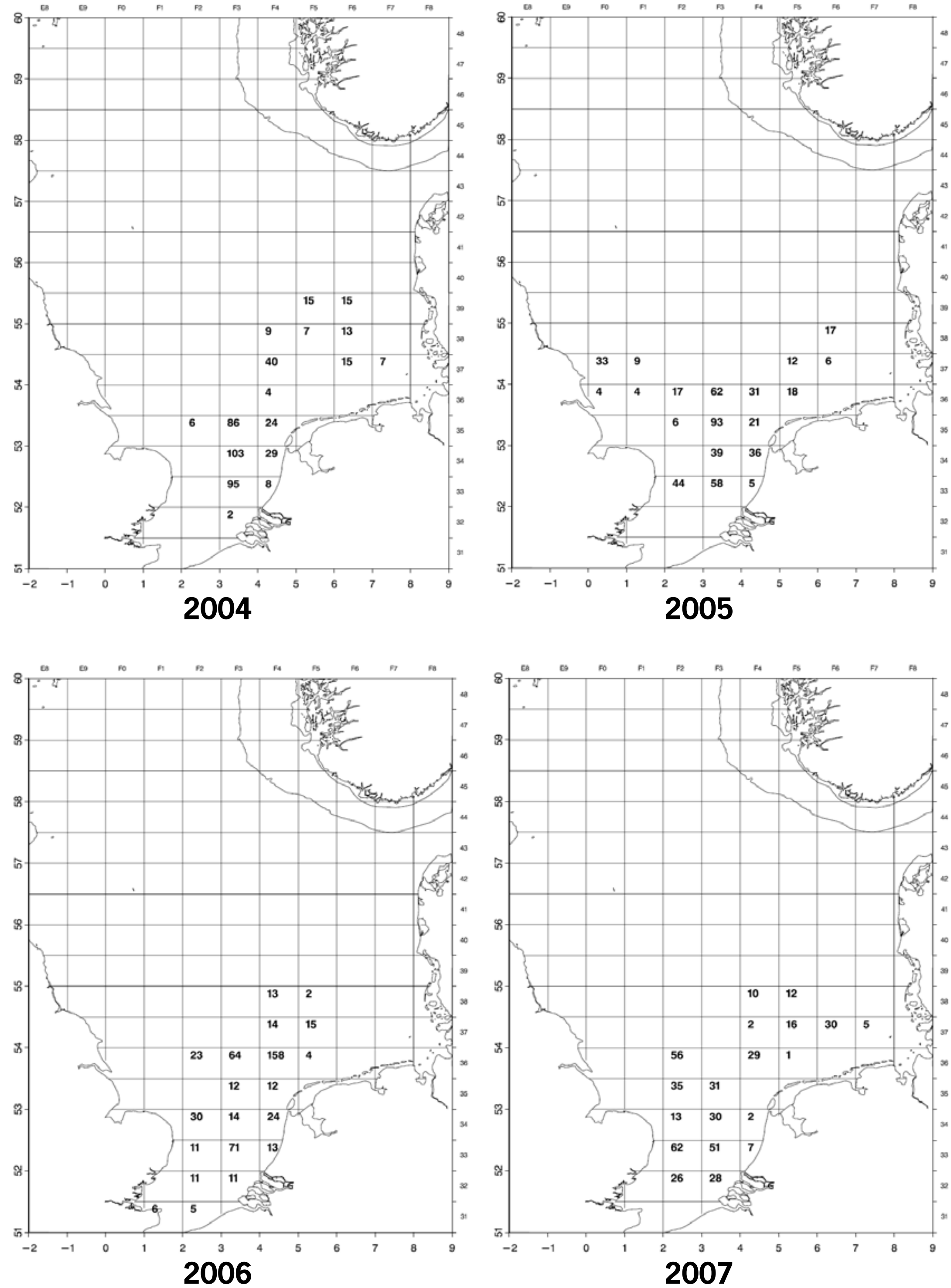
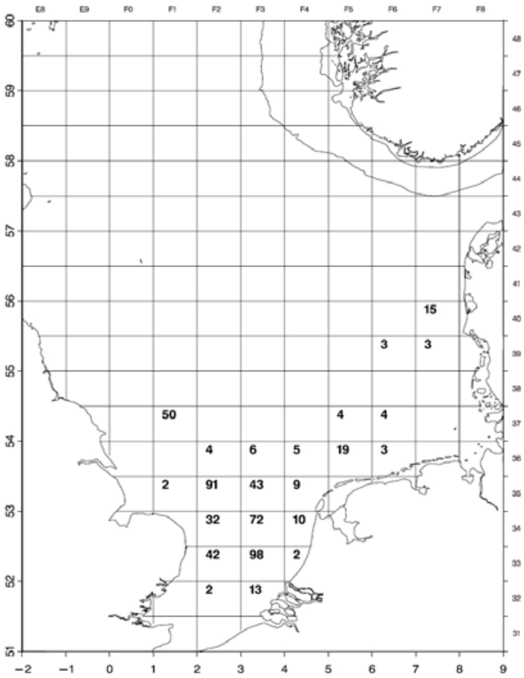


Figure 3.1.1 – The Dutch beam trawl fisheries > 300 hp: sampled number of hauls per year and by ICES rectangle.



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
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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

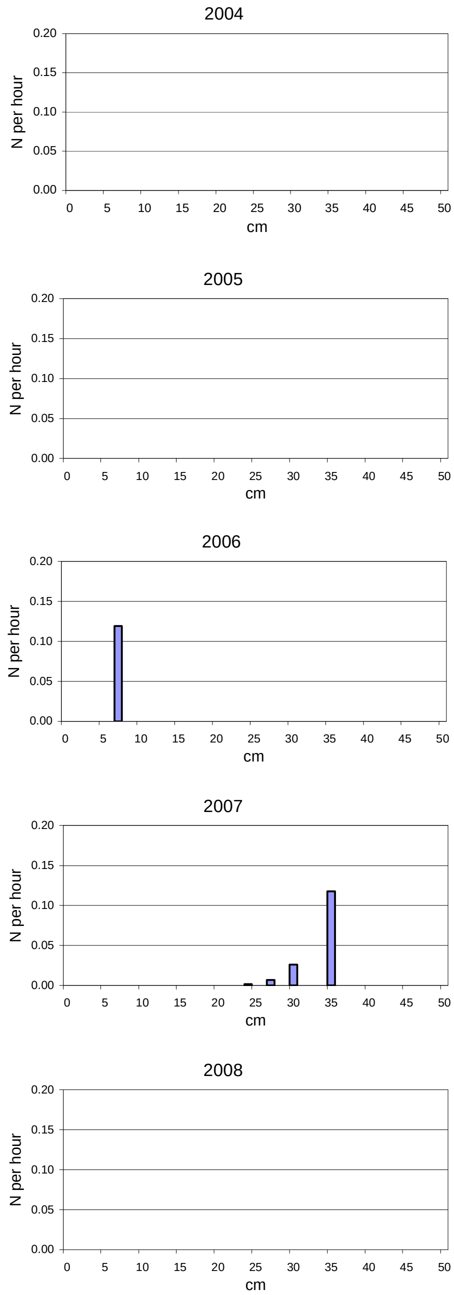

Figure 3.1.2 – Sea bass: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

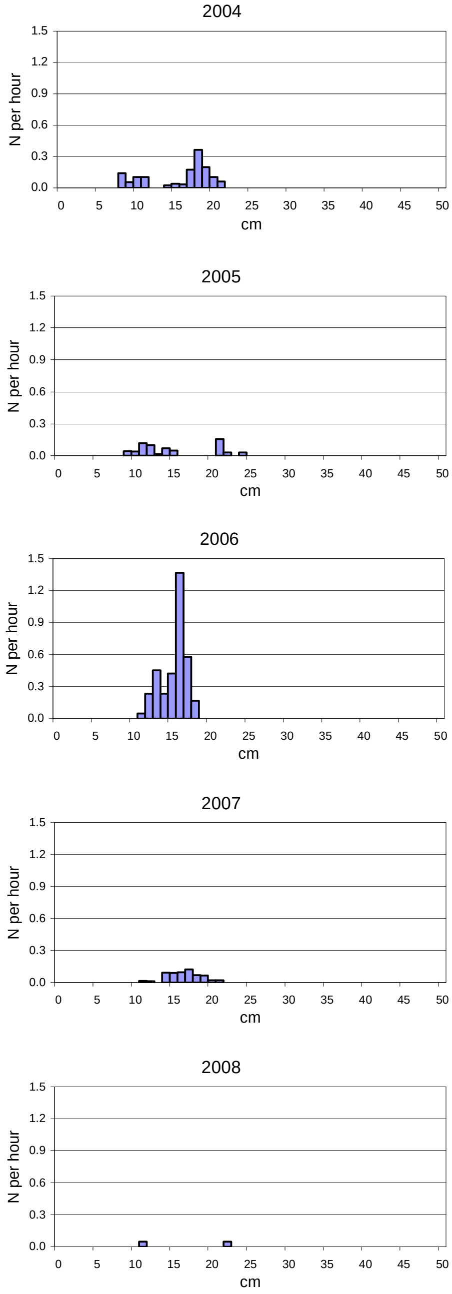

Figure 3.1.3 – Striped red mullet: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

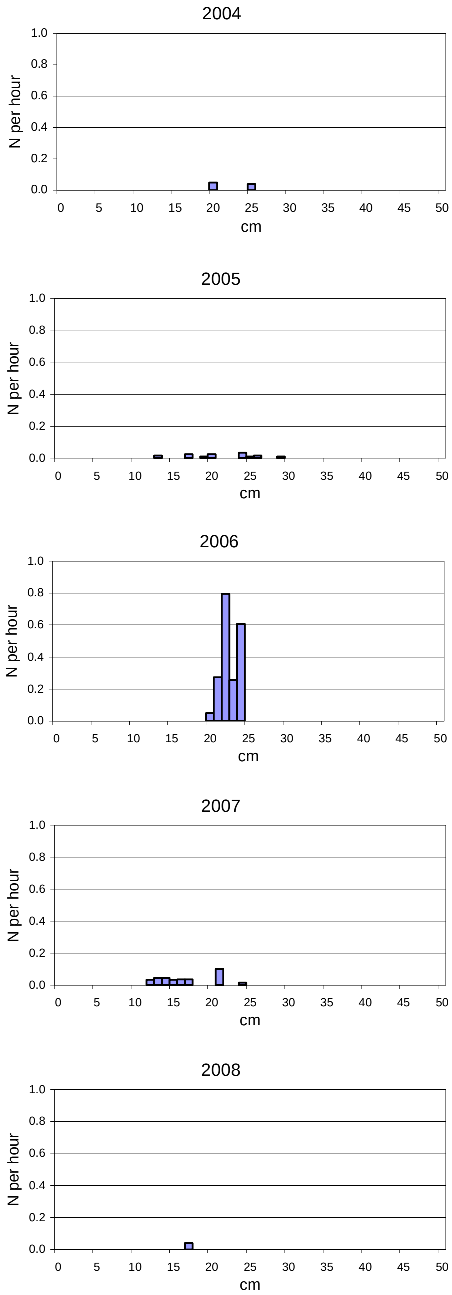

Figure 3.1.4 – Red gurnard: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

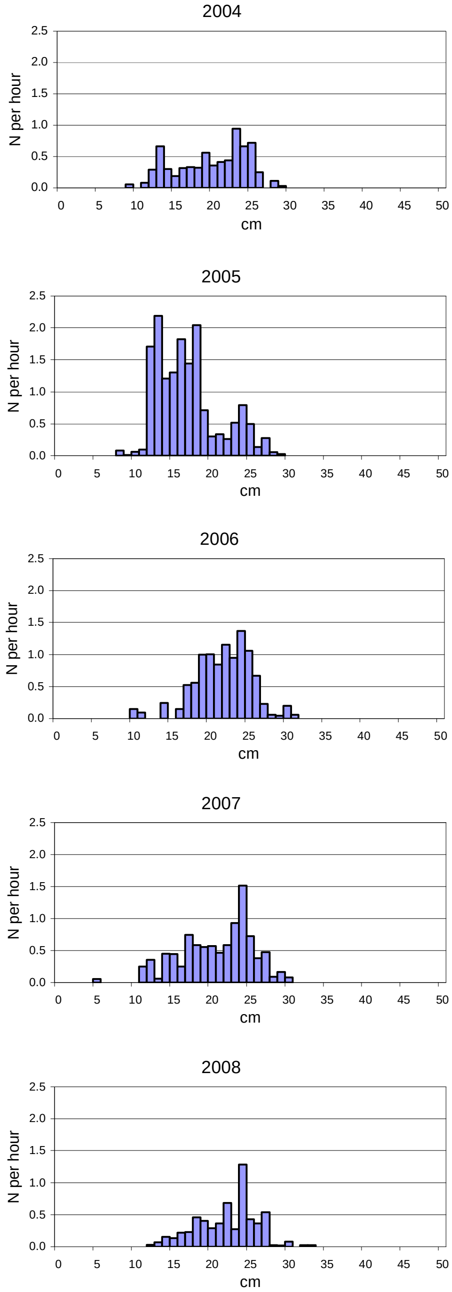

Figure 3.1.5 – Tub gurnard: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

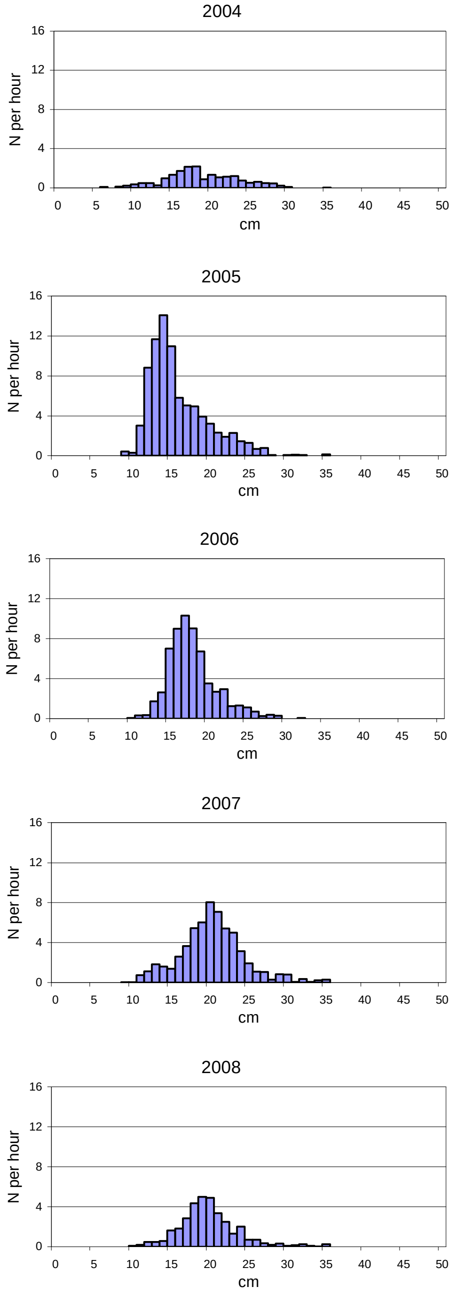

Figure 3.1.6 – Grey gurnard: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

