ICES WGNEW Report 2007

ICES Advisory Committee on Fishery management
ICES CM 2007 ACFM:01
Ref. LRC

Report of the Working Group on Assessment of New MoU Species (WGNEW)

9–11 January 2007

Lorient, France

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

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H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

ICES. 2007. Report of the Working Group on Assessment of New MoU Species, 9–11 January 2007, Lorient, France. ICES CM 2007/ACFM:01. 228 pp.
https://doi.org/10.17895/ices.pub.19280207

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Executive summary

WGNEW covers a number of species/stocks for which ICES, with the exception of sea bass, has never provided management advice. The species include sea bass, striped red mullet, red gurnard, tub gurnard, grey gurnard, brill, turbot, lemon sole, dab, flounder and witch flounder. WGNEW suggests adding John dory (Zeus faber) to this list because of its growing importance in the coastal areas of Brittany and the western Channel.

WGNEW had its first meeting in 2005 and met again in January 2007. Following the 2005 WG's comment on the problem of double coverage of some flatfish stocks by the Baltic Fisheries Assessment WG and WGNEW, the Baltic stocks were removed from the WGNEW ToR's.

Sea bass has been relatively well studied in the UK (England & Wales) and in France for several years. Recent work was done on striped red mullet in France. With the exception of these two species, most other WGNEW species do not get much attention in the ICES area.

In 2005 WGNEW made a first overview of the available knowledge of all 11 species, and tried to provide information on general biology, stock identification, fisheries, survey data, biological sampling and parameters, stock trends and management. In addition an inventory was prepared of data requirements.

During this meeting the information compiled in 2005 was further updated, but, unfortunately, not very much progress has been made since WGNEW met for the first time. The group felt that this was mainly due to the poor attention given to WGNEW species, compared to the commercially more important ones, despite the fact that a lot of information on WGNEW species lies hidden in cupboards and in different databases containing data from market sampling and research vessel surveys.

To make significant progress WGNEW is of the opinion that it is essential that some funding is provided to make these "hidden" data available to WGNEW and to perform some analyses of these data. During the meeting of the EU Regional Coordination Meeting on the North East Atlantic in Lisbon (October 2006), a proposal was submitted for a Small Scale Project that could provide such funds to the participants of WGNEW. This proposal has since then been selected for further consideration and hopefully a detailed proposal for funding can be submitted in the course of 2007.

In addition to the Project just mentioned, IFREMER will submit a second proposal for further work on the stock ID of striped red mullet. For the first project a period of 6 months was thought to be sufficient, whereas a stock ID project should last for at least 18 months.

Another meeting of WGNEW should only be considered after a Small Scale Project to make data on WGNEW species available has been carried out. Such a Project is currently foreseen for the second half of 2007 or the first half of 2008 at the earliest. The third and probably last meeting of WGNEW could then be held late 2008.

1 Introduction and Terms of Reference of WGNEW.

The latest Memorandum of Understanding signed between the European Commission and ICES provides in its Annex I, a list of species in the ICES Fishing Area for which recurring advice may be requested by the Commission. In addition to the standard species for which advice has been requested within former agreements, a list of species was added under a paragraph "New species": Seabass, lemon sole, dab, flounder, turbot, brill, spurdog, skates and rays, gurnard, red mullet, lesser spotted dog fish and porbeagle. The Working Group on Elasmobranch Fishes [WGEF] has included the assessment of spurdog, skates and rays, lesser spotted dog fish and porbeagle in its TORs, and for the other species, it was resolved at the September 2004 ACFM meeting that a Working Group on Assessment of New MoU Species would be created. The WG had its first meeting in December 2005.

Following the 2005 Working Group's comment on the problem of double coverage of some flatfish species by the Baltic Fisheries Assessment WG and WGNEW, the TOR's have been modified and for its second meeting the WG TORS were:

a **Working Group on Assessment of New MoU Species** [WGNEW] (Co-Chairs: Henk Heessen, Netherlands and Jean-Claude Mahé, France) will meet in Lorient from 9-11 January, 2007 to:

consider possibilities for fish stock assessments/input to management processes/indicators of the following species: sea bass, flounder (except for the Baltic), common dab (except for the Baltic), lemon sole, brill (except for the Baltic), turbot (except for the Baltic), witch flounder, red gurnard, tub gurnard, grey gurnard, and striped red mullet; through

1) review of knowledge on stock structure,

2) existing fisheries monitoring programmes and surveys including the EU Data Collection Programme,

3) existing databases useful for fish stocks assessment.

WGNEW will report by 15 of January 2007 to ACFM and LRC.

2 Participants

The following persons attended the meeting:

Robert Bellail	France
Franck Coppin	France
Wim Demaré	Belgium
Heino Fock	Germany
Jon Ruiz Gondra	Spain
Henk Heessen (co-chair)	Netherlands
Stephen Keltz	UK (Scotland)
Jean Claude Mahé (co-chair)	France
Kelig Mahé	France
Yvon Morizur	France
Anders Svenson	Sweden
Sarah Walmsley	UK (England)

3 Background to the report

The meeting decided that the most fruitful approach to its task was to continue on the basis of last year's approach in summarizing by species the progress made in information and analysis available including:

- a description of the fisheries in the ICES area in which "new" species are taken, as target species and as by-catch;
- where possible, stock boundaries within which assessments might be conducted and management measures applied;
- available fisheries and biological data for each species within these areas, and indicate where relevant studies have been carried out;

For some species/stocks, the group evaluated the amount of data and analysis available and if this was found informative enough, the group decided to provide some conclusive statement on the state of the resource.

For all species, recommendations are made for further work, either through analysis of existing data or by further data collection for the purpose of assessing the status of these stocks and providing management advice as and when it is requested.

In this report, each species is dealt with in a separate section, giving information on general biology, stock identity and possible assessment areas; description of the fisheries, historical landings, catch and effort data by sea area and country; survey data, including recruit series; associated biological sampling and research on population biology; and the results of any analyses on stock trends that have been carried out. The final section of the report considers data requirements and recommendations for further research.

Two working documents were prepared for our meeting and is included in Annex 2 and Annex 3 to the report.

The information included in most of the single species chapters is still to be considered as a first attempt to synthesize all available information of use to the WG to fulfil its tasks. Therefore, these chapters should not be considered free of omission or misinterpretation.

4 Sea Bass

4.1 General Biology

Sea bass, *D. labrax*, are distributed in Northeast Atlantic shelf waters from southern Norway, through the North Sea, the Irish Sea, the Bay of Biscay, the Mediterranean and the Black Sea to Northwest Africa. A detailed description of the general biology can be found in the 2005 WGNEW report (ICES, 2006).

Briefly, adult bass move to the south and west as the water temperature decreases during October-December (Pawson *et al.*, 1987), returning to the same feeding area each summer. Once bass mature, they either occupy well-defined (usually inshore) feeding areas or pre-spawning and spawning areas, which tend to be offshore. Bass spawn in the south of Division VIIIa and in the north of Division VIIIb in the Bay of Biscay and spawn offshore in the English Channel and eastern Celtic Sea. Bass larvae resulting from offshore spawning move towards the coast as they grow and, when they reach approximately 11–15 mm in length, they actively swim into estuarine nursery habitats (Jennings and Pawson, 1992). They remain here through their first and second years, after which they migrate to over-wintering areas in deeper water, returning to the larger estuaries in summer. Several studies indicate the existence of similar bass nursery areas in bays and estuaries on the French coasts of the Channel and Bay of Biscay and southern Ireland.