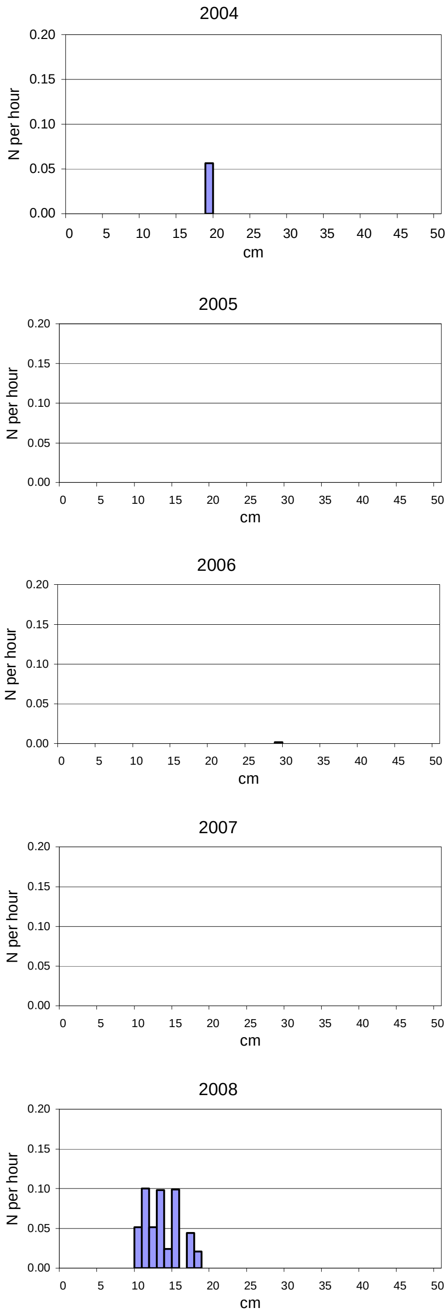

Figure 3.1.7 – John dory: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

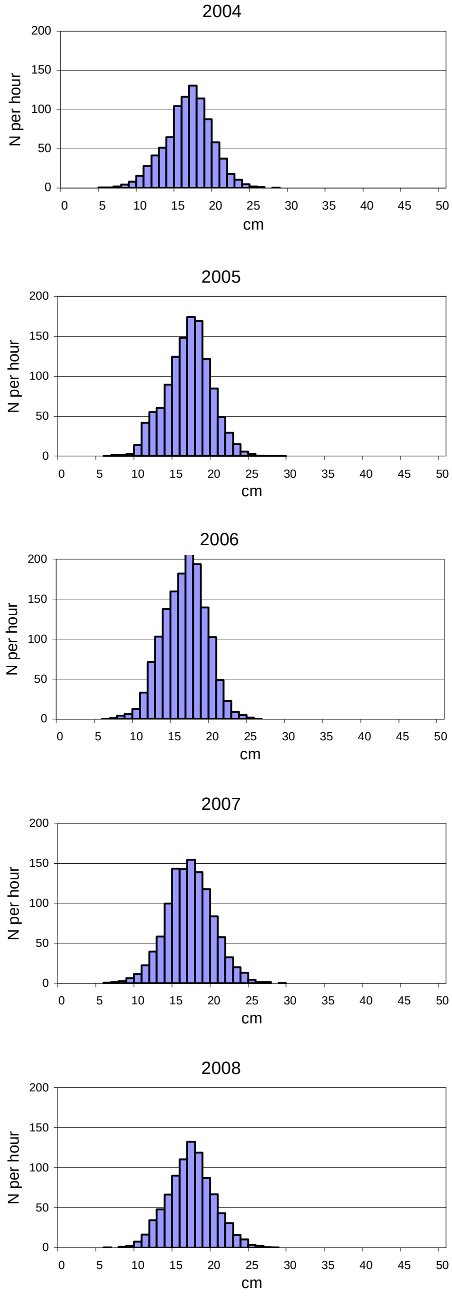

Figure 3.1.8 – Dab: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

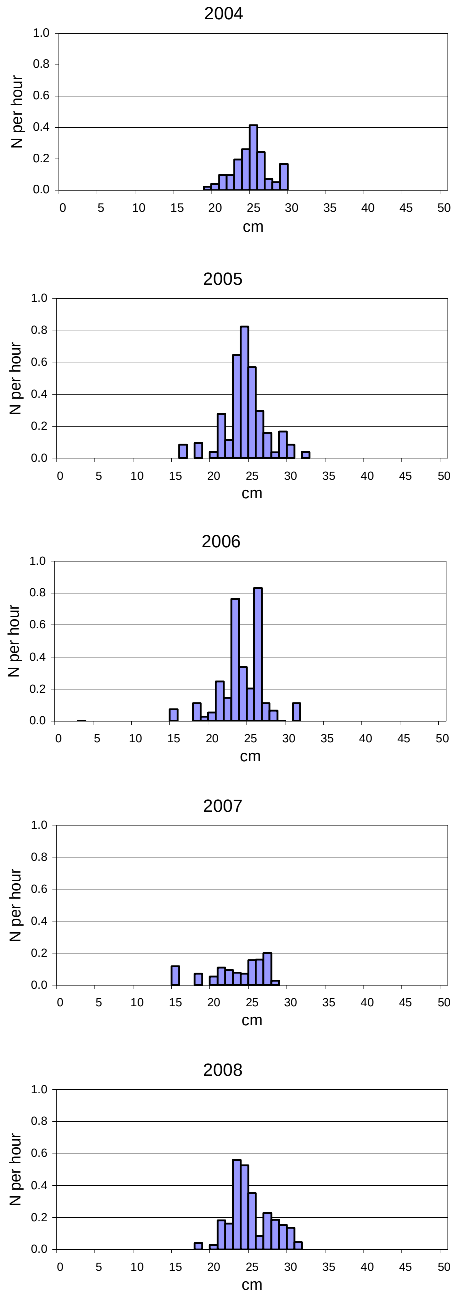

Figure 3.1.9 – Flounder: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

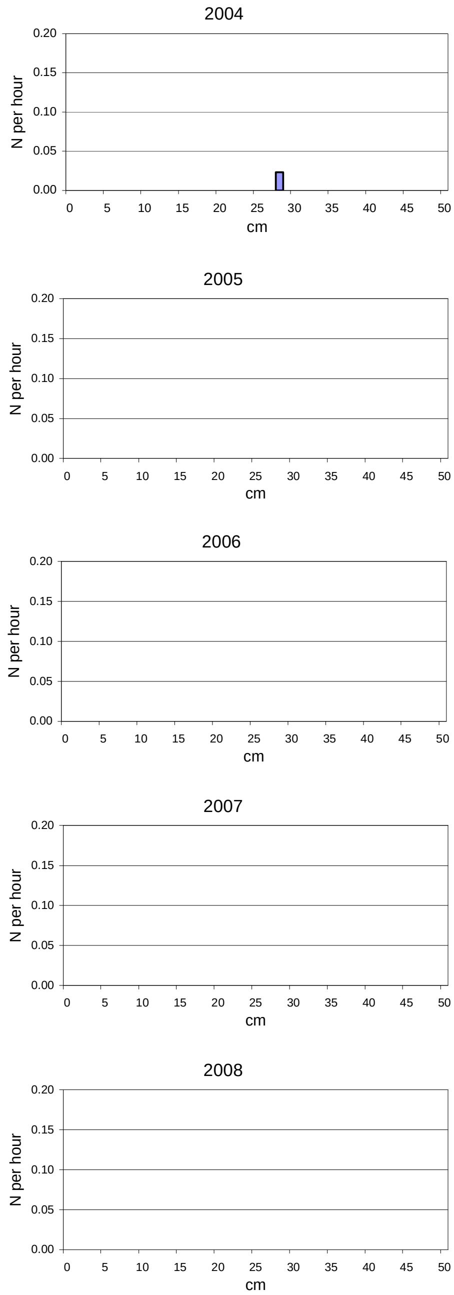

Figure 3.1.10 – Witch flounder: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

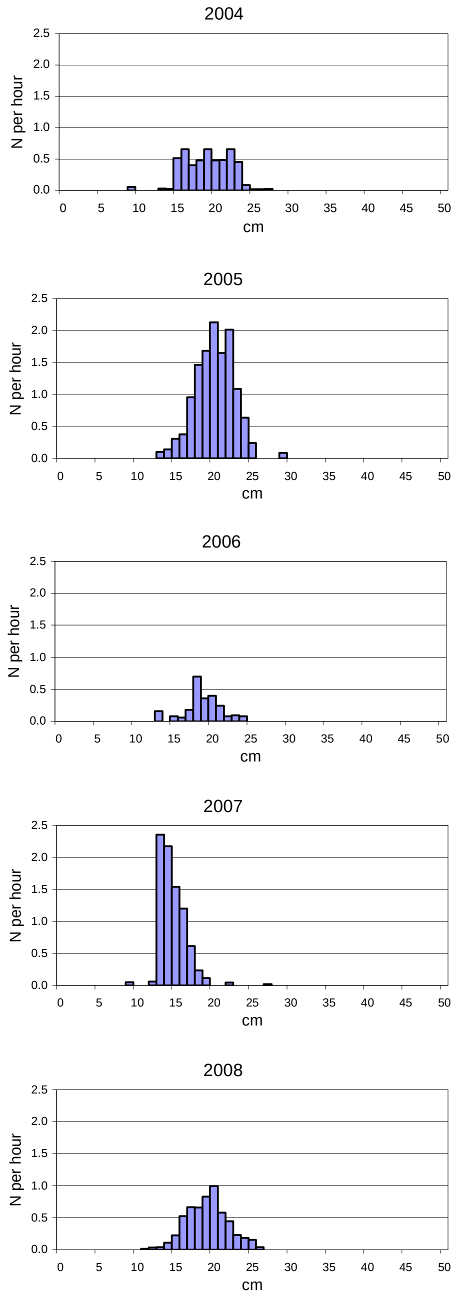

Figure 3.1.11 – Lemon sole: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

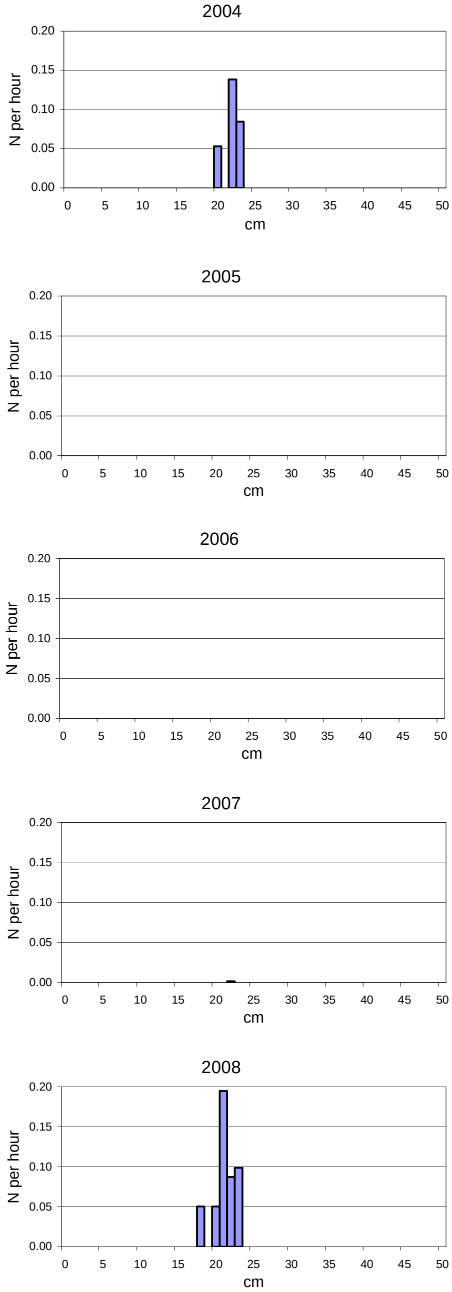

Figure 3.1.12 – Turbot: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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

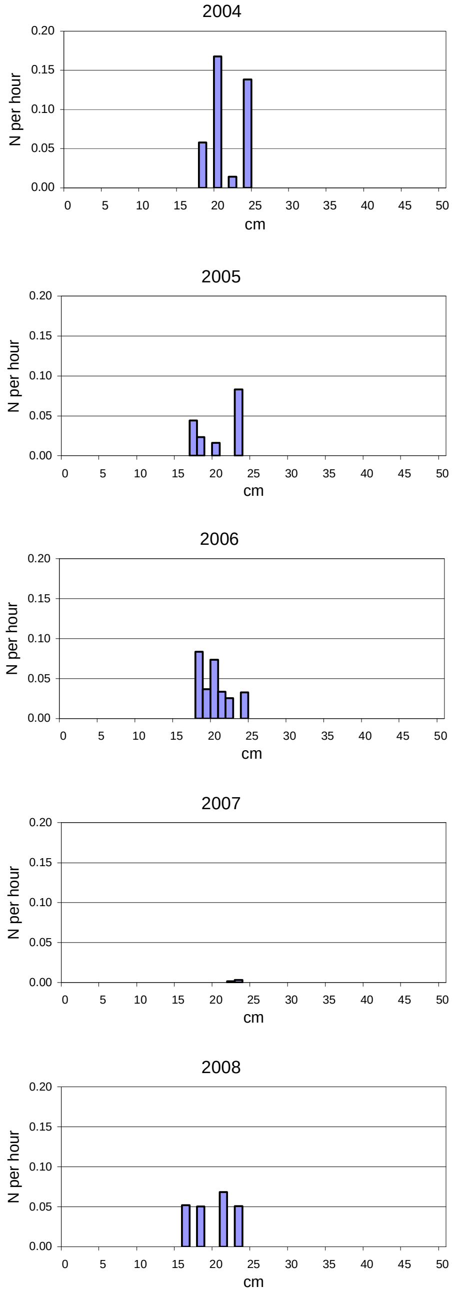

Figure 3.1.13 – Brill: number at length discarded per fishing hour in the Dutch beam trawl fishery in the years 2004 to 2008.

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.

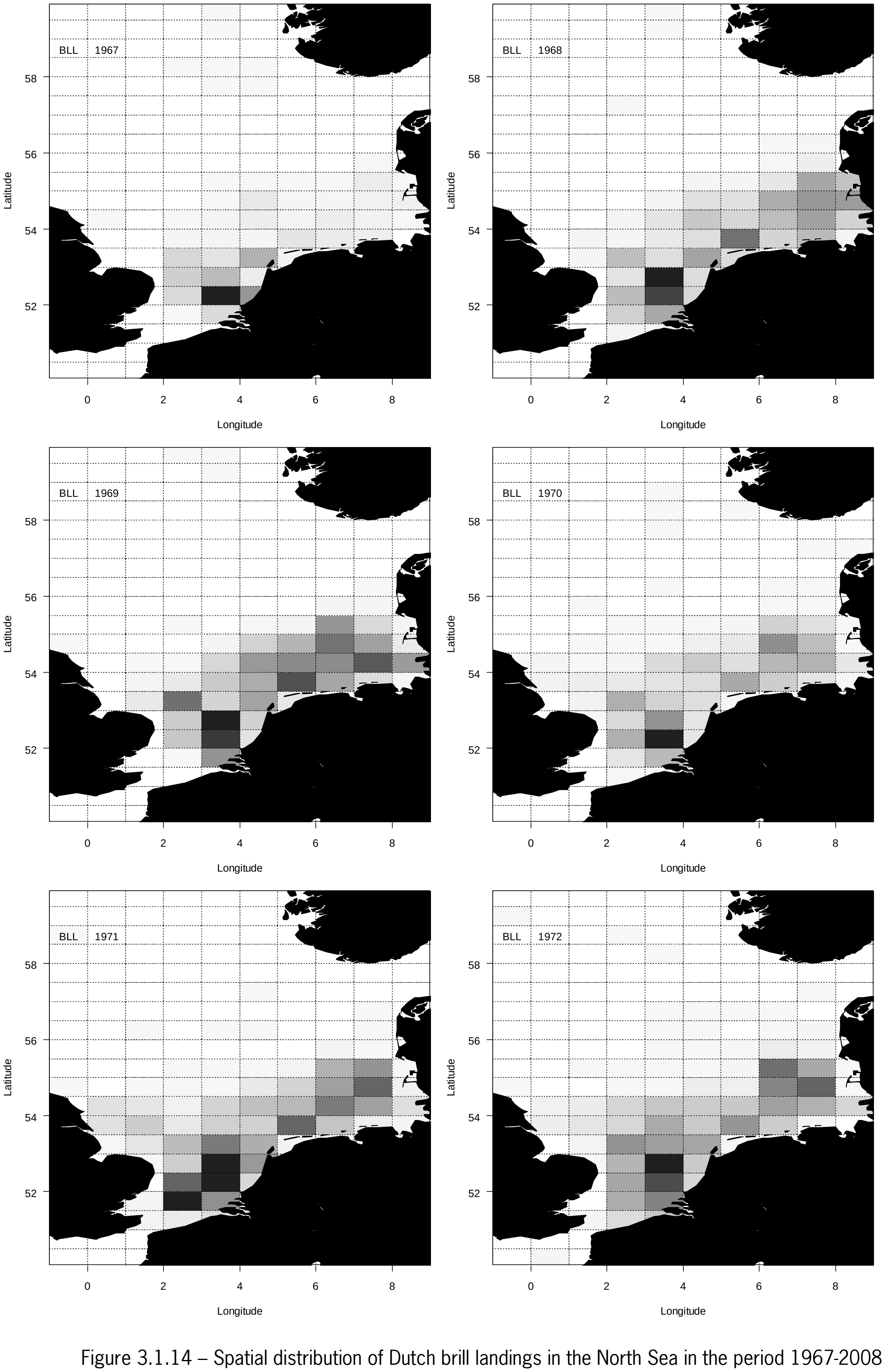

Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008.

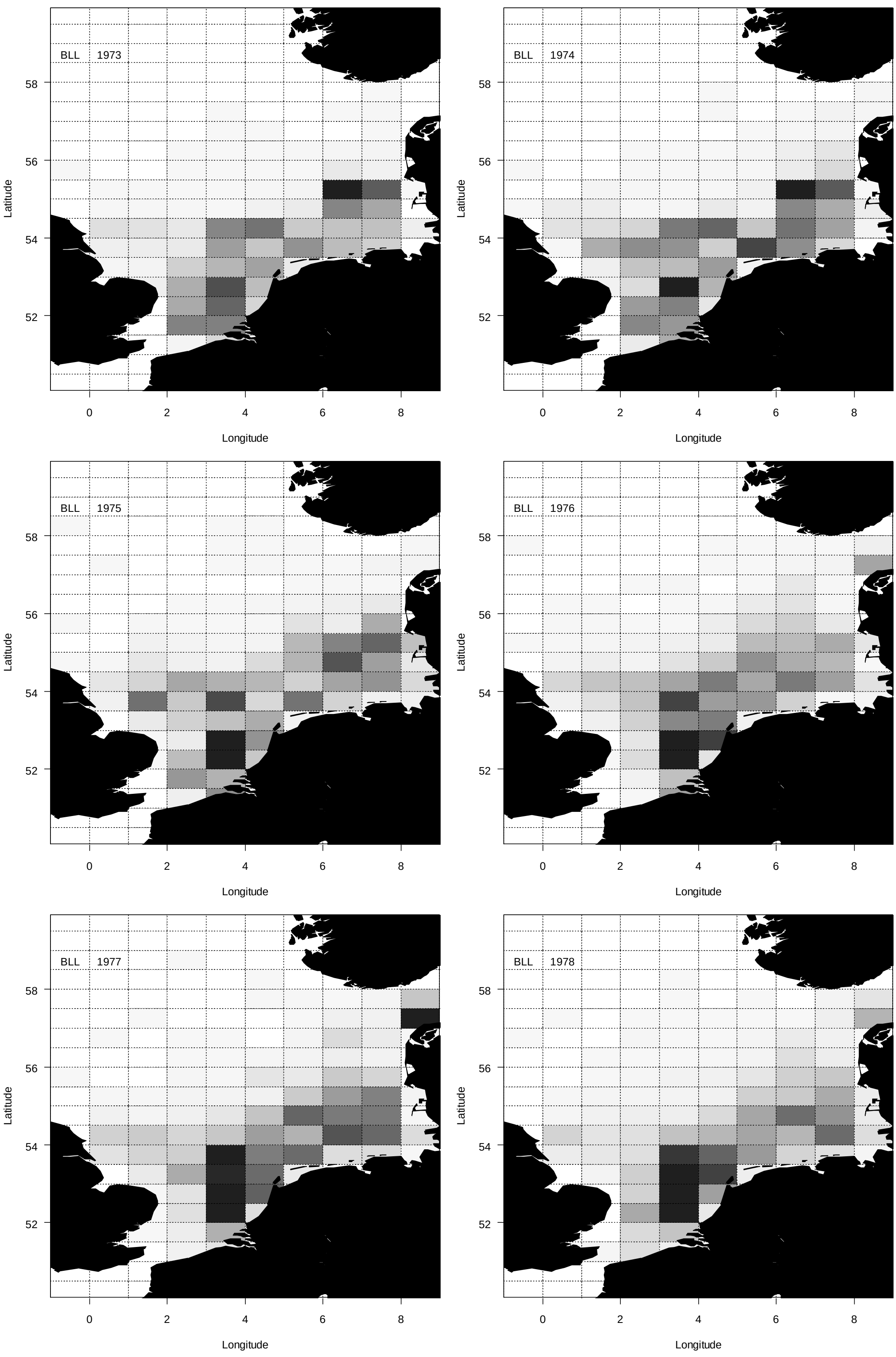

Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

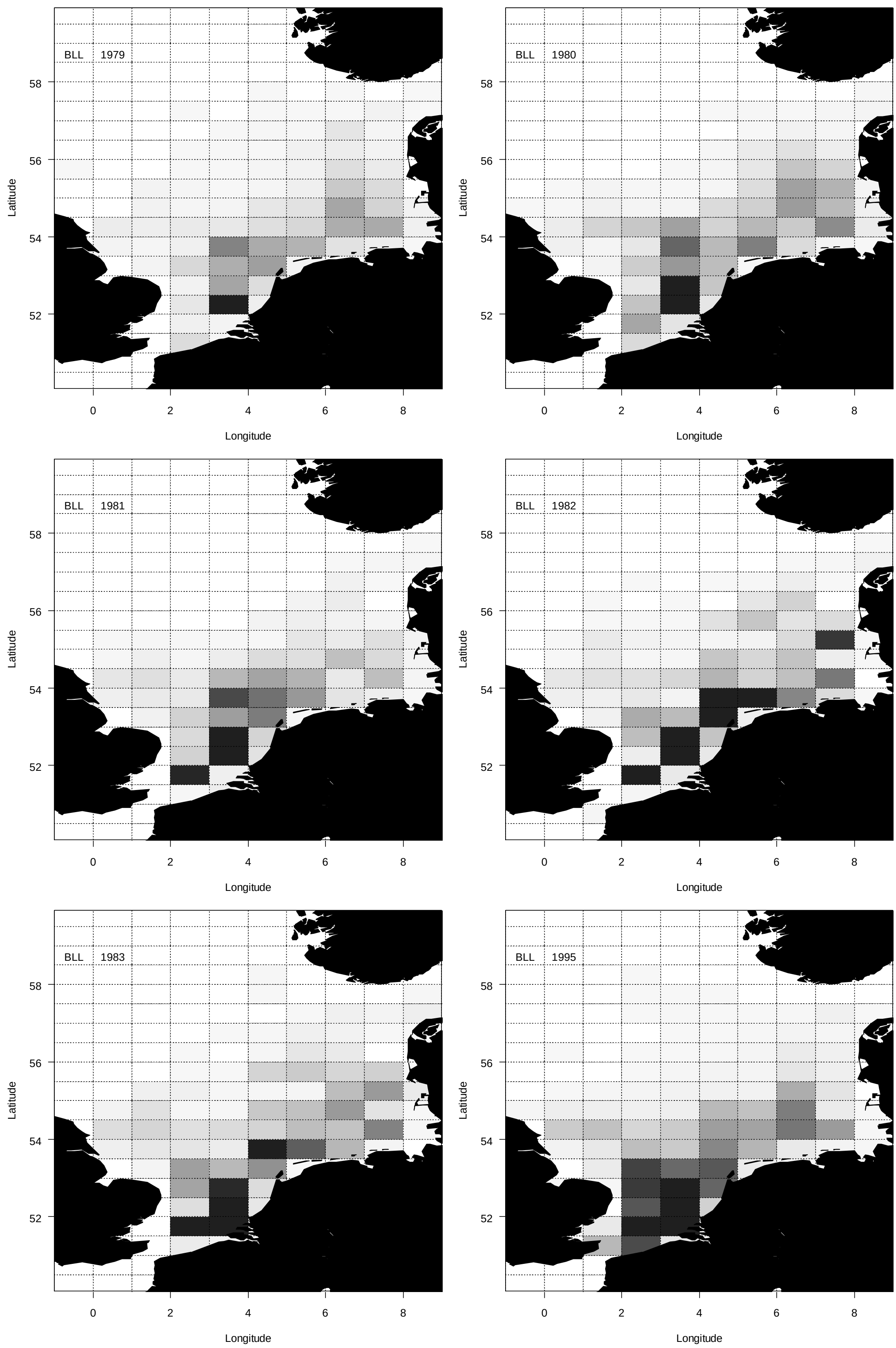

Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

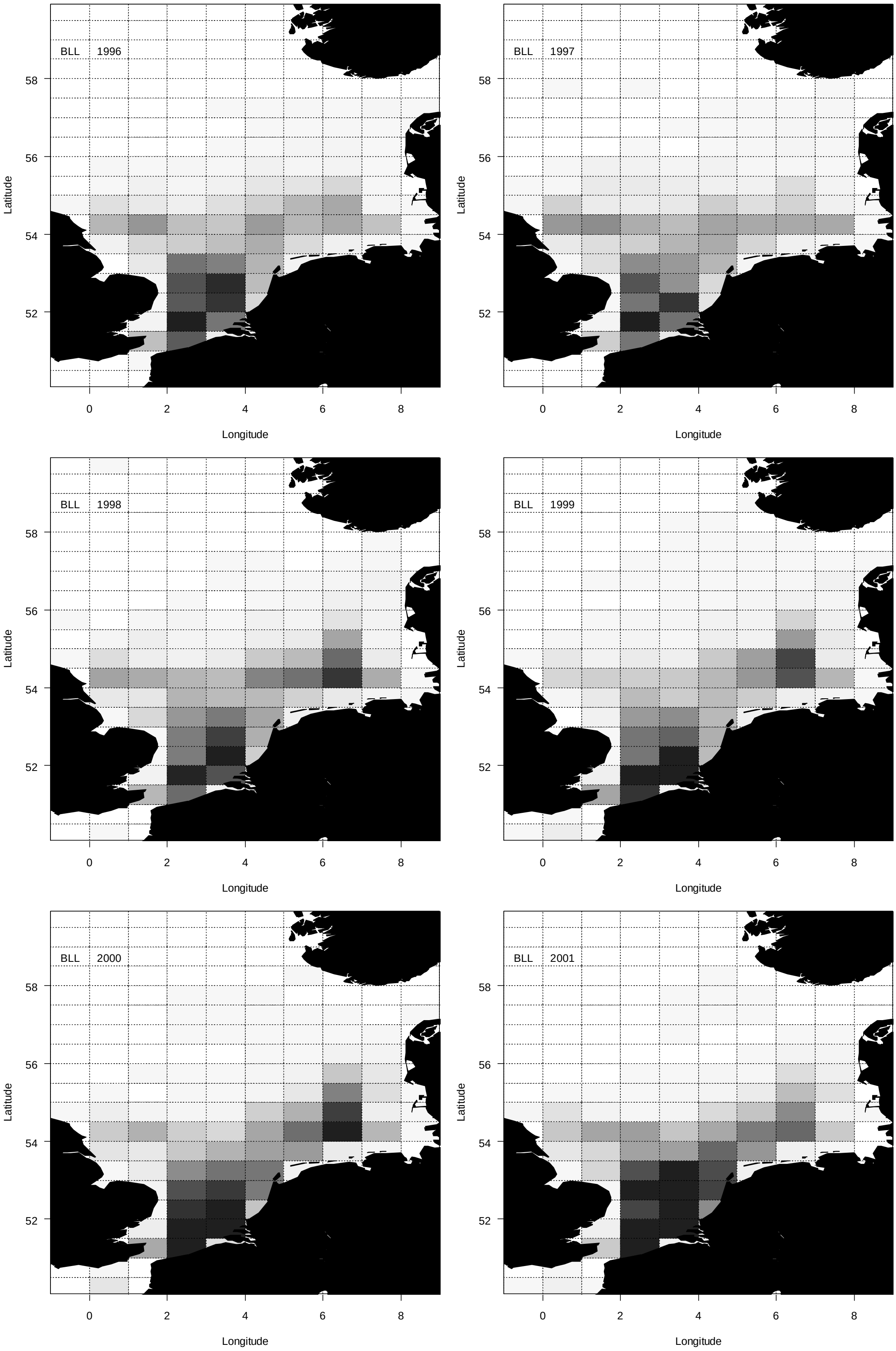

Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

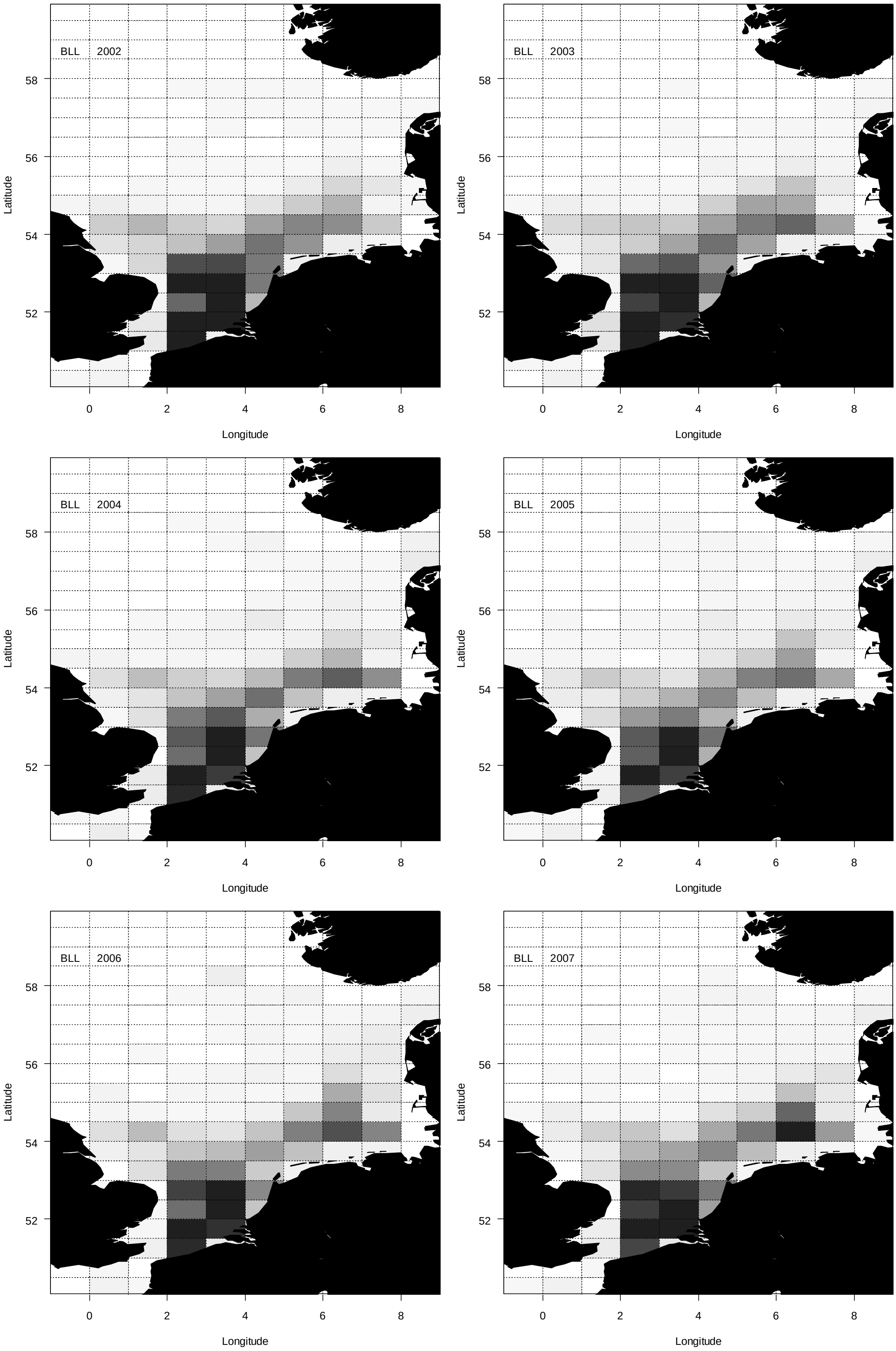

Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

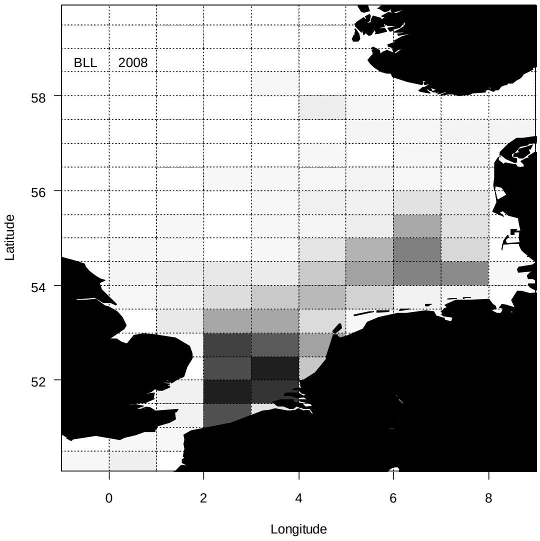

Figure 3.1.14 – Spatial distribution of Dutch brill landings in the North Sea in the period 1967-2008 (continued).

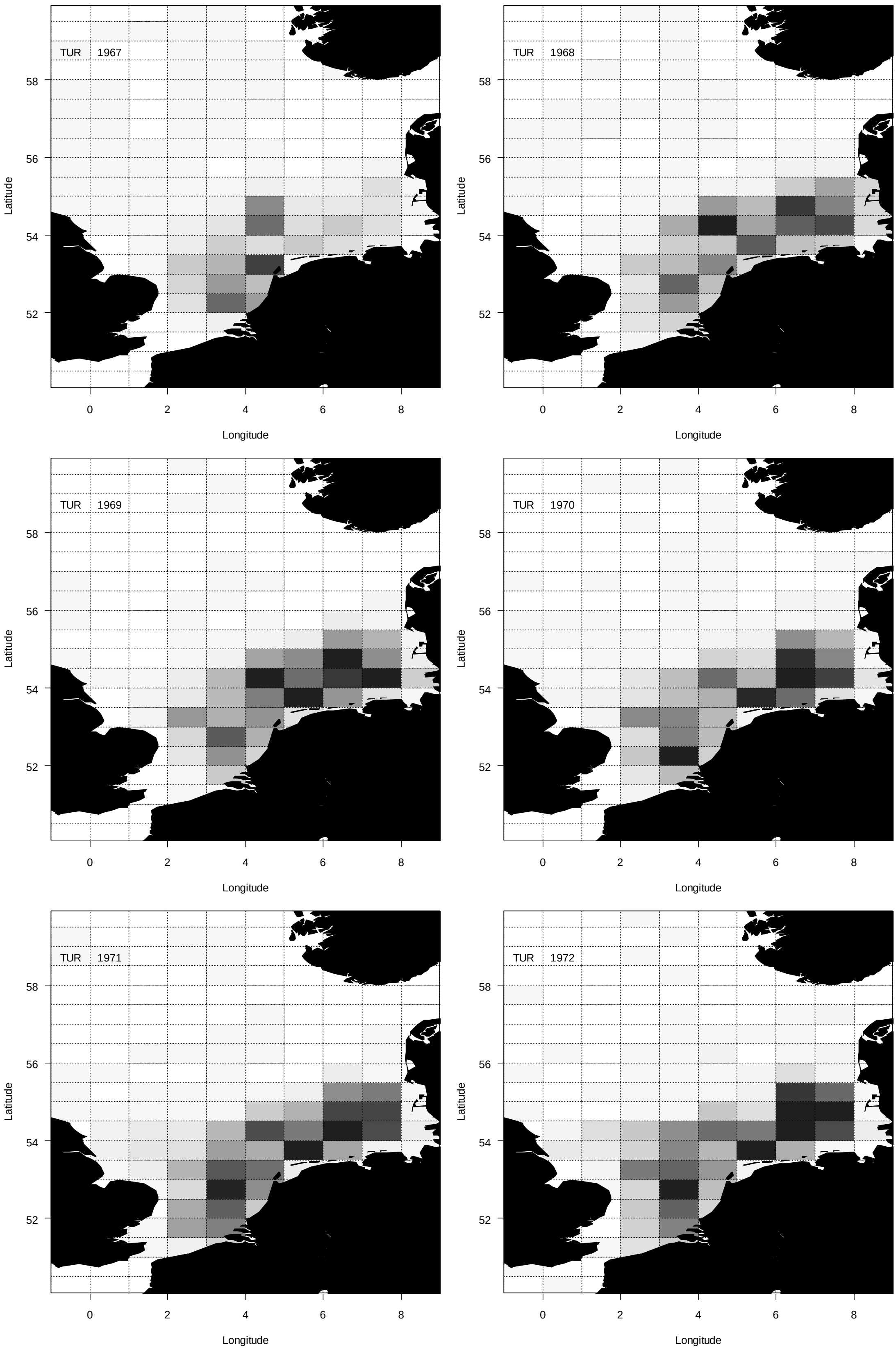

Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008.