On the south and west coasts of the UK, juvenile bass emigrate from these nursery areas at around 36 cm TL (age 3–6 years, depending on growth rate), often dispersing well outside the 'home' range, and not necessarily recruiting to their specific parent spawning stock (Pawson *et al.*, 1987; Pickett *et al.,* 2004). It appears that there is substantial mixing of bass at this stage throughout large parts of the populations' distribution range. After 4–7 years, or at approximate lengths of 35 cm for males and 42 cm for females, bass attain maturity (Kennedy and Fitzmaurice, 1972; Pawson and Pickett, 1996).

A recent tagging study (2000–2004) (Pawson, in press) suggests that the seasonal migration of adult bass from the North Sea to the Channel is now much less evident, though there is still considerable mixing at the adolescent stage between bass in the North Sea and populations further west (Pickett *et al.,* 2004).

4.2 Stock identity

Previous reports of SGBASS (ICES, 2002, 2004a) presented information, which can be used to identify stocks of bass in Community and adjacent waters in the Northeast Atlantic, and provided an interpretation in relation to potential stock assessment areas. This information was used to propose ‘stock’ boundaries for 6 areas within which fishery and biological data could be used in assessments of bass populations and for which management advice may be given (Figure 4.2).

We propose that bass in the North Sea may be considered as a separate stock, whose links with the population in the Channel appear weaker than previously. Both the eastern and western Channel have resident and seasonal visiting bass and, though there is little evidence of a "biological" boundary between these stocks, we suggest that the boundary between ICES Divisions VIId and VIIe be retained for assessment purposes, because the respective fisheries are separate and different in character. Very few bass appear to move north or south across the Hurd Deep within VIIe, which suggests that fish around North Brittany and the Channel Islands could be separated from UK stocks and possibly included with those in Sub-area VIII. The results of tagging studies indicated a distinct stock in Irish waters.

The bass population in the Bay of Biscay appears to be relatively self-contained, though some fish from further north move there in winter, including fish from the Channel Islands. There

appears to be an inshore migration of bass from the offshore spawning areas in spring and summer all along the Biscay coast.

4.3 The fisheries, history and development, and catch and effort data

4.3.1 Bass Fisheries in NW Europe

Commercial bass fisheries in NW Europe developed rapidly in the late 1970s and 1980s. It is not always easy to distinguish between the directed commercial bass fisheries and those where bass are taken as a by-catch, as many fishermen in England and France may target up to 4–6 species on any fishing trip and bass are rarely exploited as the main target species throughout the whole year. However, the commercial bass fisheries can be split into inshore and offshore components. In the inshore fishery, small boats operate daily trips and use a wide variety of fishing methods with relatively little activity in winter, and have in the past exploited juvenile bass <36 cm in inshore nursery areas where they can be extremely vulnerable. Once bass mature, they are less available to the inshore fishery, but they have been increasingly targeted in their pre-spawning and spawning grounds by French mid-water pair-trawlers since the early 1980s and more recently by British vessels, chiefly between November and April (ICES, 2002). Catches of bass taken by rod-and-line have comprised a substantial part of the overall landings into southern Britain and Ireland for many years (Dunn *et al*., 1989; Dunn and Potten 1994), where the bass is widely regarded as the most important marine recreational angling species.

Recreational angling for bass is popular along the French coast, particularly between the Cherbourg Peninsula and southern Brittany and is becoming increasingly important in parts of southern Norway, the Netherlands and Belgium. For the purpose of this report, the bass fisheries in North-west Europe are presented by groups of ICES divisions that encompass the major differences in patterns of bass migration and seasonality of exploitation (see Section 4.2).

4.3.1.1 North Sea – (IVa,b&c)

Though bass are caught by angling around Oslo and the far north of Scotland, and near warm-water discharges from power stations on the Scottish east coast, these fish are towards the periphery of the species' normal range. Southwards along the English coast, small quantities of bass are taken as a by-catch in trawls and set nets and occasionally by directed angling, and are regularly caught in the southern North Sea as part of a mixed fishery in fixed and drift nets, trawls and by lines, and may be targeted in the local estuaries and around wrecks and offshore banks from May until November by both commercial fishermen and recreational anglers often using charter boats. Bass are caught in the southern North Sea by French boats using bottom trawls, and both shore and boat angling for bass has become popular and worthwhile along the Netherlands coast of the North Sea.

4.3.1.2 The eastern English Channel – (VIId)

Bass are caught inshore along the English coast by beach-launched day-boats which fish trammel and gill nets for a mixture of species. There are commercial and recreational rod and line fisheries for large bass off headlands and on offshore banks, and trawlers (often working as pairs) occasionally take large catches of bass. In the Solent area, the bass fishery using fixed gill nets and drift-nets, and long-lines and rod-and-line between April and November in the entrances to natural harbours has been restricted since these were designated as bass nursery areas in 1990. Small trawlers have used locally designed, high-headline bottom trawls for bass fishing. In addition, a few charter boats take out groups of anglers specifically to catch bass, the larger vessels going offshore as far as the Channel Isles.

Bass are taken as a by-catch by French boats using bottom trawls in the eastern Channel, and by netters and liners operating out of eastern Channel ports. Pelagic trawlers also operate in this area, usually towards the end of the spawning season.

4.3.1.3 The western English Channel – (VIIe)

Most of the boat fishing for bass along the English coast is with rod and line, both commercial and charter recreational angling off the estuary mouths and headlands, and there is also some fixed gill netting inshore. Traditional trolling/handlining fisheries for bass around offshore rocks and reefs had all but died out by 2000, though a resurgence was reported in 2003/4. There is relatively little gill netting for bass in south Cornwall, though there is considerable recreational and some commercial rod and line bass fishing all year round.

The largest bass fishery in the western English Channel uses pair trawls from February until April for bass shoaling offshore prior to spawning, and involves a few local French boats and up to 20 pair teams from ports in the Bay of Biscay that return to fish in Biscay during the rest of the year. Effort towards targeting bass by these vessels may have increased since 2005. Individual landings of 20–30 t (very large for a bass fishery) have been reported. During the early 2000's, this fishery has included Scottish mid-water pair-trawling teams, but these were not seen in 2006. One or two pairs of UK mid-water trawlers may target bass between November and April.

Along the French coast, to the west of the Cherbourg Peninsula, artisanal boats take bass as a by-catch all year round, and also target bass using long-lines in spring and summer and trolling with artificial sandeel baits, as on the south coast of England. The local gill net fleet, which has similar characteristics to the English inshore fisheries in the western Channel, takes bass as by-catch in nets directed at other species. Trawlers may also catch bass. Recreational boat angling for bass takes place around north Brittany.

There is a small commercial bass fishery in the many tide races and overfalls around the Channel Isles, using drifting long-lines and rod and line, and trolling and gillnetting around the rocky reefs. The recreational angling fishery for bass around Jersey and Guernsey has grown steadily in recent years.

4.3.1.4 The Celtic Sea and Bristol Channel – (VIIf,g,j)

The main bass fishery along the north coasts of Cornwall and Devon uses nets and rod and lines in summer in the estuaries and tide rips, whilst around 25 trawlers take bass as a by-catch throughout the year and one or two small trolling vessels take bass close inshore in St Ives Bay in winter.

Along the South Wales coast, vessels using various netting methods, including drift netting, take bass from May to November. Over 200 small boats may use rod and line or handlines for bass, and some of the larger boats may take out angling charters or fish for large bass using lures on offshore reefs and areas of tidal overfalls.

Commercial exploitation of bass in the Republic of Ireland has been prohibited since 1990.The best of the bass angling fishery extends from the west of County Wexford around the southern coast to County Clare, where bass shoal in estuary mouths, off rocky headlands and reefs and along open storm beaches.

4.3.1.5 Irish Sea – (VIIa)

In Cardigan Bay, bass are taken by small boats setting gill, trammel and stake nets close inshore, and some have recently been landed by trawlers. Commercial rod and line fishing tend to predominate along the north-west Welsh coast and, with netters and recreational anglers, target bass shoals on the broad sand banks at each end of the Menai Strait. Eastwards,

along North Wales, the Lancashire and Cumbrian coasts of the Irish Sea, fixed gill nets or drifted gill or trammel nets are used in summer to catch bass, and they are also caught in nets and lines set inter-tidally and by rod and line, both recreational and commercial. Bass are taken as a by-catch in nets or traps set for flatfish or salmon throughout the Solway Firth.

Few bass are caught along the Irish coast of the Irish Sea to the north of the River Boyne.

4.3.1.6 Bay of Biscay – (VIIIa,b)

Trolling for bass is carried out to the north of the Loire, whilst small boats fish with mainly floating long-lines and fixed nets further south to the river Gironde. Over 100 long-liners may target bass in the Bay of Biscay, along with some 200 gillnetters and small vessels using drift nets inshore. Bass are also taken as a bycatch in the sole gillnet fishery and by bottom trawlers, though the most important bass fishery is by pelagic pair-trawlers (56 vessels), chiefly in late summer and autumn, with some moving into VIIe during the winter. Since 2001, purse seiners from South Brittany have taken around 50 t of bass per year in winter.

In the south of this region, bass are taken as a by-catch in mixed demersal fisheries operated by the Basque fleet, particularly the "baka" bottom trawl off the central western French coast (Gironde area), by high vertical opening pair bottom trawls, longlines and gill nets, and by purse-seiners targeting pelagic species. Bass are mainly caught in this fishery from September until March.

4.3.2 Fisheries data

4.3.2.1 Catch and effort data availability

Table 4.3.2 presents a summary of the data that were available for use by SGBASS, updated for the 2007 meeting of WGNEW. Data on fishing effort expended by vessels taking bass are not available for all countries and years for which bass landings are given. The quality of the data is patchy, but bass fisheries in the English Channel appear to have been generally well sampled in recent years.

4.3.2.2 France

France has effort data for 8 métiers, by groups of ICES Division (covering VIId,e and VIIIa,b) for all years 1985–2004. Data quality is good for pelagic trawls since 1986 and for bottom trawls since 1993. The data for lines and nets are of poorer quality. Landings data are available for the above métiers for all years – price/grade data are good throughout. Landed weight and value/division are good for pelagic trawls since 1996 and other métiers since 1993. There are some data on discards of bass in French fisheries: mid-water trawling targeting bass in the Bay of Biscay and English Channel (Morizur *et al.*, 1996) and some western bottom trawl and net fisheries. Discards of bass are negligible (though a high proportion of bass caught by the recreational sector might be released alive), and landings can be generally considered as total catches for all gears. Since 1999, the data are available from a logbook database containing estimates of catch and fishing effort.

French cpue were calculated using only those boats for which fishing effort data (days at sea) of sufficient quality was found. However, for coastal fisheries (nets, lines, long-lines), the fishing effort unit is the catch-selling day, which sometimes includes several fishing days. This should not introduce a bias in the - series of annual abundance indices, as the number of selling days per week is more or less constant if the composition of boats landing to a market is the same through the time series.

4.3.2.3 UK

The UK (England and Wales, no bass landings are reported into Scotland or Northern Ireland) has catch and effort data for 13 métier groups, covering 4 groups of ICES Divisions – IVb,c, VIId, VIIe,h and VIIa,f,g. These data include a regional fleet census from 1985 to 2006. The effort data are recorded in 'boat-days' or 'days on the ground' and are classed as good for mid-water (pelagic) trawls from 1994, gill nets and long-lines from 1985, commercial rod and line and handlines from 1986. The rest of the data for trawling métiers is of poor quality.

The UK has good landings data by division and rectangle for mid-water (pelagic) trawls and by division for all other métiers. Other data by rectangle are of poor quality and there are no data by rectangle for recreational angling. Data on catch value per ICES division and price per grade are now moderate or good for most métiers and some price data for commercial lines are available.

The best estimates of annual catch and effort for bass have been obtained by integrating official statistics derived from landings declarations and local market sales at major ports with those from a voluntary, paid log-book system administered by CEFAS for minor ports and for the <10 m fleet which covers the bass fishery in England and Wales. The CEFAS logbook system has provided daily catch records from a sample of 45–60 inshore fishing vessels, including charter angling boats, since 1985. Estimates of total landings by this sector are obtained from the sampled catch and effort, raised to numbers of active vessels, and stratified by gear, boat-type and division, derived from an annual fleet census. Catches by gear-type, derived from each system, have been compared by 'stock area' on an annual basis for 1985–1995, and quarterly since 1996, and the higher values chosen. Best estimates of quarterly and annual landings are a composite of these figures. Catch per effort series, expressed in kg/boat day are obtained separately for >10m (official data – mainly trawlers) and <10m (log-book system) vessels.

Limited discard data are available from the Cefas discard sampling programme.

Effort data - number of trips, days at sea, days on the ground, number of hauls etc - for UK >10 m vessels are obtained from the Fisheries Activity Database. Data from this source for the <10 m fleet are considered unreliable, but effort estimates derived from the CEFAS log-book scheme are available from 1985 to 2005 for all métiers taking bass. Due to the wide range of gears used for bass - up to 3 per boat in one day - it is almost impossible to derive accurate gear-specific effort (e.g. soak-time). A distinction also has to be made whether the gear is targeted at bass. The most reliable measure of effort for the UK bass <10 m fleet is the boat-day (Pickett, 1990) and for the >10 m sector the standard measure is days on the fishing ground.

4.3.2.4 Ireland

Ireland has had no legal commercial bass fishery since 1990, but a time series of angler success, expressed as number of bass by age group caught per rod-day, is available for 1963–2003.

4.3.2.5 Spain (Basque Country)

Information on bass landings and landings per unit effort made by the Spanish fleets landing into the Basque Country ports, extending from 1994 to 2004, was presented in a working document to WGNEW 2005 (ICES, 2006). There is less detailed information from other important Spanish regions. The Basque Country data, obtained from EC log-books, skippers logbooks and *ad hoc* monitoring of the trips and landings into Basque ports, cover more than 14 commercial métiers, in four sea areas: Subarea VI; Subarea VII (mainly VIIh,j); Divisions VIIIa,b,d and Division VIIIc (eastern part). Economic values per year in recent years are available for all métiers and sea areas considered together. In 1991–1992, *ad hoc* sampling,

conducted by AZTI to study the artisanal métiers in the inshore waters of the Basque Country coast (eastern Division VIIIc and southern Division VIIIb), produced data on bass catches, effort and length compositions for surface long-line and trammel net (Puente, 1993). AZTI monitoring for bass in 1994 and 1995 did not include landings of the main fleets operating in Division VIIIc, particularly long-line and gillnet; thus total landings reported for those years in this area must be considered underestimated.

Fishing effort data are expressed in "days fished" and are available since 1994 for "Baka" bottom otter trawls in Div. VIIIa,b,d, and also for other trawling métiers and for longlines and trammel nets. The best estimator of bass abundance trends (lpue) in the period 1994–2004 is based on landings into the Basque port of Ondarroa by the "baka" otter bottom trawl fleet working in Division VIIIa,b,d. This fleet takes the largest bass catches of the Basque fleet, and its fishing effort can be quantified with accuracy through the period. However, this is currently a mixed-species fishery, in which bass is an economically important by-catch restricted to a period of the year. The effective fishing effort of this fleet was calculated as fishing days, obtained by multiplying the number of trips in Divisions VIIIa,b,d by the mean number of fishing days by trip in the area, season (quarter) and year.