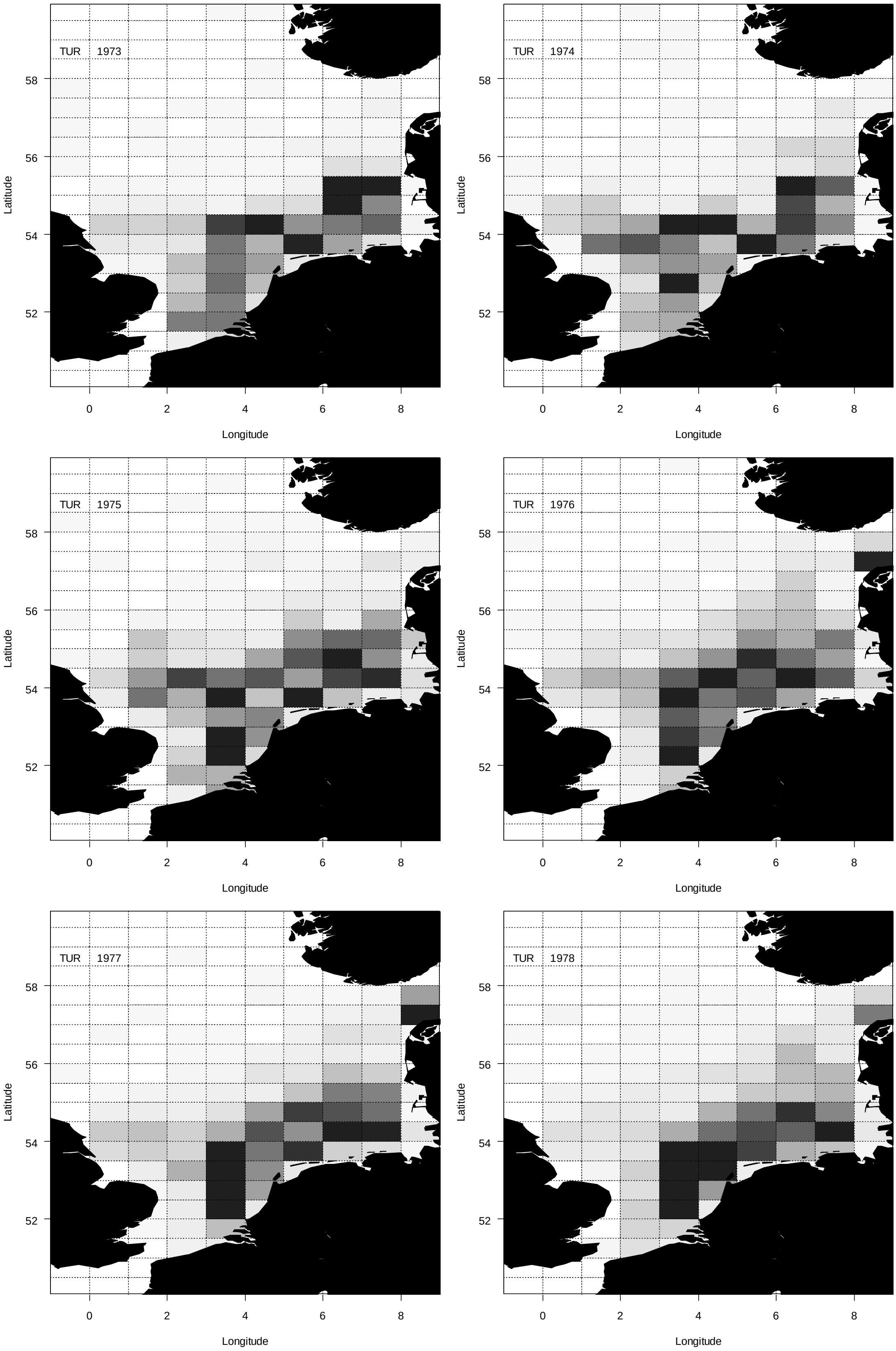

Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

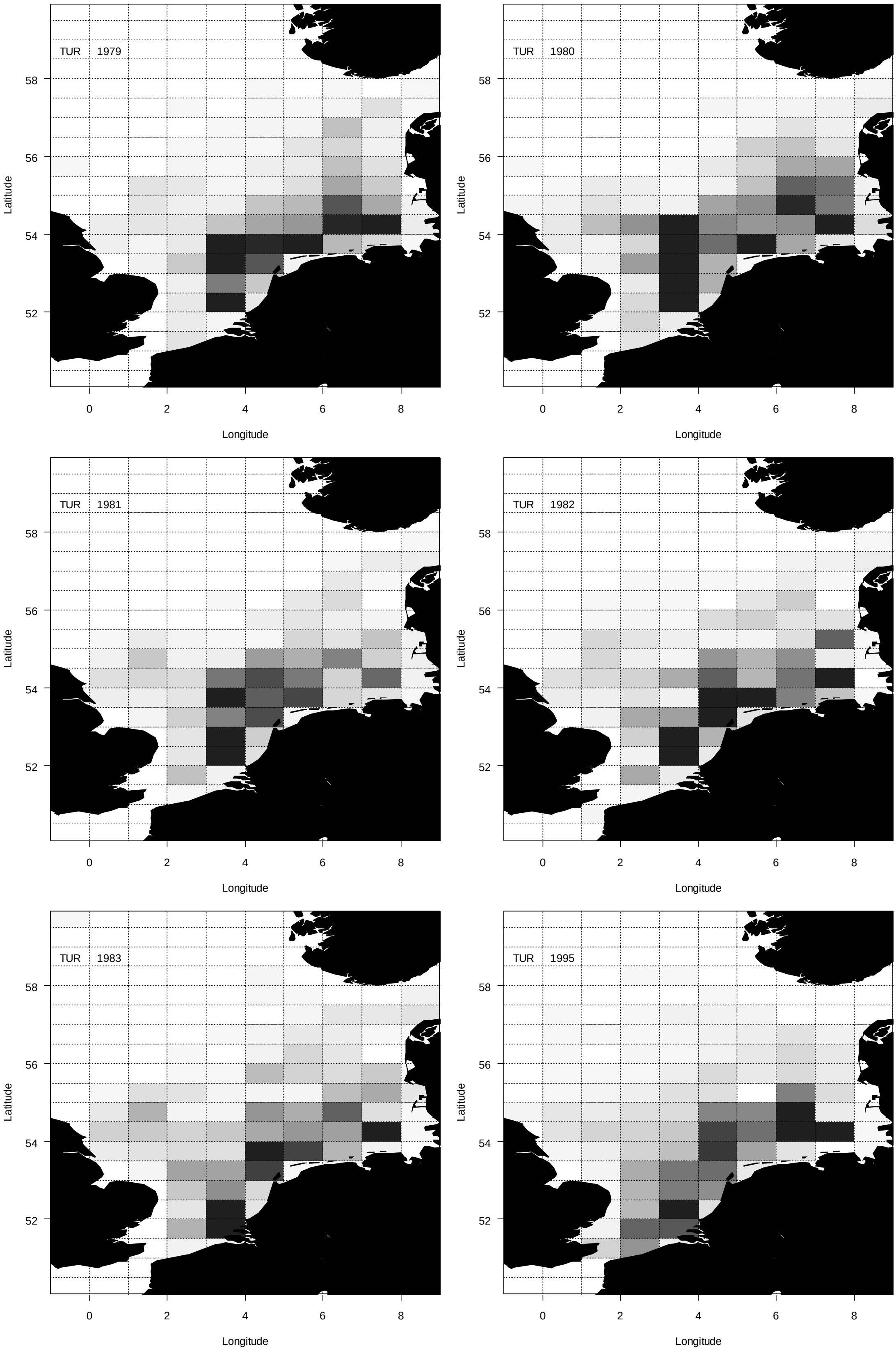

Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

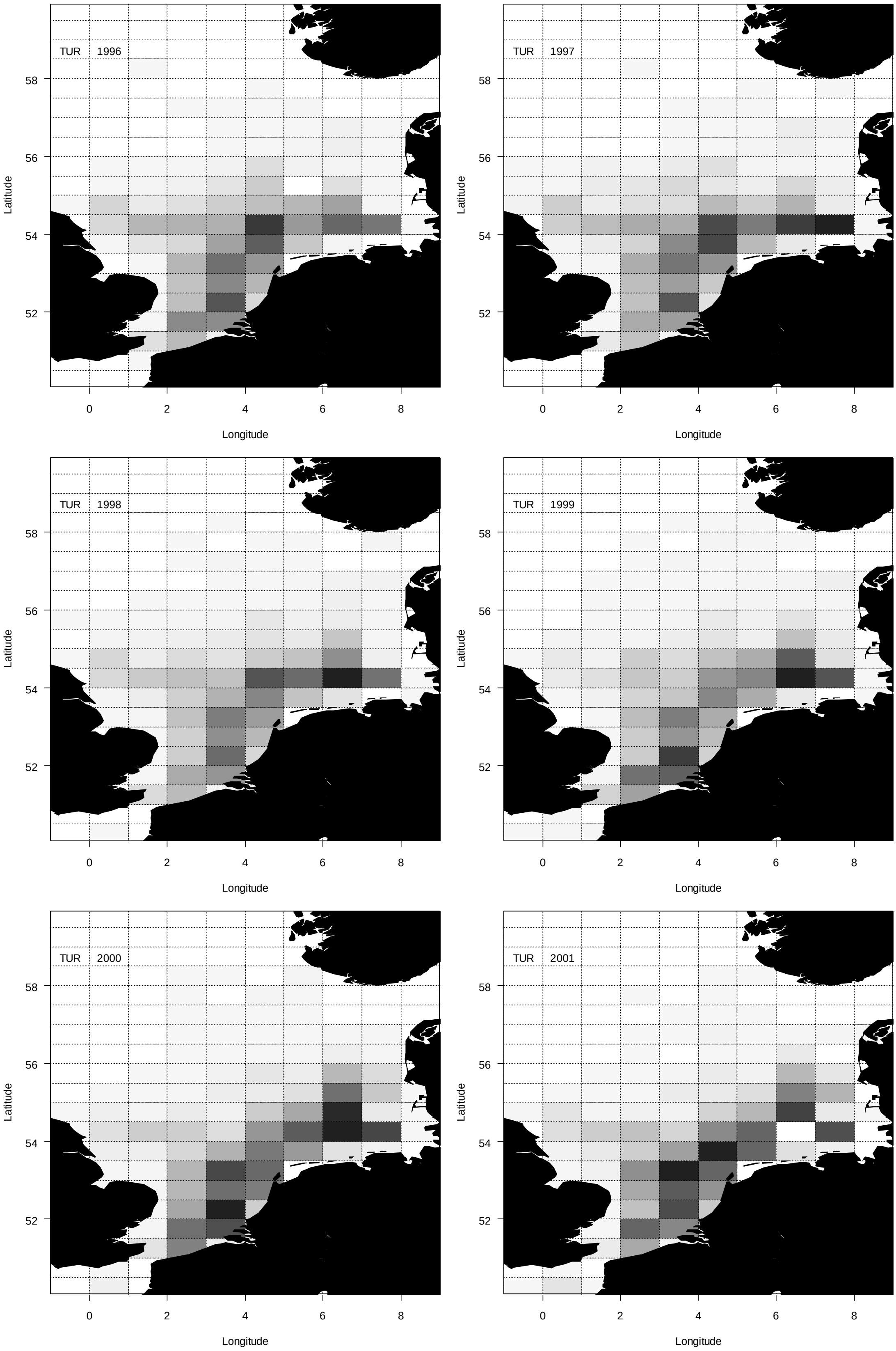

Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

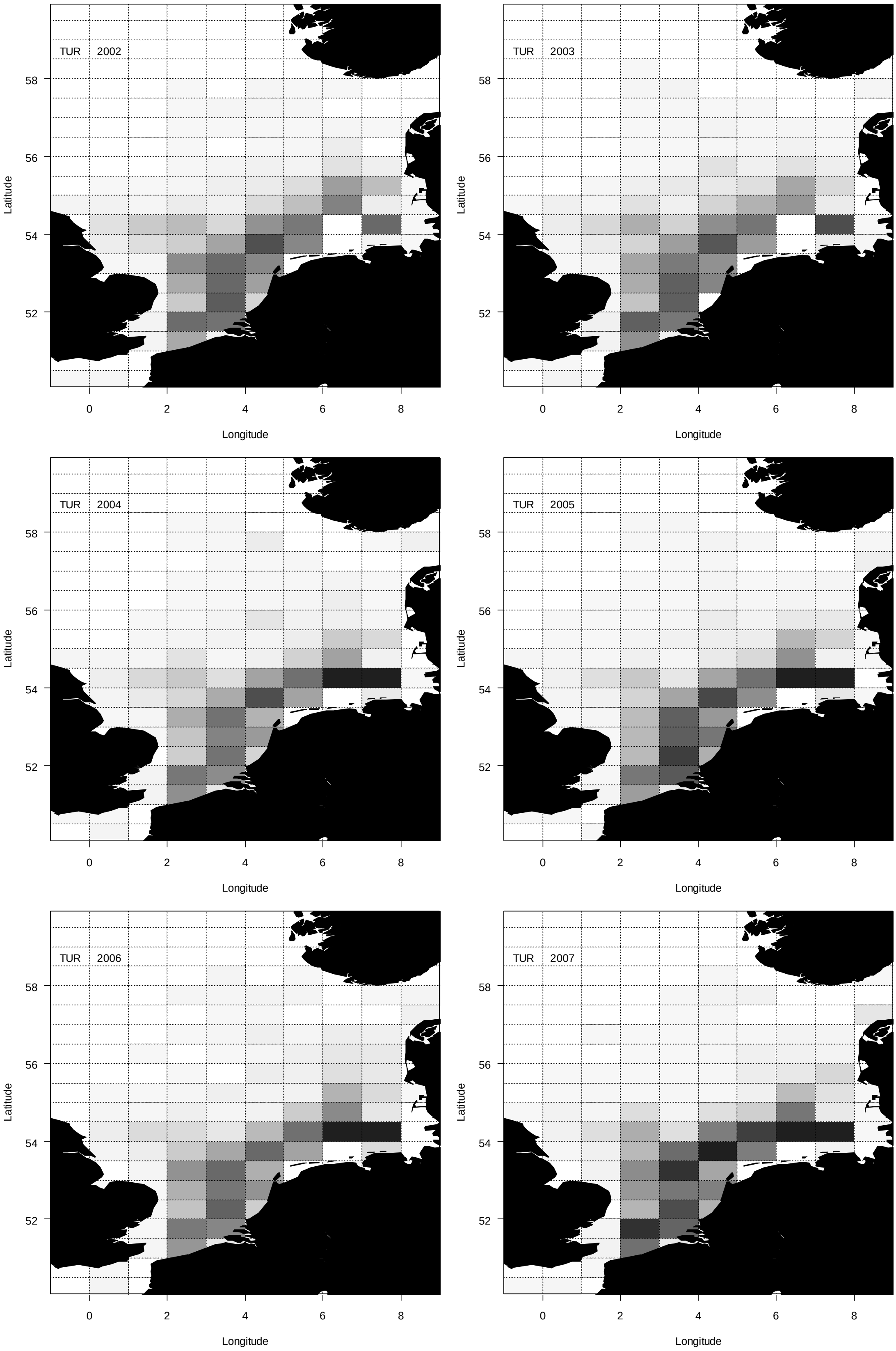

Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

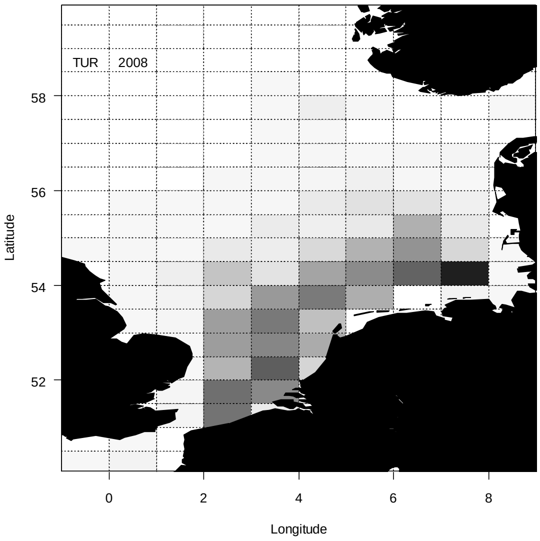

Figure 3.1.15 – Spatial distribution of Dutch turbot landings in the North Sea in the period 1967-2008 (continued).

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	

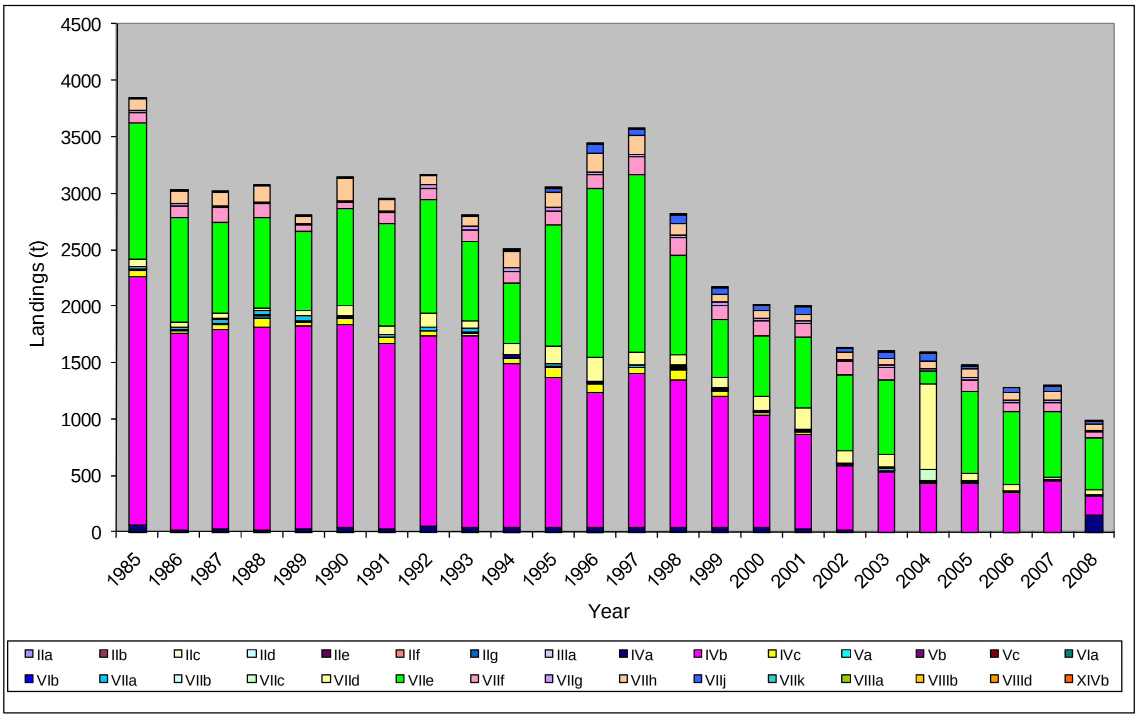

Figure 3.2.1 – Landings of lemon sole (t) by UK vessels landing into England and Wales and by England and Wales vessels landing outside the UK between 1985 and 2008, by ICES Division.