No discards were observed during an observer survey in 2000, conducted by AZTI on board "Baka" trawlers in Subarea VII and in Divisions VIIIa,b,d as well as on pair trawlers with VHVO nets in Division VIIIa,b,d and in Division VIIIc.

There is very little information on bass taken by the recreational rod and line fishery close to the Basque coast and in the river mouths (eastern Division VIIIc and southern Division VIIIb), but their catches might be considered of very low importance (possibly less than 3 t per year). The main catches are taken in autumn (September to November) (L. Arregi, pers. com.), although major effort is applied in summer months (holidays season).

4.3.2.6 Spain (other than BC)

Statistics were provided of bass landings by Spanish vessels outside the Basque Country for 2000–2002 by sea area and gear. No associated effort data are available.

4.3.2.7 Portugal

In Portuguese continental waters (Division IXa), more than 90% of the bass landings are caught by the artisanal fleet using mainly gillnets, hooks and traps. Landings by gear are available for 1986–2003.

4.3.2.8 Other countries

Landings data have been provided by Scotland for 2005.

4.3.3 Catch by country

Official statistics and the Working Group's estimates of total landings (difference shown as "unallocated") of bass by country over the period 1984 to 2004 are presented in Table 4.3.3.1. More detailed catch data by stock assessment areas are given in Tables 4.3.4.1–4.3.4.7

4.3.3.1 France

The quality of data on bass landings by French vessels has improved since 2003. Total landings were around 2000 t during the period 1986–1995 and have increased to around 4000–5000 t in the most recent years. The landings from Subarea VIII are generally higher than in Subarea VII. The recent increase in landings is mainly due to the catch in Divisions IVc and VIId (mainly the latter): for example, bass landings in Boulogne increased from 130 t in 1997 to 540 t in 2003. In Divisions VIIe,h, there were peaks in landings in 1987 and 1996 (the consequences of the arrival of strong year classes in the pelagic fisheries), and a smaller

increase was also noted in 1992. The picture is quite different in Subarea VIII, where there was less variation in landings after 1986, except for a decrease in 1998 followed by an increase over the three following years. The major part of landings from VIII in the recent period came from VIIIa, reaching a maximum of 2300 t in 2003. Since 1996, the French landings in Subareas VII and VIII are of the same magnitude, whereas previously the landings of Subarea VII were less than one third of the landings from Subarea VIII.

Most of the French catches in Subarea VII are taken by trawling, whereas lines, long-lines and nets take the greater part of the catch from Subarea VIII. The nominal landings of mid-water and bottom trawlers reach a maximum in spring in VII, and in winter in VIII, which reflects the different spawning periods in the two areas and confirms that trawlers mainly exploit pre-spawning and spawning concentrations.

Recreational catch.

A preliminary study on recreational fishing in France was carried out by IFREMER and BVA at the beginning of 2003. Representative samples of the French population > 15 years old were interviewed by telephone, using the "quota method" stratified at a national level and taking into account geographical and socio-economical characteristics of the population. A total of 2008 people (in 2 representative samples of approx. one thousand) were asked about their fishing activity in 2002. From the responses, the declared catch of 30 fishermen, who fished for bass on at least 5 days in 2002 (11 taking a total of 49 kg in the English Channel and 19 taking 152 kg in the Atlantic) was raised to the corresponding French population (48 million), giving an estimate of 1200 t for the English Channel and 3600 t for the Atlantic.

This study was repeated in 2004, when 14 samples (of 1000 persons each) were interviewed with increased sampling during the summer. Three different time scales were covered: the whole of 2003; part of 2004, and the last fishing day. The results showed that the percentage of persons who said they fished for bass during 2004 varied between 0.6 to 2.1%, according to season, with the highest percentage in summer. The average percentage of persons having fished for bass during 2003 was around 2.2%. Only a small part (9%) practises diving, and hook and line is the main gear used from the shore or from boats. More than 90% of the fishermen are not registered in recreational fishing associations. Extrapolation gives 900 000 persons saying that they fish for bass, whilst 300 000 of them fish more than 7 times a year to take an estimated catch of 4351 t (CI= 3450–5220 t when attributing a zero catch to the 17% of respondents who provide no answer on catch weight). These catch estimates should be taken as minimal values, but they indicate that the French catch of bass in recreational fisheries is probably as high as the commercial catch. A new study was done by using telephone interviews in 2006 with a slightly modified methodology. The result for sea bass will be made available in mid 2007.

4.3.3.2 UK (England and Wales)

The official total bass landings in England and Wales from Subareas IV and VII rose from 106 t in 1985 to 660 t in 1995, and have ranged around 500 t since then. Much of the bass catch landed into the UK is taken by small inshore vessels in a mixed gear fishery and does not go through major ports: these figures are therefore underestimates. The 'best estimates' (see fisheries data), suggest that landings remained around 600 t between 1985 and 1992, rose rapidly to 2200 t in 1994 (as the strong 1989 year class recruited), and then fluctuated between 1050 and 1900 t (mean around 1500 t) until 2005. During this period, bass landings into England and Wales arose mainly from netting and line metiers.

Recreational catch

Good quality data on recreational catch and effort in England and Wales were obtained for 1986/7 and 1992/3 as a result of two economic studies (Dunn *et al.*, 1989; Dunn and Potten,

1994), which estimated that some 24 500 sea-anglers fished regularly for bass in the UK in 1986/87, and that the annual catch of bass taken by anglers in both 1987 and 1992 was around 410 t. There are no more recent estimates of recreational landings.

4.3.3.3 Ireland

There is no commercial fishery for bass in Ireland, and no estimate of recreational catches is available.

4.3.3.4 Spain (Basque Country)

AZTI have continued to compile and update the basic information on bass landings and landings per unit effort made by Spanish fleets landing into the Basque Country ports, since 1994 (see working document by Ruiz *et al.* in Annex 2). In 2004, landings were 53 t. As discarding is prohibited, landings can be considered as catches.

As in previous years, almost all catches were from the Bay of Biscay: around 88% in Divisions VIIIa,b,d and 13% in Division VIIIc (eastern Cantabrian Sea, *i.e.* south-eastern Bay of Biscay). Only < 0.5% of total catches were from Subarea VII (Celtic Sea). No catches were taken from Sub-area VI (west of Scotland and around Rockall Bank) in 2004.

During the period 1994–2004, the main catches of bass were taken by bottom trawl (around 75%, split baka" otter trawl (62%) and VHVO pair bottom trawl (38%)) and by longline (around 18%); the remainder by set net (5%) and purse seine (2%). A decrease in the "baka" trawl catches compared with the pair trawl catches was observed in 2003 and 2004 in relation to previous years (they amounted to about 85% and 15% respectively in 2002 and before). "Bou" otter trawl and twin nets trawl working in VIIIa,b,d, reported around 2% of total trawl-caught bass up to 2000; since when these two metiers have not operated.

Recreational catch

A traditional, but small, recreational fishery (by rods and lines) takes place close to the coast and in the rivers mouths along the Basque coast (eastern Division VIIIc and southern Division VIIIb). No information on catches is available, though the main catches are obtained in autumn (September to November) (L. Arregi, pers. com.), whilst the major effort is applied in summer (holiday season).

4.3.3.5 Spain (Atlantic Coast outside Basque Country)

Landings data by gear and sea area for each quarter in 2000–2002 were made available to the Group. Though some landings were made from Sub-area VII (<0.6 t, on lines), bass are mainly taken from VIIIa,b (up to 53 t annually), VIIIc (74–133 t) and IX (49–105 t). The artisanal fishery, followed by hook and line, trawl and gill net, made the largest catches and the main bass fishery season is in the 4th and 1st quarters.

4.3.3.6 Portugal

Portuguese landings peaked in 1989 at around 500 t, and have been below the mean of the whole period (321 t) in the last three years (at 280 t).

4.3.3.7 Other countries

Only the Channel Islands, with landings of between 12 and 108 t taken from VIIe, regularly accounts for bass in their official statistics, though the Netherlands has recently begun to take them in IVc and VIId,e (40 t in 1998).

4.3.4 Catch trends by sea area.

4.3.4.1 Divisions IVb, c and VIId (Table 4.3.4.1)

Total international landings of bass from the southern North Sea and eastern Channel were relatively stable at around 500 t over the period 1984–1990, and then rose to a peak of 1900 t in 1994, since when they have fluctuated between 1210 and 1900 t. According to national official statistics, annual landings have recently been higher for France than for England, but inclusion of estimates of the landings of English inshore boats obtained through a voluntary log-book scheme (see Section 4.3.2.3) indicate that the English catch until 2000 was higher than that reported by France. Recorded bass landings by Netherlands boats have been negligible until 1998. UK landings peaked in 1994, 1997 and 1999, whereas French landings increased from 1993 onwards.

4.3.4.2 Divisions VIIe, h (Table 4.3.4.2)

Landings of bass from the western Channel and Western Approaches fluctuated between 260 and 520 t over the period 1984–1993 (except for 980 t in 1987), rose to a peak of 1440 t in 1997 and then reached approximately 1749 t in 2004. French vessels have accounted for the main part of the annual landings - usually at least 50% - whilst English vessels landed most of the remainder. The landings by vessels from other countries, chiefly the Channel Islands who took between 5 and 10% of the total each year, peaked in 1999, and have averaged around 50 t since 1993.

4.3.4.3 Divisions VIIa, f&g (Table 4.3.4.3)

Total international landings of bass from the Irish Sea, eastern Celtic Sea, and Bristol Channel fluctuated between 110 and 310 t over the period 1984–1992, and then rose to a peak of 850 t in 1994, since when they have fluctuated between 360 and 680 t. According to national official statistics, these landings have been equally shared between France and England and Wales, but estimates of the landings of UK inshore boats obtained through the CEFAS log-book scheme indicate that the English and Welsh catch comprises at least 90% of total international landings in most years.

4.3.4.4 Divisions VIa, b and VII b, c, j, k (Table 4.3.4.4)

Offshore catches of bass are occasionally reported from Sub-area VI and the western divisions of Subarea VII, amounting to an annual average of less than 0.5 t for France and the UK in the period 1994–2003, though increasing in recent years. Spanish landings of up to 40 t are occasionally reported from this area, though the provenance of these data is questionable. In 2004, no bass catches were reported by Spain from Subarea VI, as in the most of the whole period considered – except in 1997 (735 kg) and 2000 (64 kg), in both cases in December, by "baka" trawl. A catch of 0.3 t was reported from Sub-area VII by Spain in 2004, taken by longline.

4.3.4.5 Divisions VIIIa,b &d (Table 4.3.4.5)

Landings of bass from the Bay of Biscay increased rapidly to 1550 t from 1984 to 1987, since when they have fluctuated between 1300 and 1680 t until 1999, rising to around 1900 t in 2000–2001 and to more than 2140 t in 2004. French vessels appear to have accounted for around 90% of the annual landings.

Spanish (only Basque Country) bass catches from Division VIIIa, b, d have been relatively constant, amounting to an annual average of around 50 t in the period 1994–2002 (range 29–60 t) and mostly due to the "Baka" otter trawl and long-line fisheries. A very regular and marked seasonality (main catches in the 4th and 1st quarters) is observed in the Basque landings throughout the period 1994–2004.

4.3.4.6 Division VIIIc (Table 4.3.4.6)

Between 1988 and 1998, Spain consistently reported landings of between 250 and 400 t of bass from the southern Bay of Biscay, Division VIIIc, but landings declined to 110 t by 2002 though landings were higher (150t) in 2003. Inshore catches reported by the Basque Country have amounted to an annual average of 9 t in the period 2000–2004 (range 5–14 t), and comprise long-line (about 70% of the total landings), gillnet (15%) and purse seine (10%). In 2004, the purseiners catch reached 3 t.

4.3.4.7 Div. IXa (Table 4.3.4.7)

Total landings of bass reported from the western coast of Spain and Portugal reached a peak of 600 t in 1989, and have since fluctuated between 360 and 540 t without an apparent trend. The Spanish catch from this area reached a peak in 1997 (184 t) and has fallen below 100 t since 2000, whilst the Portuguese catch peaked at over 500 t in 1989 and has since remained around 300t.

4.3.5 Fishing effort

Fishing effort for fleets which target bass or for which bass is a reliable bycatch (for lpue estimates) are available for three countries, France, the UK and Spain (Basque country), by métier and sea area.

4.3.5.1 France

In 1996, 288 boats were recorded as targeting bass from French ports located in Subarea VII, and 683 boats were registered as fishing for bass from ports in Subarea VIII. Between 20 and 40 French mid-water trawlers have targeted pre-spawning and spawning bass in the winter: offshore fishery in VIIe each year since the early 1980s. Some of these move from the Biscay ports to Subarea VII to fish for bass in the spawning season. Trends in nominal effort of the pelagic pair-trawl fleet vary between Subareas VII and VIII, with a peak in VII in 1987, followed by a decline until 1995 and then a rapid increase, whereas effort in VIII peaked in 1991 and has declined thereafter.

In 2004, the databases show that 2498 boats landed bass at a time in the year and those having landings exceeding 500 kg/year were 1069 boats (55 pelagic vessels, 222 bottom trawlers, 91 mixed trawlers, 251 liners). Half of the French commercial landings are provided by only 5% of the vessels having some bass in their landings.

An increase of fishing effort is questionable for the offshore fishery, some fishing effort may have moved from the anchovy fishery during the years 2005–2006. Opposite it should also be stated that the number of boats in the French pelagic fleet has decreased since the beginning of 2005. Ten pairs of pelagic trawl vessels have been withdrawn since the end of 2004. The result in terms of offshore fishing effort directed on sea bass from the 2 previous opposite factors is not yet known for the years 2005 and 2006.

4.3.5.2 UK

The numbers of UK vessels involved in fishing for bass in each stock area are estimated from a fleet census carried out bi-annually since 1985. In 1985, it was estimated that 185 UK boats were involved in fishing for bass in Subarea IV, increasing to 493 in 1994 decreasing to 232 in 1996 and rising to 626 in 2005. In Subarea VII, 1791 boats were involved in fishing for bass in 1985, rising to a peak of 1966 in 1994, with 1485 in 1996 and 2016 in 2005.

Total UK nominal effort (all areas combined) increased in the demersal trawl fleet from an annual mean of around 6000 days during 1984–1990 to a mean of 22 000 days during 1991–1995. Lower effort was estimated for the demersal trawl fleet during the period 1996–2003,

with a mean of 16 000 days. These fishing effort data are only indicative, having been compiled in various ways over the years.

Effort in the netting fleets has varied considerably with no real trend over the period 1984–2005, reaching a peak in most regions in 1993 and a trough in 1998/99. Effort in the line fleets were relatively constant from 1985 to 1990, after which they increased to a peak in 1992, fell across the years 1994–1996, and have since shown a slight increase.