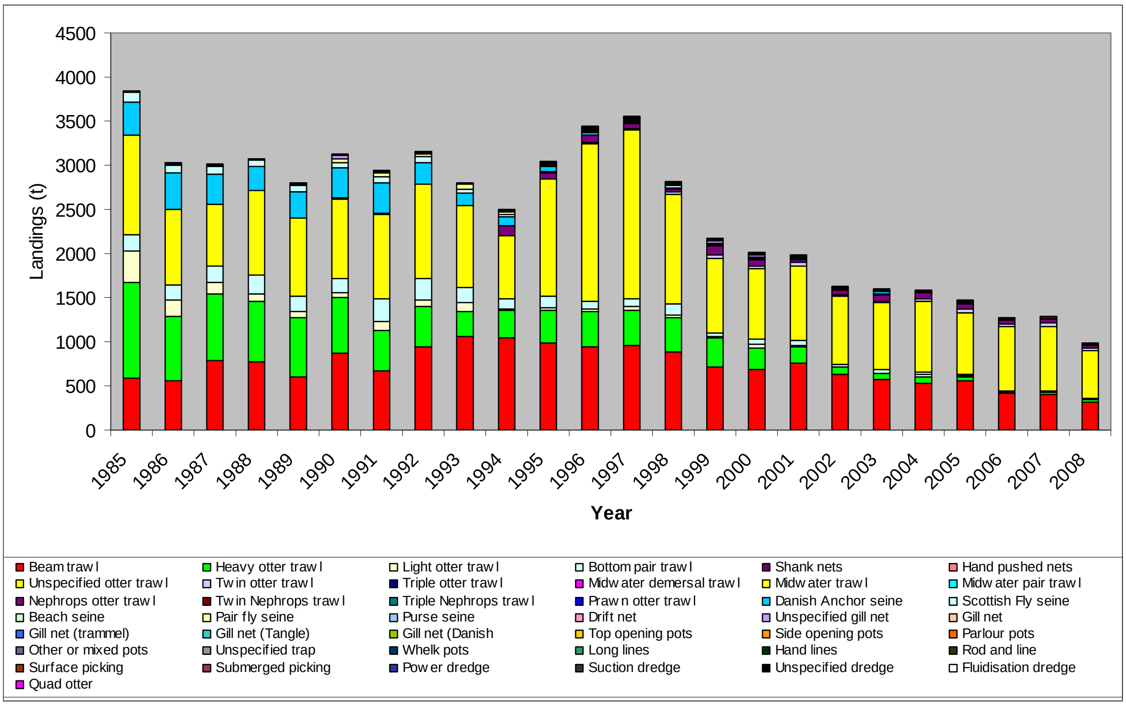

Figure 3.2.2 – Landings of lemon sole (t) by UK vessels landing into England and Wales and by England and Wales vessels landing outside the UK between 1985 and 2008, by gear type.

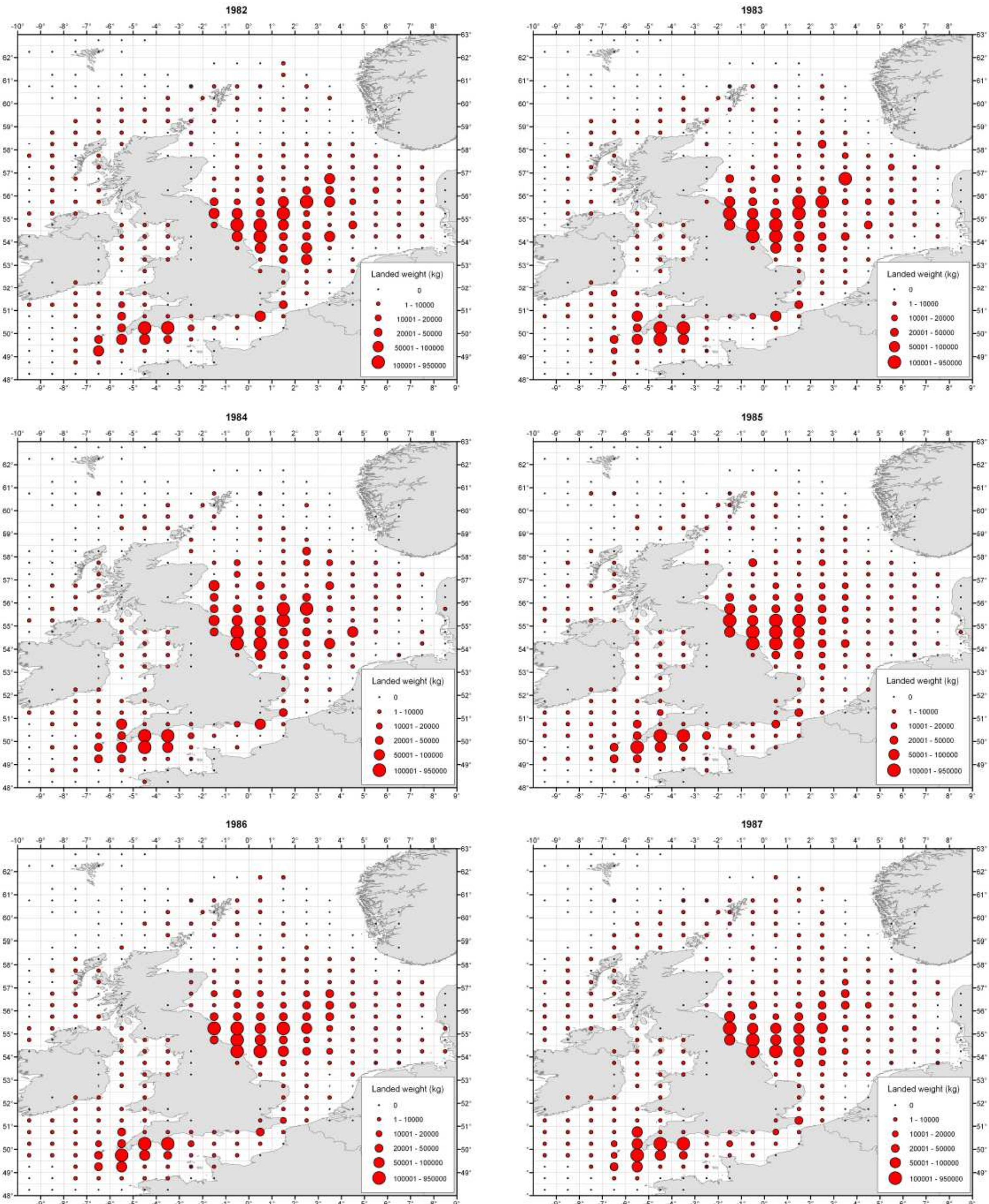

Figure 3.2.3 - Landings of lemon sole by UK vessels into England and Wales and by England and Wales vessels outside the UK, by ICES Rectangle.

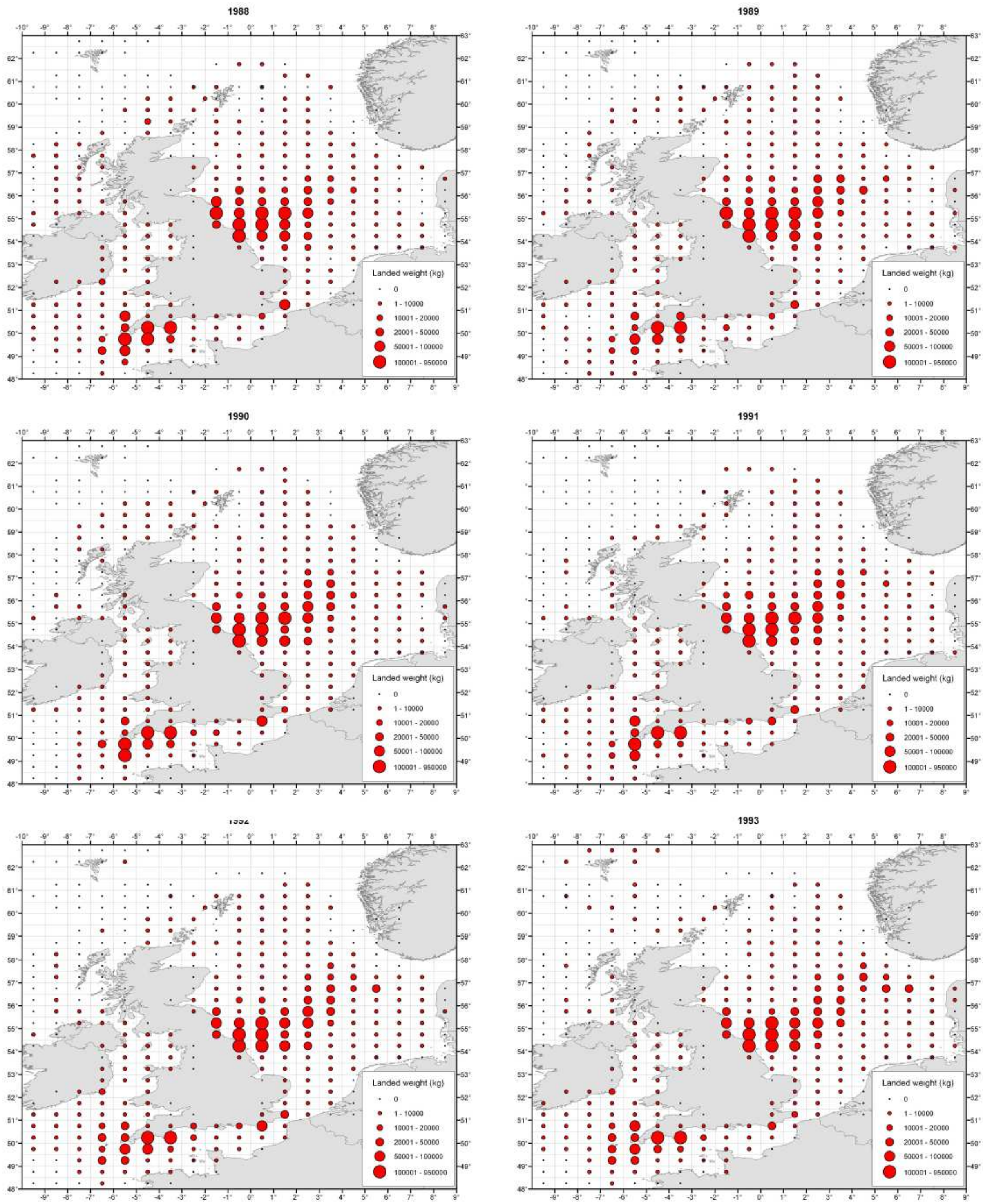

Figure 3.2.3 – Continued.

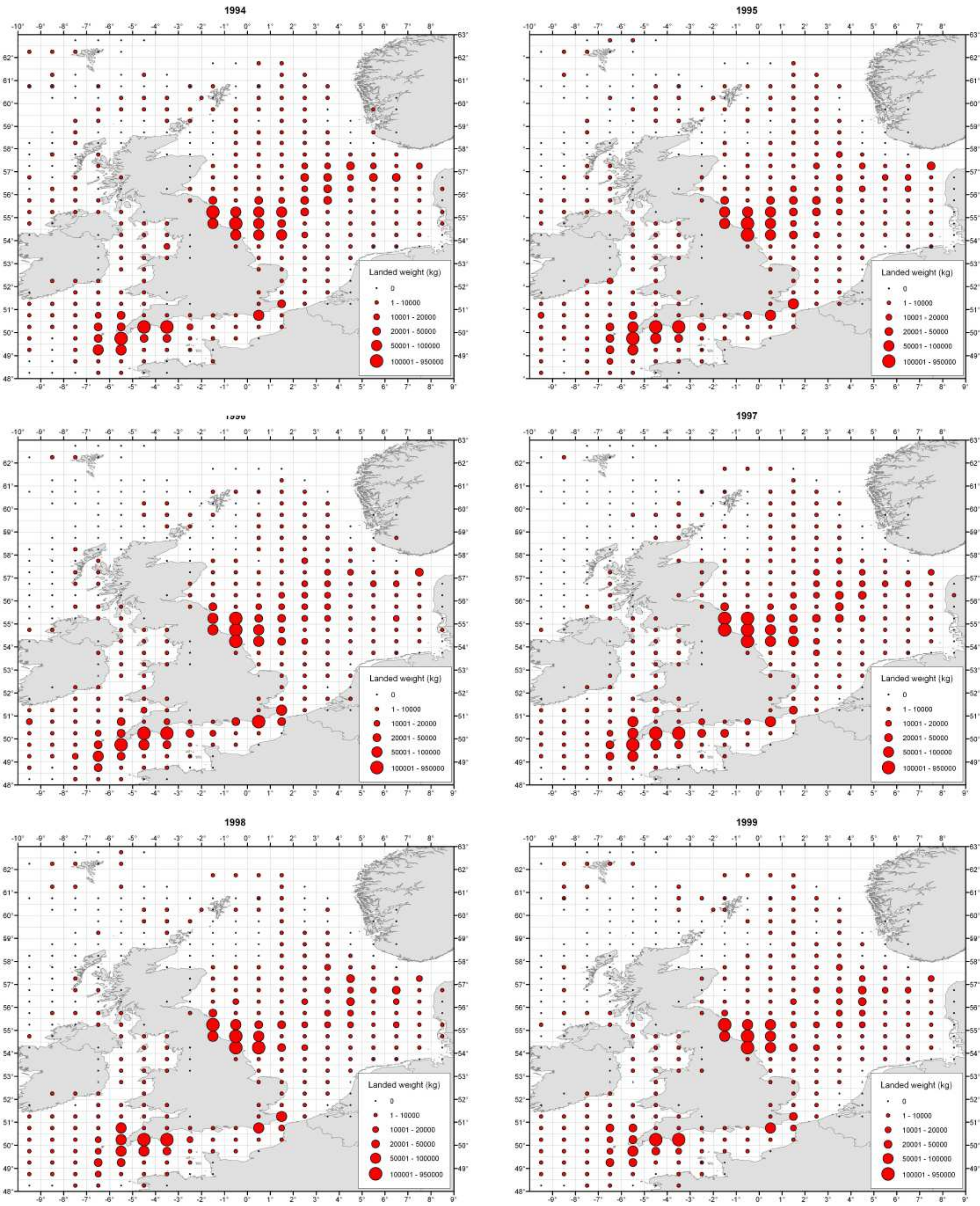

Figure 3.2.3 – Continued.

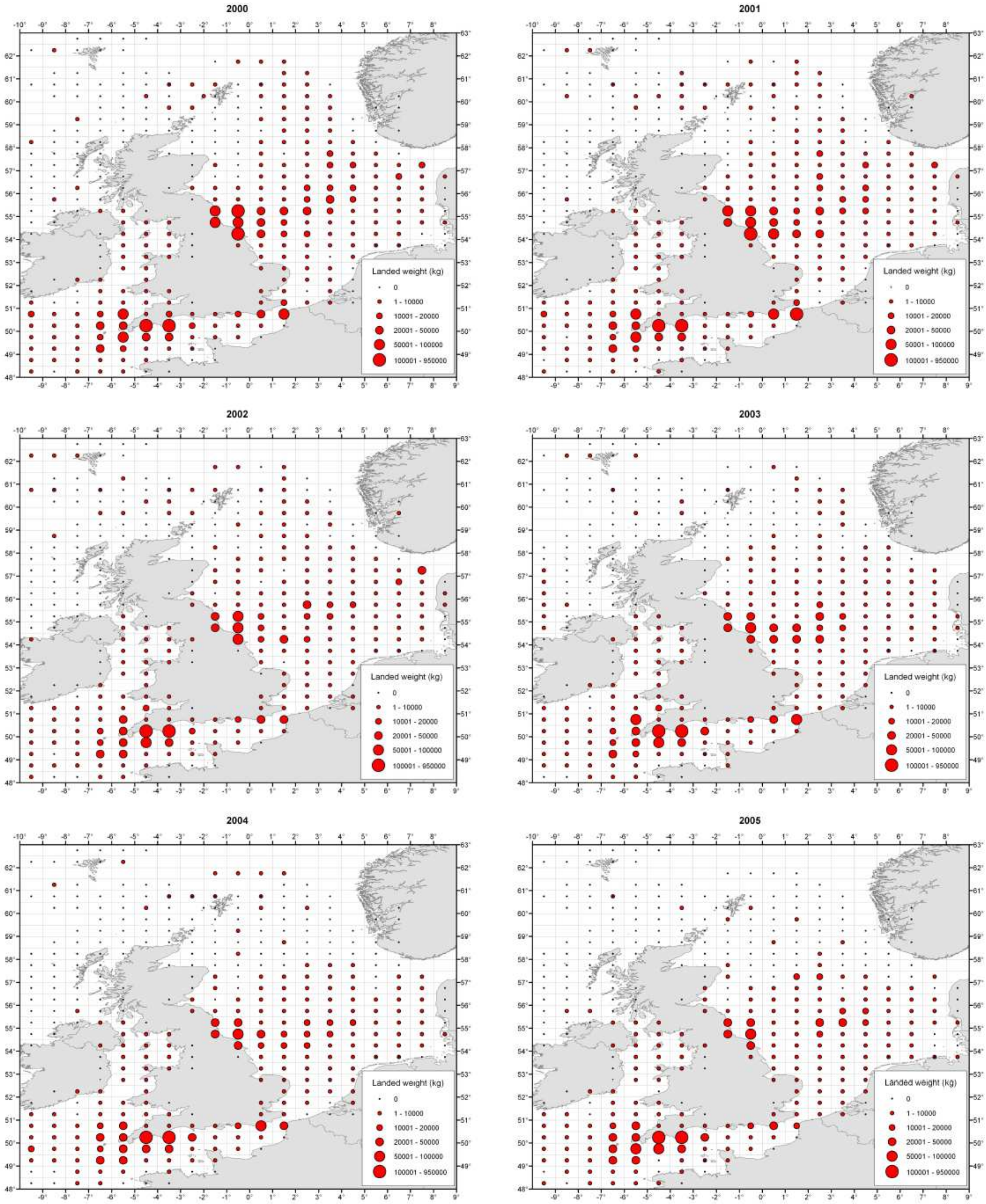

Figure 3.2.3 – Continued.