From 1995, up to 7 pairs of mid-water trawlers targeted bass over the winter/spring 2003/04, and spent a total number of 412 boat-days fishing, more than the previous highest (270 days), recorded in 2002/03.

Overall, the number of UK boats fishing for bass peaked in 1994 (2282) and again in 2002 (2328).

4.3.5.3 Spain (Basque Country)

In 1994, it was estimated that 81 Spanish boats landed a bycatch of bass in the Basque ports from Divisions VIIIa,b,d and Subareas VI and VII; most of them being bottom trawlers. In 1999, fewer than 60 boats fished in the same sea areas. No estimate is available for the artisanal fleet working mainly in eastern Division VIIIc and southern Division VIIIb and catching bass, but their number is likely to have decreased between 1994 and 2000.

The effective fishing effort (fishing days) of the "baka" bottom trawl fleet operating in Div. VIIIa,b, mainly off the central western French coast, has decreased by more than 60% between 1994 and 2004, due mainly to a reduction in the number of boats of this Basque fleet.

4.3.6 Landings per unit of effort (lpue)

Most lpue series for the UK fisheries in which bass are caught show a declining trend from 1985 to 1992, followed by a strong increase to a peak in 1994, and then generally high but fluctuating catch rates until 2004. As indices of abundance, these series suggest that production of bass in Subareas IV and VII has remained higher in the mid-late 1990s than in the late 1980s, probably due to the recruitment of the very strong 1989 year class and several subsequent years of good recruitment.

In VIII, the bass annual lpues of the Basque Country "baka" trawl remained relatively stable during 1994–1998 (around 5 kg/day), and trebled between 1999 and 2004 (to about 15 kg/day). The bass lpues are practically zero in the 2nd and 3rd quarters, and high in the 1st and 4th quarters. This recent increase in bass lpues must be viewed with caution, since hake was one of the main targets for the "baka" trawl (about 20% of total landings) until the middle of the 1990s, but now represent only around 5% in a fishery which appears to have changed its character, allocating more effort to non-TAC species such as bass.

4.4 Survey data

Data series that provide indices of the abundance of pre-recruit bass are available for the following sea areas: IV (Thames Estuary; Westerschelde; CODS, Germany); VIId (UK Solent; French CGFS); VIIe (Tamar); VIIf (Camel, Severn Estuary); southeast Ireland (border of VIIa and VIIg); and VIIIa,b (EVHOE), and are given in Table 4.4.1. Most of these time series (Thames Estuary trawl; Solent; Tamar; Camel; and southeast Ireland) derive from surveys that are directed at juvenile bass in representative nursery areas, whilst the rest include bass as an incidental bycatch to the pre-recruit roundfish or flatfish target species.

The Solent trawl survey covers the main bass nursery area on the south English coast (VIId) and provides numbers of each year class caught at ages 2, 3, and 4 in up to 6 successive

surveys, which are used to derive abundance indices (Pawson, 1992). Details of the survey are given in ICES (2004a).

A French survey in VIId (CGFS) uses a bottom trawl and started in 1988. The time series shown in Figure 4.4.1 is based on the average density of bass from all statistical rectangles in VIId and indicates an increase of abundance, especially since 1996.

The French EVHOE survey takes place in parts of Subareas VII and VIII with bottom trawl, using tows of 30 min duration. The time series shows no trend numbers of bass over the years 1987–2002. This time series was completed by adding another survey undertaken in the Bay of Biscay in 1973. This year has been included in the time series 1973–2002. (Fritsch *et al.*, 2005).The result is that there is no perceptible trend in the abundance index in the 30 years.

4.4.1 Year class strength

It is known that warm or cold summers and winters can have a considerable affect on the survival of 0-group bass through their first year (Kelley, 1986; Pawson, 1992). This has a general influence on year class strength of bass (see Section 1.7.3.1), but it can also have a local effect, as seen in the disparity of year-class strength patterns in the Camel, Tamar, and Oldbury 0-group series. Though the annual variability in local abundance of 0-group bass is readily apparent from the various time series, abundance indices at ages 2/3/4 are more useful for forecasting pre-fishery abundance, i.e. recruitment.

The 1989 year class is the most abundant in all the series and the year classes of 1992, 1993, and 1995 also appear to have been good, although possibly not so widespread. Overall, however, the available series indicate an increase in the frequency of good year classes since 1989.

4.5 Biological sampling

4.5.1 France

Good biological sampling data (length and age) are available for all métiers in VIIe (except pelagic trawls) for one year, 1989–1990, and for all métiers by quarter in VIId,e for 1994–1995. Since 2000, a quarterly ALK has been produced for Subarea VII based on 250 aged individuals, allocated 5 per 1 cm length interval. The samples used for this ALK came from Audierne (liners) and from some pelagic trawlers sampled in winter. Length samples for VIId were combined by commercial category, and then raised to landings by quarter and commercial category for each gear. Length samples for VIIe were combined and raised by gear where samples were adequate, but where samples were not sufficient samples were aggregated and raised by commercial category, as for VIId. An annual ALK was applied to the raised length distributions. All ALKs consisted of at least 150 specimens.

4.5.2 UK

Lengths of bass in commercial landings are measured from either the whole landing or samples of >50 fish from each commercial size category, against targets set by métier group (i.e. demersal trawls, gillnets, lines, and pelagic trawls). Half-yearly (Quarters 1 and 4, non-growing period; Quarters 2 and 3, growing period) length distributions by métier-group and stock area are then raised to equivalent total landings. In each stock area, length-stratified “all gears” scale samples of at least 150 fish are used to provide corresponding age data, stratified to ensure that ALKs contain a minimum of 5 ages per 1-cm total length class across the available length range. Where sampling is sparse (usually because of sampling difficulties with landings outside the main port market system), annual ALKs are used. Data on length and age obtained from recreational catches of bass taken by boat anglers contribute some 20–

30% of the "lines" métier group (it is assumed that selectivity patterns of commercial and recreational line boats are similar).

Length and age data have been used to compile "stock" files for the period 1985–2004, that include age-length distributions and data on mean fish weight by age and by year. Sex ratio, maturity, growth, condition factors, and TL to FL conversion data are largely derived from biological sampling carried out between 1982 and 1990 (Pawson and Pickett, 1996), and from sampling of the UK offshore fishery in 1999 and 2002.

Good length and age composition data are available for the main métier-groups in VIId and VIIe,h from 1986 to 2004, with the exception of lines in 1989. The winter offshore pelagic fishery in Sub-area VII was also well sampled between 1996 and 2004. In the North Sea, sampling was largely confined to IVc, where gillnets have been well sampled since 1987 and lines since 1988, although demersal trawl catches have never been well sampled (the best was 154 lengths in 1994). Division VIIa has generally been poorly sampled and, because there appears to be a single west coast bass stock (see Section 4.2), the data have been combined for assessment purposes with those of VIIf,g, where sampling has been good since 1988 (except for lines in 1989, and trawls and nets in 1992). Over the period 1985–2004, annual UK sampling in each stock area averaged >500 age samples (all métiers combined; Table 4.5.2), which appears to be sufficient for assessment purposes.