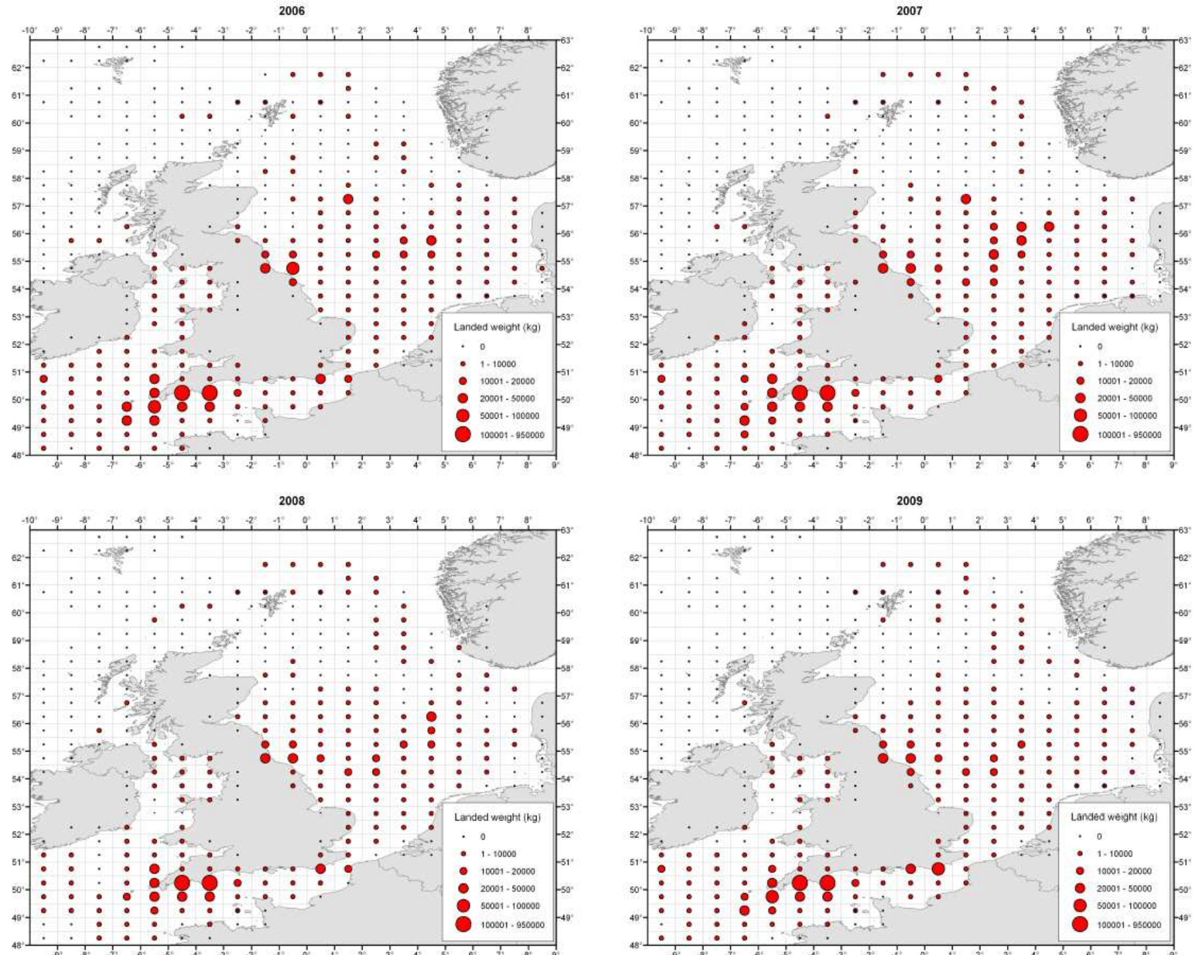

Figure 3.2.3 – Continued.

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.

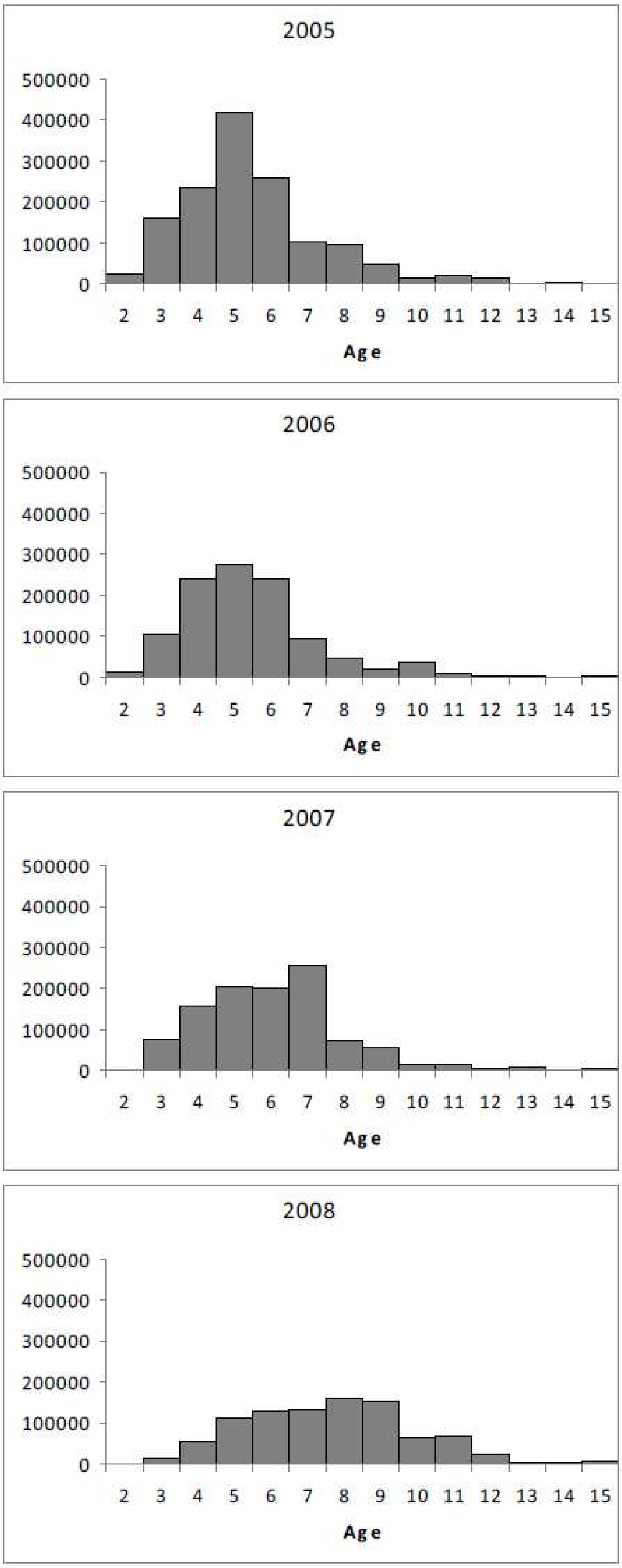

Figure 3.2.5 - Catch numbers at age for lemon sole landed in Area IV and Division VIId by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 2005 and 2008.

ICES Divisions Split into Rectangle groups for use with CPUE program.

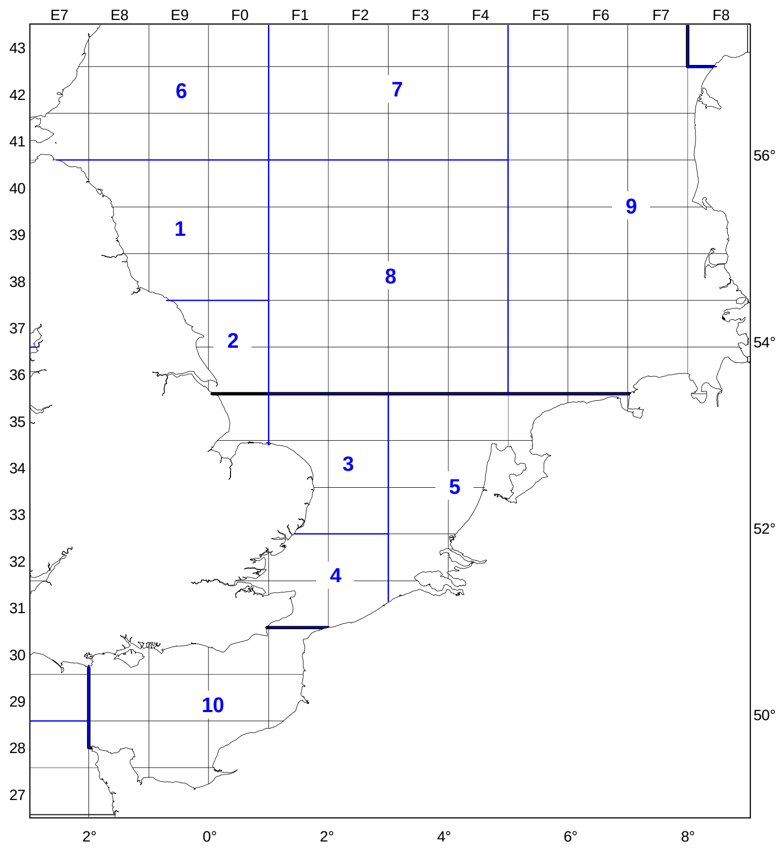

Figure 3.2.6 - North Sea rectangle groups, used for processing lemon sole LPUE.

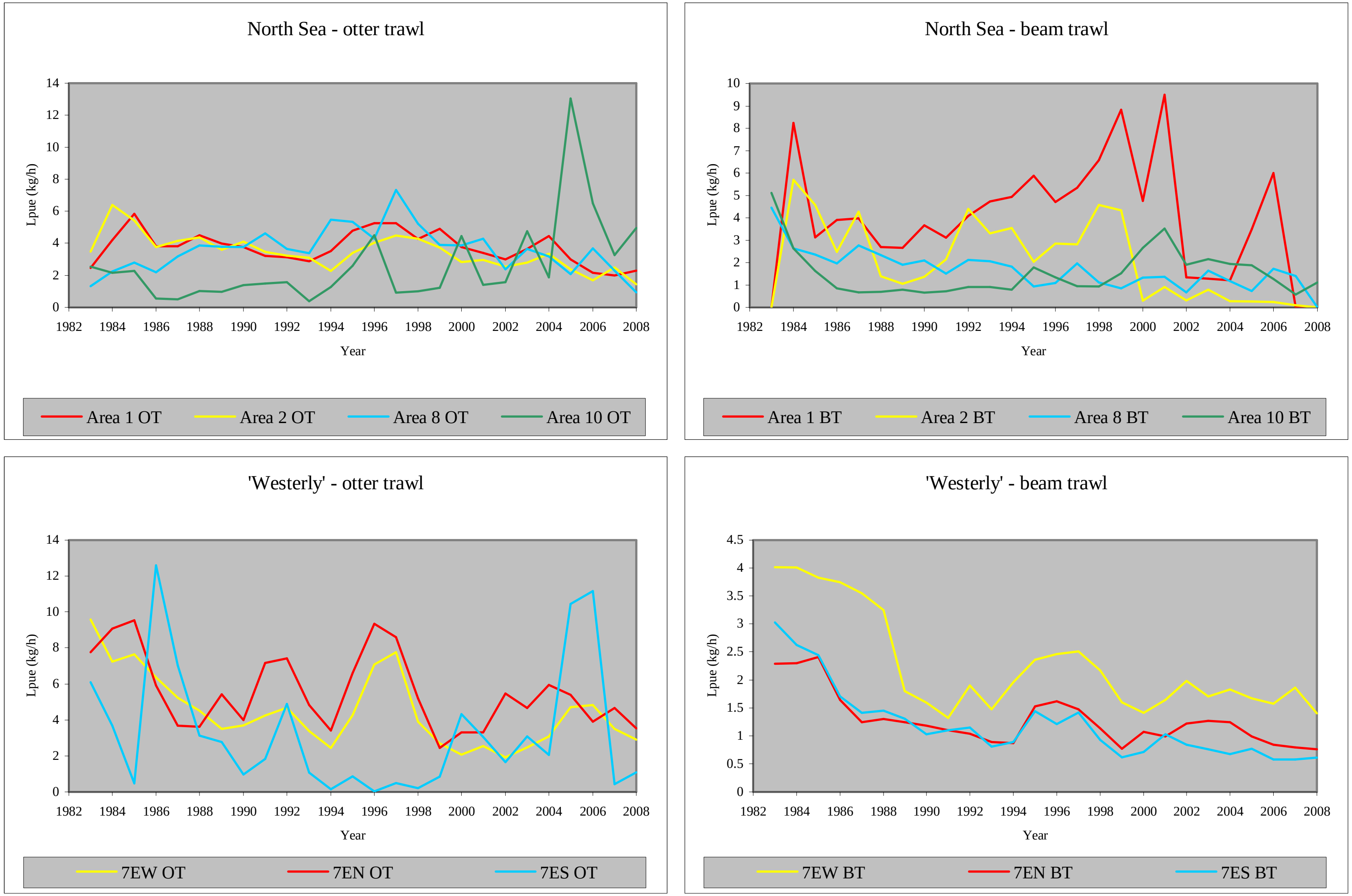

Figure 3.2.7 - LPUE of (top panels) North Sea lemon sole in roundfish areas 1, 2, 8 & 10 and (bottom panels) 'westerly' lemon sole in areas 7EW, 7EN and 7ES, for otter trawlers (left panels) and beam trawlers (right panels) of < 24 m length.

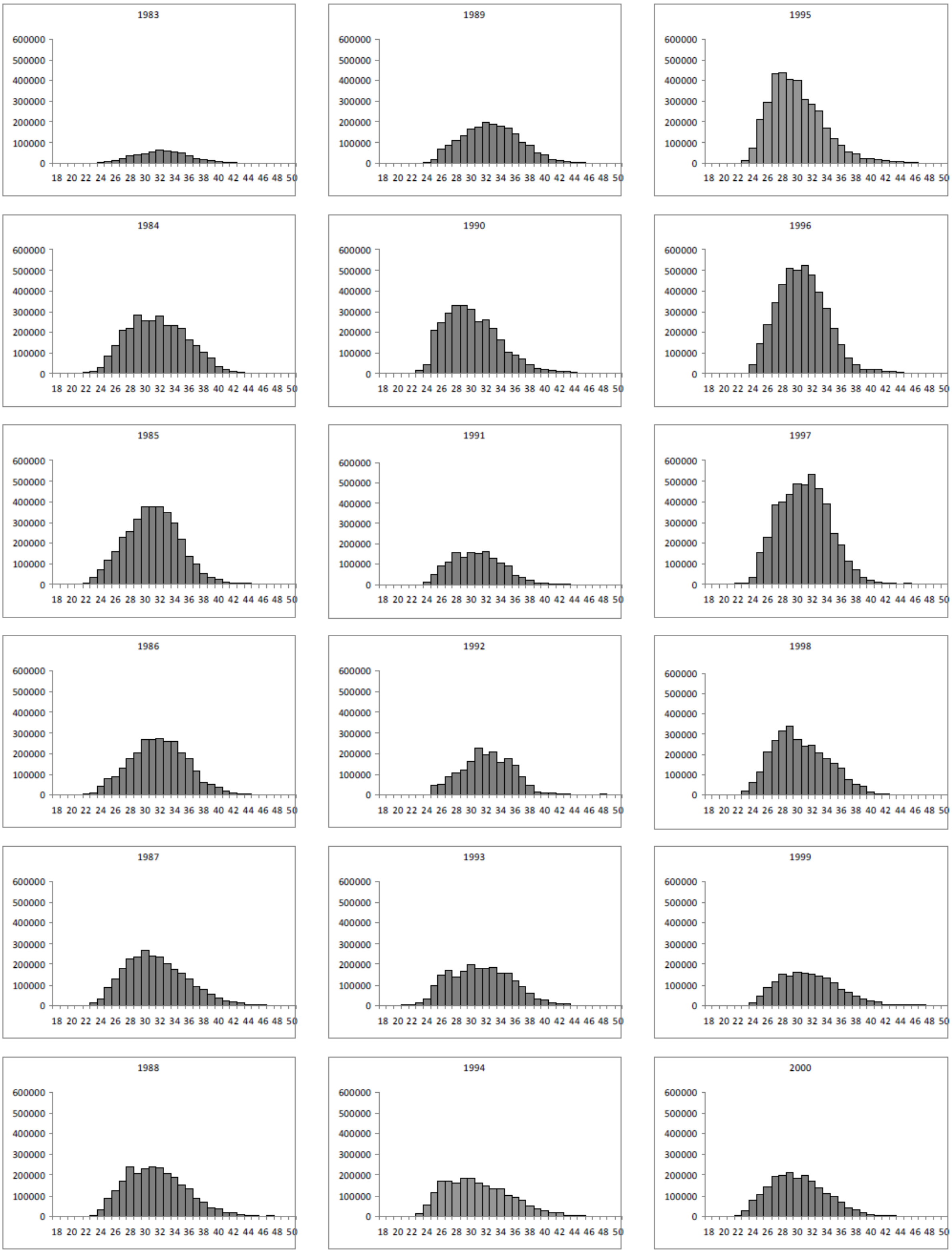

Figure 3.2.8 - Catch numbers at length for lemon sole landed into ICES Divisions VIIe-k by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 1982 and 2008.

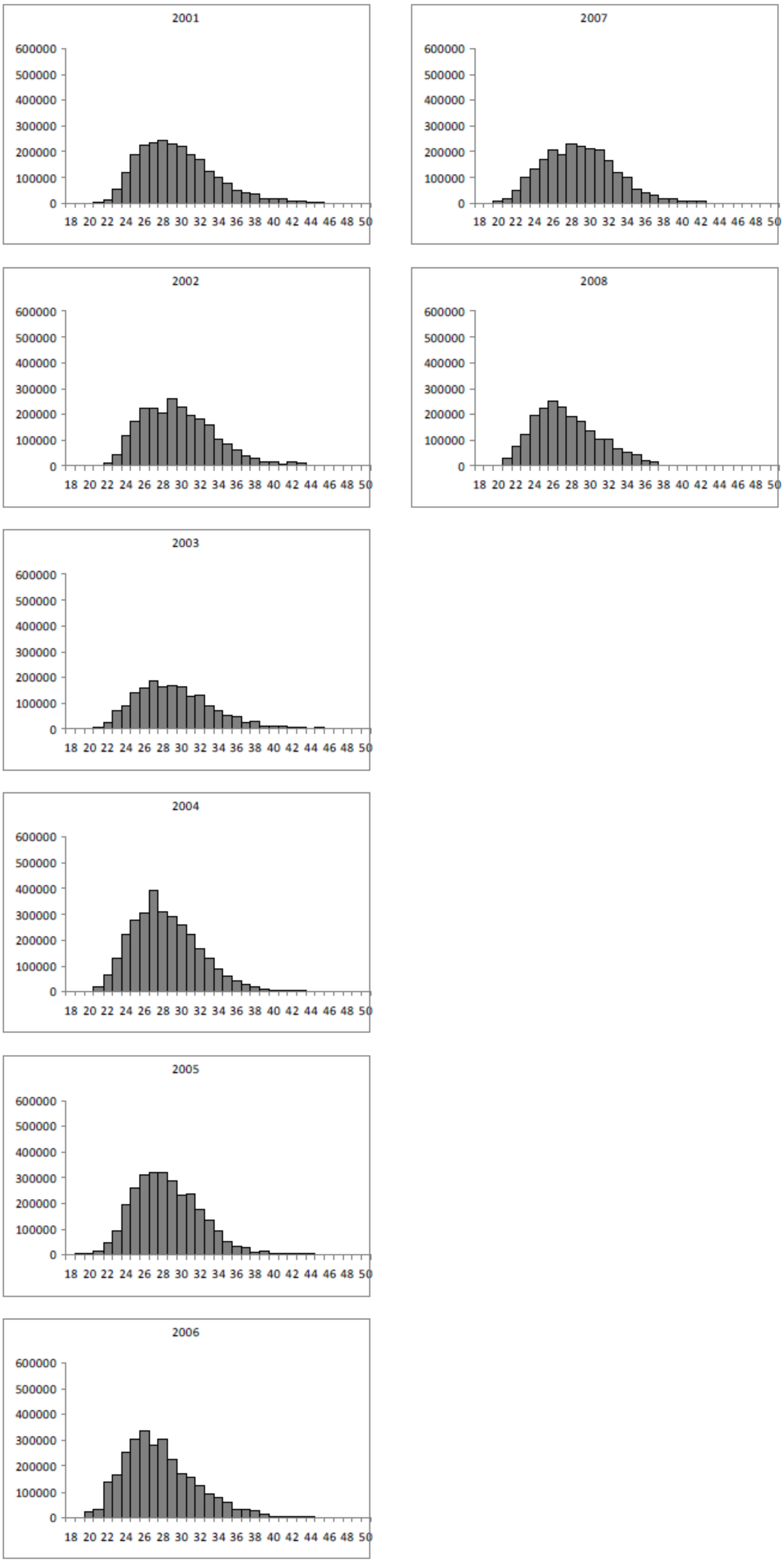

Figure 3.2.8 – Continued.

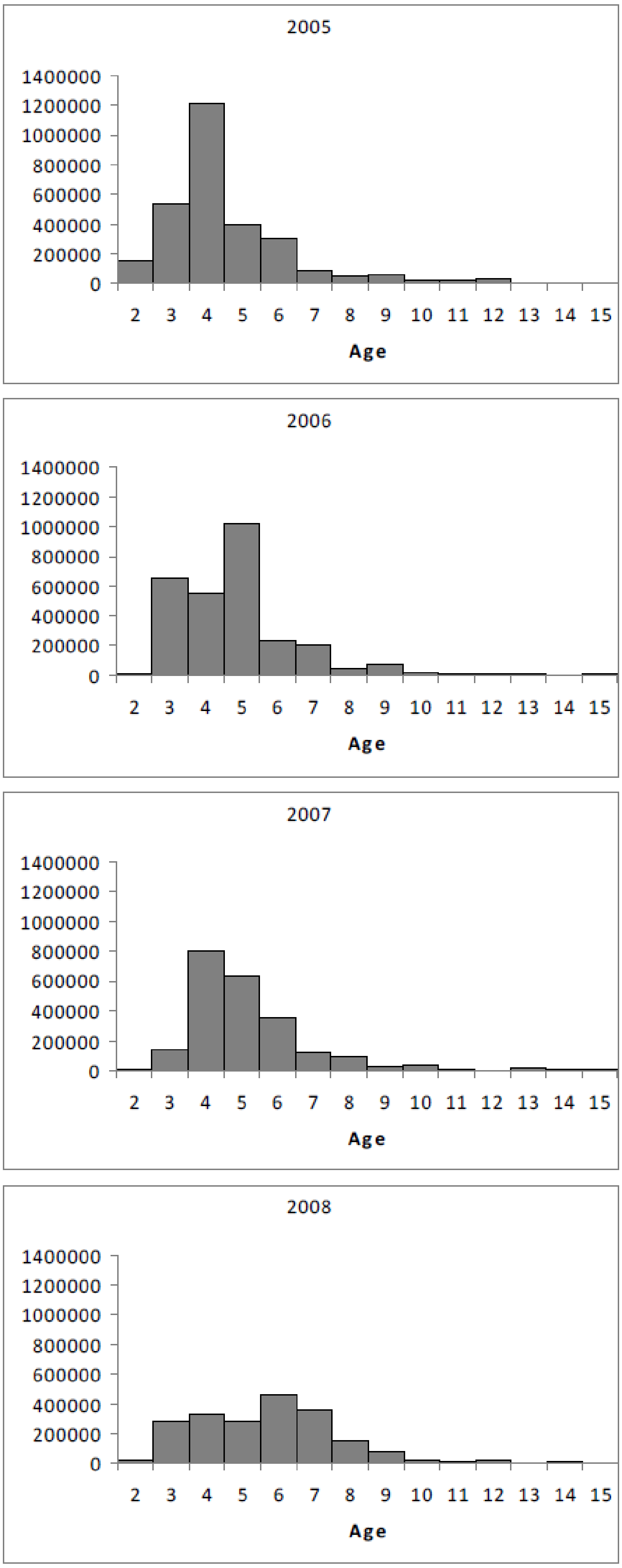

Figure 3.2.9 - Catch numbers at age for lemon sole landed in Divisions VIIe-k, by UK vessels landing into England and Wales and by England and Wales landing outside the UK, between 2005 and 2008.

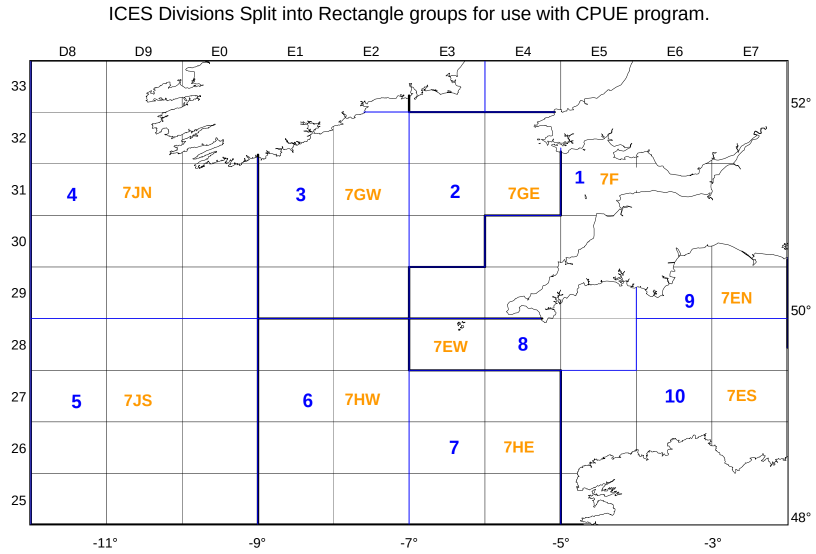

Figure 3.2.10 - Westerly rectangle groups, used for processing lemon sole LPUE.

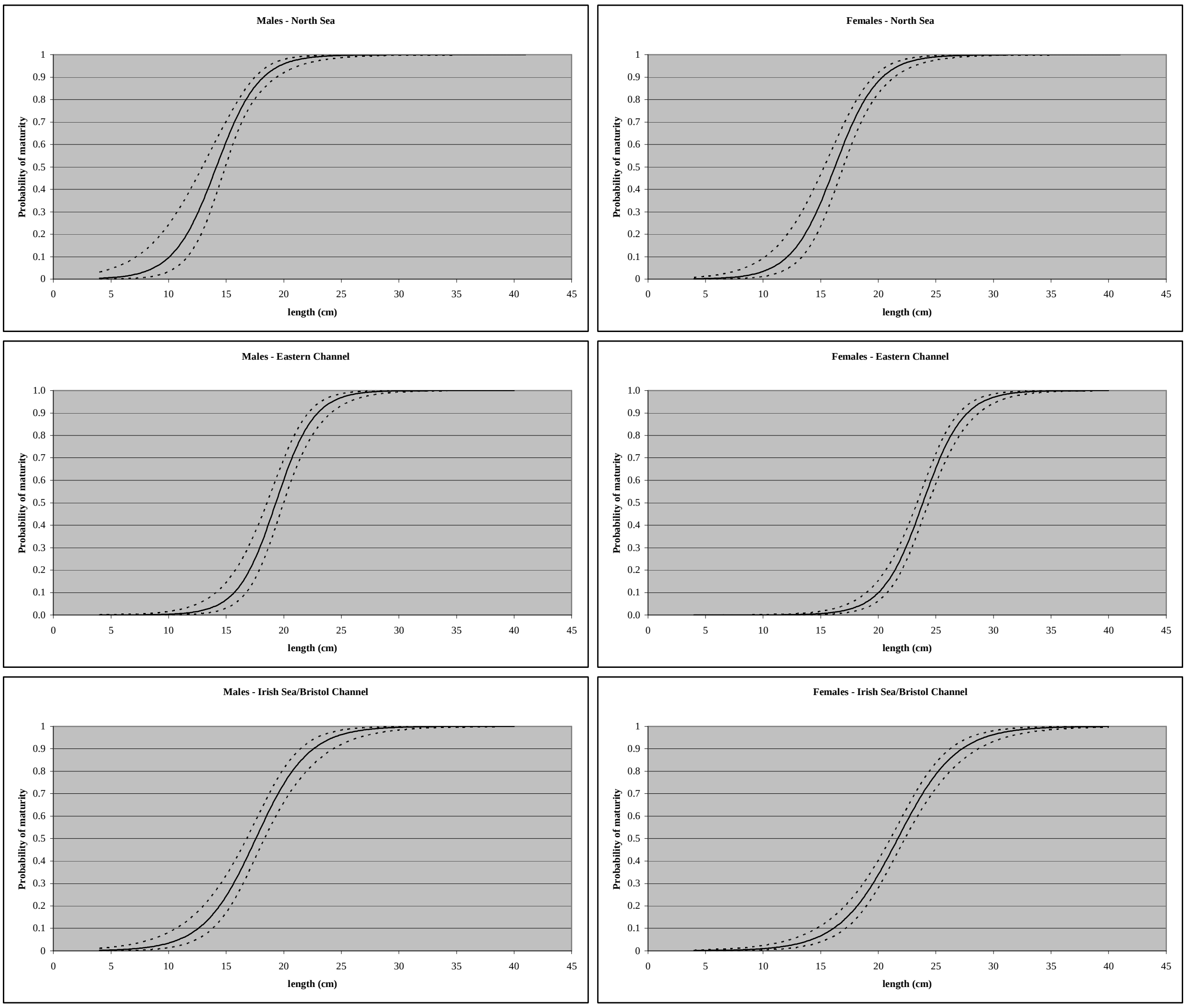

Figure 3.2.11 - Fitted maturity ogives for male and female lemon sole sampled in the 3rd Quarter North Sea IBTS Groundfish Survey (IBTS3E) (male n = 460, female n = 696), eastern Channel Beam Trawl Survey (BTS7d) (male n = 288, female n = 487) and the Irish Sea/Bristol Channel (VIIa, f, g) Beam Trawl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

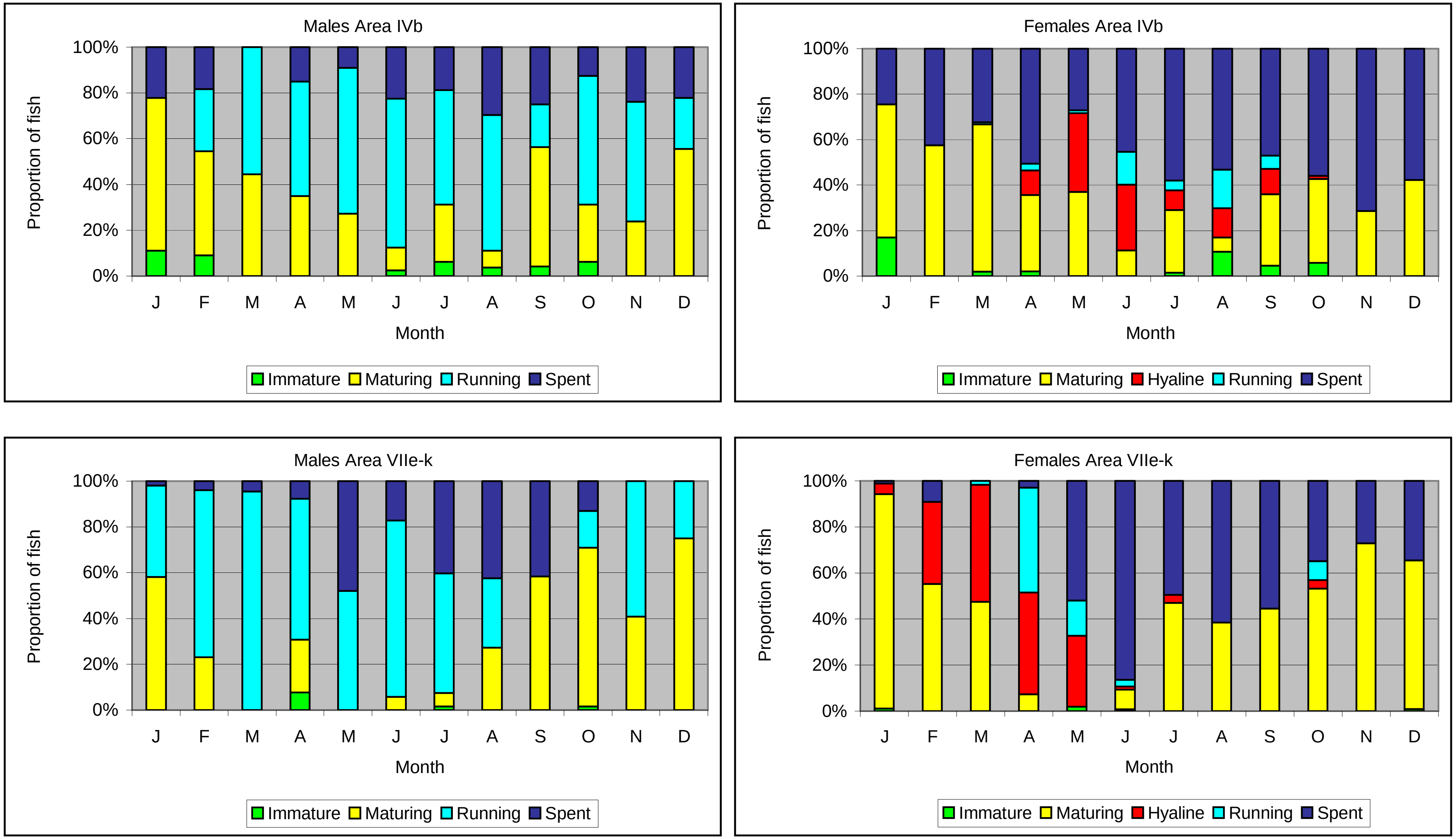

Figure 3.2.12 – Proportion of fish by maturity stage for fish sampled by the Cefas Biological Sampling Programme between 2004 and 2008 for ICES Division IVb (males n = 246; females n = 1082) and ICES Divisions VIIe,f,& g (males n = 444; females n = 984).

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.

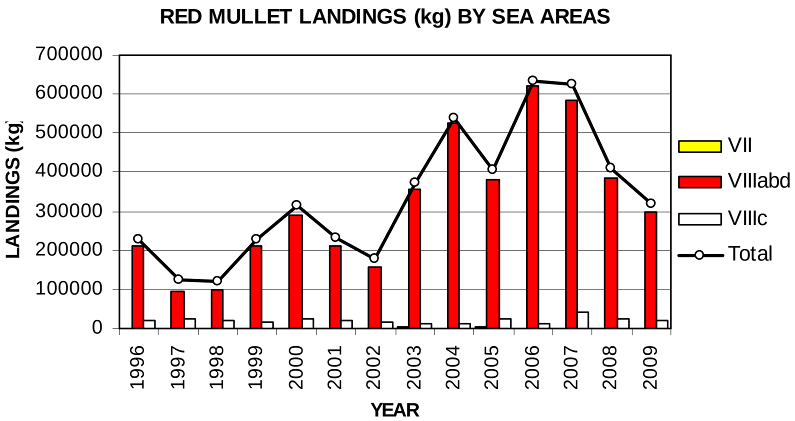

Figure 3.3.1 - Red mullet landings by area for the period 1996-2009.

[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).