4.5.3 Ireland

Data are available for some years within the period 1981–2000 for length, weight, and age of individual bass from four separate divisions (VIIa,b,g,j), though numbers of fish sampled and method of capture are not given. Scales, accompanied by length and some weight data, were collected by anglers from Divisions VIIg, j between 1996 and 2001. Sample size ranged from 128 in 1996 to 39 in 2000. An additional 128 scale samples were obtained in 2000/2001 through a tagging scheme. With an MLS of 40 cm, and because anglers select the fish they report, these samples cannot be regarded as representative of the smaller (younger) age groups. Also, bass above a weight threshold of 4.5 kg are registered in an Irish national "specimen" recording scheme, and fish of between 7 and 12 years old are therefore best represented in these data. Lengths at age have been back-calculated from scale samples to provide growth curves for the stronger year classes.

4.5.4 Spain

No biological data are available for the period 1994–2004 in relation to Spanish (Basque Country) bass catches. Some length distributions are presented by quarter for the Basque catches in the period 1991–1992 by inshore long-line and trammel net in eastern Division VIIIc and southern Division VIIIb.

4.6 Biological parameters

The life history traits of bass vary across their environmental range, with fish at the cooler, northern extremes usually exhibiting slower growth, later maturity and longer maximum life spans than those from warmer environments. Around Britain and Ireland, male bass mature at a length of 31–35 cm, aged 4–7 years, and females at 40–45 cm, aged 5–8 years (Kennedy and Fitzmaurice, 1972; Pawson and Pickett, 1996). Weight and maturity at age are shown in Table 4.6. Data from the south part of the Bay of Biscay (Lam Hoai, 1970, Stequert, 1972) indicate that males mature at a length of 35 cm (age 4) and females at 42 cm (age 6). Off the Tunisian coast, males mature at around 24 cm, aged 2–3 years, and females at around 32 cm, aged 4–5 years.

4.7 Analysis of stock trends

4.7.1 Stock areas IVb, c, VIId, VIIe, h and VIIa, f, g

In 2003, the ICES Bass Study Group (SGBASS) used the SURBA program with data on UK and French bass catch-at-age and fishing effort by métier groups (trawls, nets and lines) for four stock areas (IVb, c; VIId; VIIe, h; VIIa, f, g) for which sufficient biological sampling information was available over the period 1985–2002 (ICES, 2004a). The assessments utilized a separable model with 12 data sets (3 métiers for each of four stocks) to provide independent assessments of the status of each stock, and indicated common trends in spawning stock biomass (SSB) within stocks, and similar recruitment patterns both within and between stocks. Estimates of fishing mortality using SURBA were considered to be less informative, largely because of a lack of independence between the selectivities of the fishery and that of the indices of catch per unit effort (cpue) used. No biological reference points were proposed at this time.

No update on these assessments has been carried out using international data but a multi-métier, fully statistical, separable catch-at-age model based on the stage 1 stock synthesis framework of Methot (1990) was used with UK data for the period 1985–2004 (ICES, 2006, Pawson *et al.*, 2007). This analysis covered the four 'stock areas' previously proposed, namely Divisions IVb,c, Division VIId, Divisions VIIe, h and Divisions VIIa, f, g.

The model's estimates of landings and recruitment (Figures 4.7.1 and 4.7.2) generally map independent observations, which suggest that the trends in F and SSB (Figures 4.7.3 and 4.7.4) are representative of the "stocks" involved. The model indicates that the SSB of bass around the coasts of England and Wales generally increased between 1985 and 2004, although the pattern and magnitude of the increase differed between areas and the absolute values are not reliable. The respective SSB values for the assessed "stocks" are based on the premise that the bass populations in Divisions IVb, c, VIId, VIIe, h, and VIIa, f, g represent separate entities. However it is known that stocks mix considerably, as late juveniles recruiting to the fishery (ages 4–6) and as migrating pre- and post-spawning adults. Thus, these values are better taken as indicative of trends rather than absolute values for SSB, and are not entirely additive, but, if overall F is around 0.2 (a value consistent with previous analyses: ICES, 2002, 2004a), it appears that the adult biomass doubled between 1985 and 2004. This substantial increase in SSB in the late 1990s and early 2000s is associated with an increased level of recruitment from 1989 onwards, despite temporary increases in F in all areas at some time in the 1990s. Again, no biological reference points have been proposed for these four stock areas.

4.7.2 Other areas

No assessment of stocks in other areas, such as the Bay of Biscay has been undertaken and the status of the stocks is unknown.

4.8 Management regulations specific to bass

4.8.1 UK

The UK's strategy for bass conservation in the late 1980s did not include direct controls on the level of fishing for bass. Effort limitation and catch quotas were considered inappropriate in view of doubts about the efficacy of these types of control in such a fragmented multi-species fishery that employs mainly small, inshore boats, but also because there were insufficient assessment data on which to base quantitative recommendations.

In 1990, a package of technical measures was implemented in England and Wales, comprising a 36 cm MLS, closure of 37 key bass nursery areas (in estuaries or around the warm-water

discharges from coastal power stations where juvenile bass congregate and are vulnerable to fishing) under the Bass (Specified Sea Areas) (Prohibition of Fishing) Order 1990, with amendments up to 1998, and mesh size regulations for enmeshing nets which effectively banned meshes between 70 and 89 mm (i.e. those most selective for bass of 30–36 cm). In England and Wales, the Cornwall and South Wales Sea Fisheries Committees have bye-laws stipulating a 37.5 cm MLS, and the South Wales SFC also has a gill net minimum mesh size of 100 mm. Pawson *et al.* (2005) showed that these technical measures increased protection of juvenile bass, achieved the predicted increase in Y/R of bass in UK fisheries, and helped safeguard the stock fished close inshore by small boats.

During 2006, the results of a consultation exercise, on increasing the minimum landing size for bass from 36 to 45 cm total length in English territorial waters, have prompted Defra to propose implementation of a 40 cm MLS from 1 April 2007, and increasing the minimum mesh size for enmeshing nets deployed by vessels whose catches are composed of >10 % bass to 100 mm stretched mesh.

There are no bass-related local regulations in Scotland, but the weekly limit of 5 t per vessel adopted for French pair trawlers in 1996 (see below) was adopted by the UK (largely for Scottish vessels working in VIIe) in 2000 to prevent excessive landings in the winter offshore fishery.

4.8.2 France

The offshore fishery for adult bass (>40 cm) takes place when these fish are shoaled for spawning between December and early May in the Channel (mainly in Div. VIIe), on the Trevose Head grounds (VIIf), and in Biscay (VIIIa, b). This fishery developed in the early 1980s and has increased steadily, with an average of 20 French, 3 Scottish, and 3 English pelagic pair teams trawling in VIId, e, f each year. Although there are no direct effort or catch (TAC) restrictions on this fishery, a national regulation limiting bass landings by French pelagic trawlers fishing in the Channel was set up for economic reasons in 1996, when landings were limited to 2t/boat/week from 1 January to 30 April. Since 1998, this measure has been extended to all trawlers landing bass and the current limit is 5 t/boat/week. The limit of 5 t per boat per week is now applied to all boats. In 2006, the regulation mentioned only the catch in French waters. Since October 2006, the regulation was modified to mention all catch and landings.

4.8.3 Ireland

A decline in bass catches in Ireland in the 1970s prompted the introduction of a number of conservation measures. Bye-law No. 577 of 1975 introduced a size limit of 38 cm, a closed time for fishing bass by net or weir, and a restriction in the taking of bass by net in certain areas. S.I. No. 128 – Bass (Conservation of Stocks) Order, 1990 - increased the size limit to 40 cm TL and forbade fishing from a boat for bass or the use of nets in their capture or to have the fish on board an Irish fishing vessel. A Bass (Restriction on Sale) Order (S.I. No. 191 of 1991, renewable annually) prohibits the sale or offer for sale of bass. The Bass Fishing Conservation Bye-law (No. 673 of 1991) prohibited the taking or having in possession more than two bass in any 24-hour period, and a closed season for angling for bass between 15 May and 15 June was established in 1992. The cumulative effect of these regulations has been to ban commercial fishing for bass.