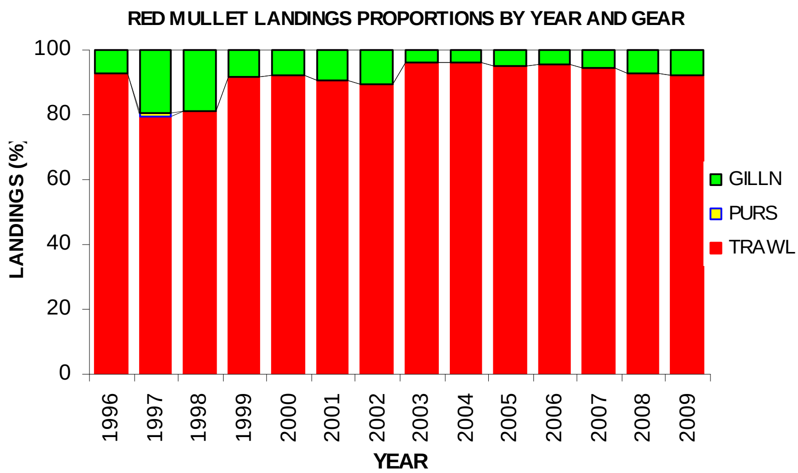

Figure 3.3.2 – Red mullet landings proportions by year and gear.

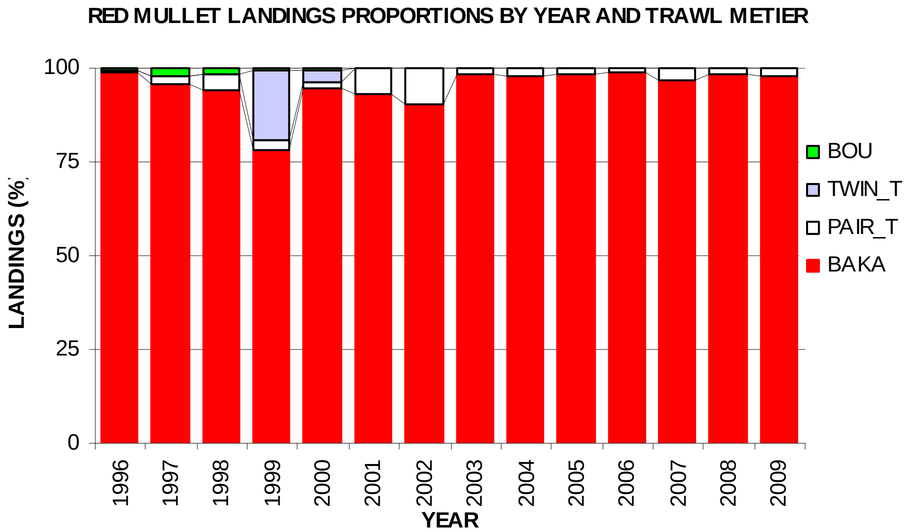

Figure 3.3.3 - Red mullet landings by gear.

3.3.2.3 *Seasonality of the catches*

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

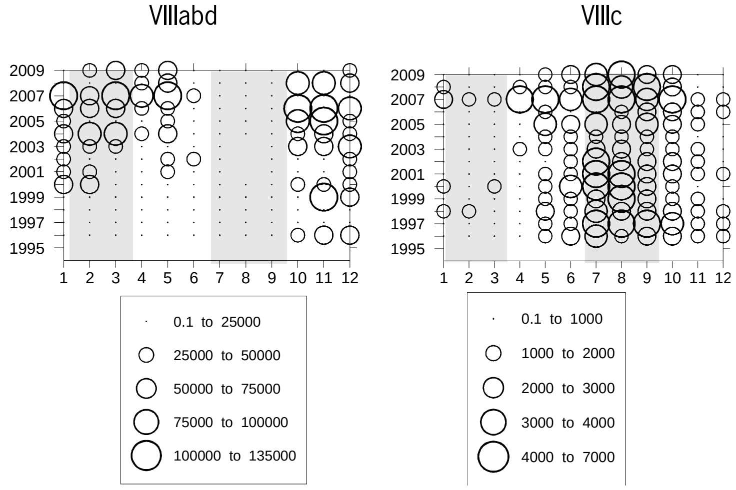

Figure 3.3.4 - Striped red mullet landings seasonality in Divisions VIIIabd and VIIIc

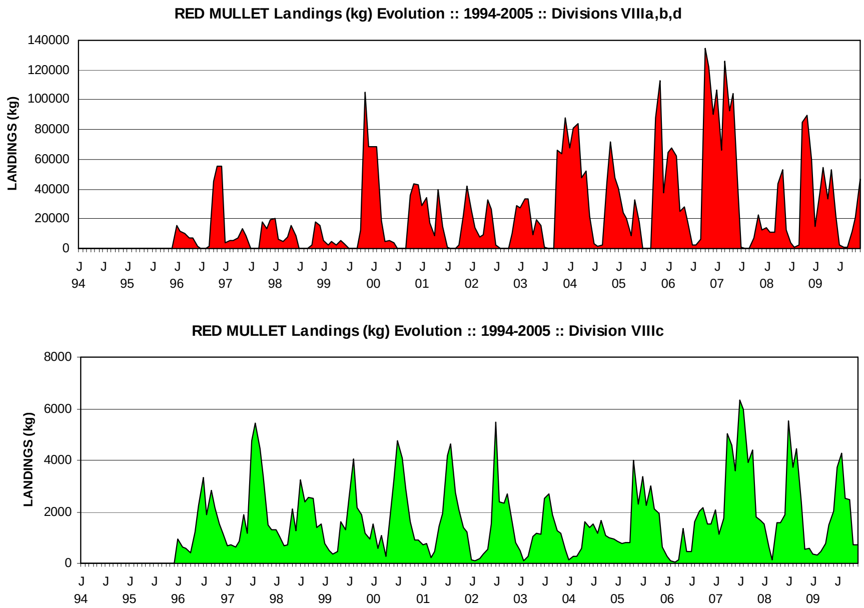

Figure 3.3.5 - Monthly striped red mullet landings (kg) in Basque ports, by ICES Sub-area, in the period 1994-2009.

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).

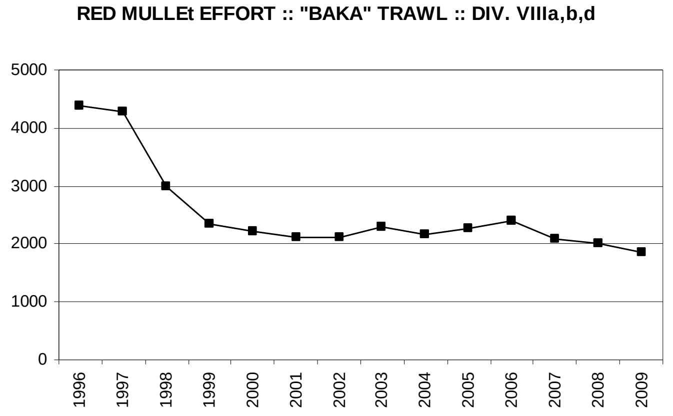

Figure 3.3.6 - “Baka” otter trawl effort (days) evolution during the period 1996-2009.

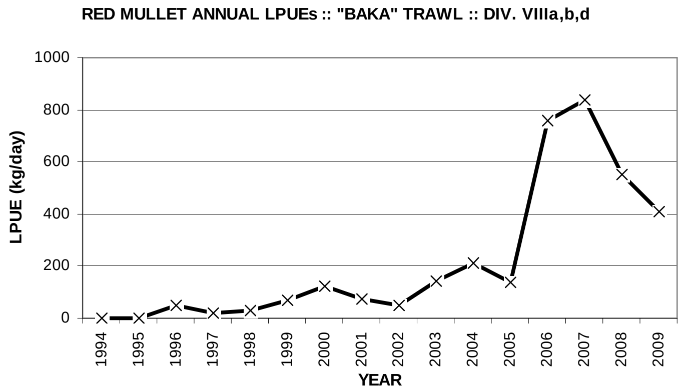

Figure 3.3.7 - Striped red mullet landings per unit effort (LPUEs in kg/day), by year of “baka” otter bottom trawl fishing in Divisions VIIIa,b,d, and landing in Ondarroa (Basque Country. Spain), in the period 1994-2005.

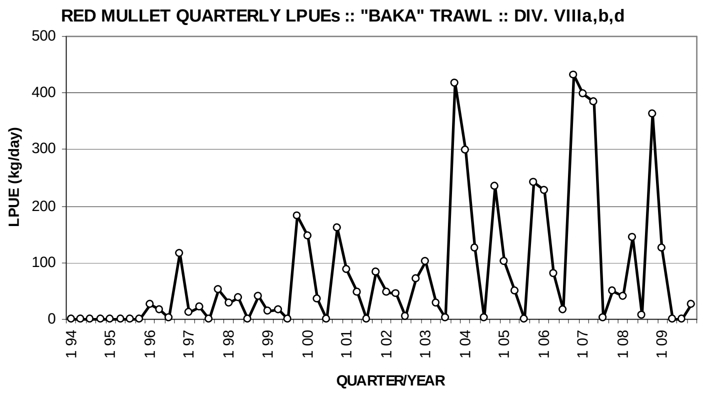

Figure 3.3.8 - Striped red mullet landings per unit effort (LPUEs in kg/day), by quarter, of “baka” otter bottom trawl fishing in Divisions VIIIa,b,d, and landing in Ondarroa (Basque Country. Spain), in the period 1994-2005.

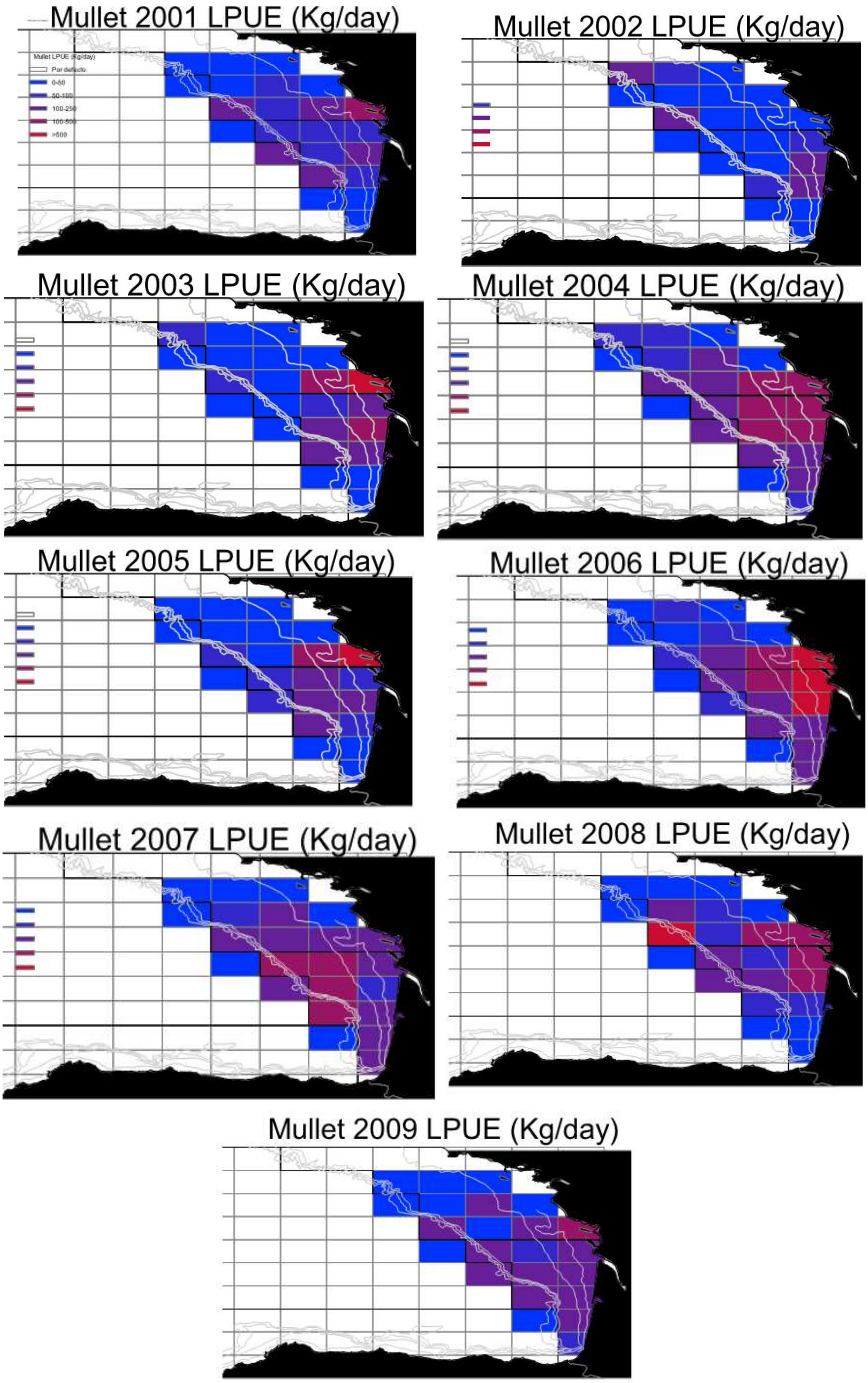

Figure 3.3.9 - Striped red mullet LPUE (Kg/day) by ICES Rectangle.

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.

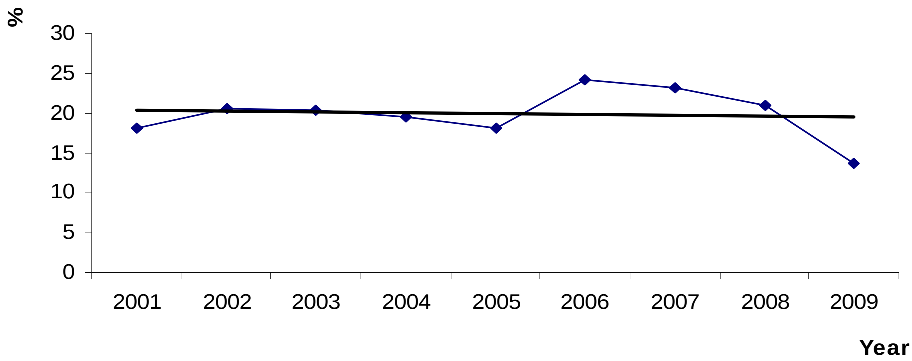

Figure 3.3.10 - Mullet revenues with respect to the total revenues of the gillnet fleet (%)

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.

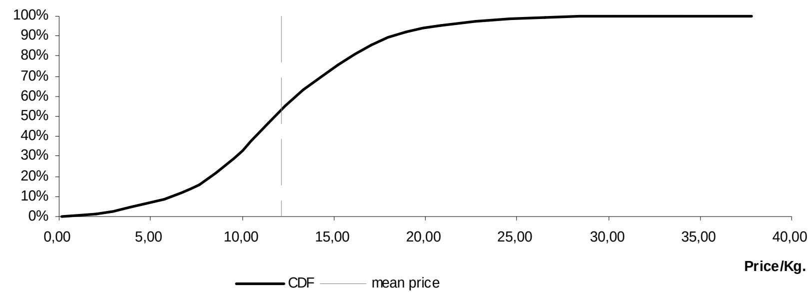

Figure 3.3.11 - Price CDF for striped red mullet landed by gillnets

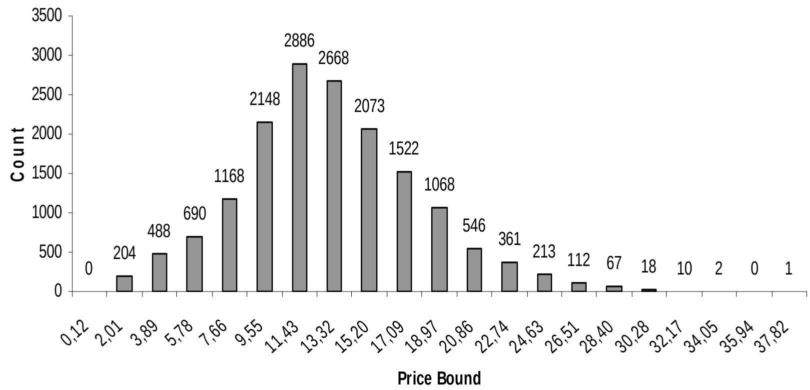

Figure 3.3.12 - Price Histogram for mullet landed by gillnets fleet

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.

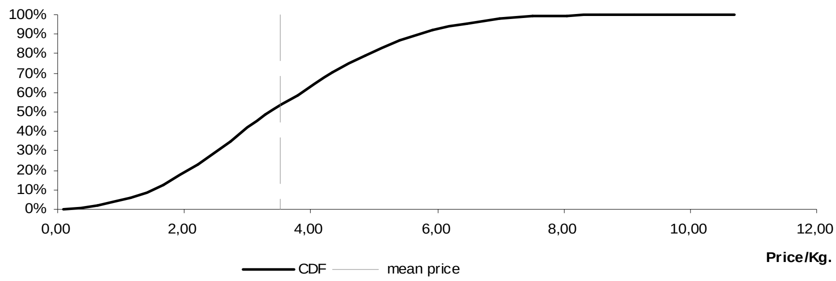

Figure 3.3.13 - Price CDF for mullet landed by Baka trawlers

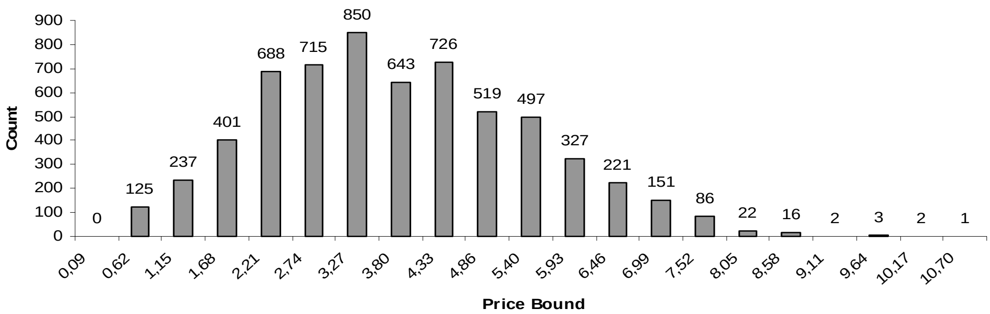

Figure 3.3.14 - Price Histogram for mullet landed by Baka trawlers