4.8.4 Spain

The 36 cm MLS for bass applies in the Spanish waters of Div. VIIIb, c and northern Div. IXa, and for the recreational fishery in the inshore waters of the Basque Country (“Decreto de la Comunidad del País Vasco” 198/2000).

4.8.5 EC

The MLS (landing, stored, sold, displayed, or offered for sale) of 36 cm total length came into force in 1990 in Regions 2 and 3 of Community waters (Council Regulation (EEC) No. 3094/86 as amended by Council Regulation (EEC) No. 4056/89), and is aimed at protecting juvenile bass that occur predominantly inshore. There is now effectively a banned range for enmeshing nets of 70-89 mm stretched mesh (the most selective range for bass of 30-36 cm) in Community waters in Regions 1 and 2 (Council Conservation Regulation 850/98; Annex VI, Fixed gear, Regions 1 and 2).

4.8.6 Future Management considerations

4.8.6.1 Stock areas IVb, c, VIId, VIIe, h and VIIa, f, g

The results of the assessments for bass stocks in UK coastal waters suggest that exploitation can be sustainable at a level of F of some 0.2–0.3 and, with an exploitation pattern that gives a near maximum yield per recruit that this has led to an increase in exploitable biomass since the mid-1990s.

The recruitment time-series in Divisions IVb, c, VIId, VIIe, h, and VIIa, f, g show common features regarding year-class strength, indicating that stocks of bass around England and Wales are linked biologically and/or that recruitment is controlled by large-scale environmental patterns that are subsequently modified at a local level. Although there is a weak positive correlation between recruitment and SSB in some sea areas, it is driven by increased recruitment levels since the early 1990s and not by SSB. Consequently, it has not been possible to set absolute or even relative F-reference points based on stock-recruit considerations. There is no sign of recruitment overfishing, and the growth overfishing observed in the 1980s has been largely ameliorated.

From what is known about stock mixing and, in particular, the common traits in stock dynamics and biological parameters, it is reasonable to assume that these trends will be reflected throughout Subareas IV and VII, and that bass populations in Northwest Europe are probably being fished sustainably. However, forecasts of the actual or potential changes in yield accompanying these stock dynamics must take account of the availability of the bass population to the various fisheries. The selectivity values for bass suggest that the fishery in the North Sea, for example, is not taking full advantage of the increased productivity of the population. Furthermore, bass are especially important to inshore artisanal fishers and recreational anglers. It is estimated that in France, bass landings by recreational fishers are of similar levels to commercial landings and the same may be true for England and Wales. Future assessments should therefore try to take account of recreational catches (Fritsch, 2005).

The WG reiterates the recommendation of SGBASS 2003 (ICES, 2004a) that implementation of ‘input’ controls (preferably through technical measures aimed at protecting juvenile fish, in conjunction with entry limitations into the offshore fishery in particular) should be promoted, and that ‘output’ controls (such as TACs) are inappropriate. This is because bass is, in general, a by-catch species caught in mixed fisheries and TAC limitation may induce discards in such fisheries.

There are many uncertainties within both the SURBA analysis of the international dataset and the analysis of the UK dataset, one of the most important being a lack of knowledge on the catches of recreational fishers. Therefore the WG also reiterates the recommendation of SGBASS 2003 (ICES, 2004a) that due to these uncertainties, the precautionary approach indicates that effort should not be allowed to increase.

4.8.6.2 Other areas

Given the fact that no assessments have been undertaken for other areas and stock status is unknown, the WG suggests that again effort should not be allowed to increase and that additional data that could be used for assessments should be collected.

4.9 Data requirements

The assessment approach described in this report requires, in addition to appropriate biological sampling, consistent landings and effort data, and attempts should be made to improve coverage of all the main metiers in each stock area. In particular, units of effort may be different for each metier but are consistent over time, and a better definition is required. The major problem with bass is that a considerable proportion of national landings comes from small-boat, artisanal fisheries and the recreational sector, which are not well (if at all) sampled through the usual market system for the main commercial quota species. Each country has, therefore, to design a sampling programme around the characteristics of the national fisheries that take bass.

The voluntary logbook scheme implemented by CEFAS in 1985 ensures that landings and effort data covering each of the main métiers in each stock area are consistent over time, but similar data on bass are only available for other countries fisheries for a relatively short period. It is, therefore, important that contracts between Member States and the EU in response to the Data Collection Regulation ensure that adequate assessment data are available for each ICES division, in particular in Subarea VIII (and IX), where there are insufficient data to carry out analytical assessments of bass.

Recreational fisheries, because of their potentially high aggregate catches, should be included in future assessments, where possible, but these (especially shore angling, where individual catches may be small) are difficult to sample. With possible changes in management regimes that may favour this sector, it is all the more important to devise appropriate methods for obtaining essential data and France is making rapid progress in this area.

The apparent stability of growth and size at maturity throughout the species' range in Northwest Europe suggests that further work aimed at improving estimates of biological parameters is unlikely to be cost-effective in relation to other assessment needs.

Finally, the WG re-iterates the recommendation of SGBASS, namely to maintain and improve monitoring of 0-group and pre-recruitment abundance, and to improve our understanding of environmental effects on bass distribution and abundance.

4.10 Reference

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Table 4.3.2. Summary of availability and quality of data on bass by area (for all métiers) - quality relates to how well landings in each sea area have been sampled.

		North Sea (IVb,c)		Channel (VIId,e,h)		Irish/Celtic Seas (VIIa,f,g)		Biscay (VIII)	
Data type		Quality	Year span	Quality	Year span	Quality	Year span	Quality	Year span
Effort		*	84-05	**	85-05	**	85-05	*	84-02
Landings	wt/Div	*	84-05	**	85-05	**	85-05	*	84-05
	wt/Rect	*	84-05	*	85-05	*	85-05	*	84-05
	value/Div	*	84-05	*	85-05	*	85-05	**	84-05
	price/grade	*	84-05	*	85-05	*	85-05	**	84-05
Discards	any data	*	84-05	*	85-05	*	85-05	*	95
Biological	length comp'	*	85-05	**	85-05	**	85-05	*	00-05
	age comp'	*	85-05	**	85-05	**	85-05	*	00-04
	fish wts	*	85-05	**	85-05	*	85-05		
	sex ratio	*	82-94	**	82-93, 99,00	**	82-93		
	maturity	**	82-93	**	82-93, 99,00	**	82-93		
	condition	**	82-93	**	82-93, 99,00	**	82-93		
	growth	**	82-93	**	82-93	**	82-93		
Recruit Index		**	75-05	**	77-04	**	72-01		
Spawning	timing	**	81-84, 03	**	81-84, 89,00	*	82-91, 99-03		
	distribution	*	81-84,89	**	81-84, 89	*	82-91(3yr)		

Quality Key: ** = good data quality; * = some data but poor quality; blank = no data available.

Table 4.3.3.1. Summary of nominal landings (t) of bass in the North East Atlantic by country of landing.

YEAR	CHANNEL ISLANDS[3]	DENMARK[1]	FRANCE	IRELAND[1]	NETHERLANDS[1]	PORTUGAL[4]	SCOTLAND[1]	SPAIN[1]	UK (ENGL. & WALES)[1]	UNALLOCATED[2]	TOTAL
1984	25		575					430	124	1063	2217
1985	18		1091					364	106	473	2052
1986	15		1765			181		388	129	493	2971
1987	14		2404	3		127		402	130	660	3740
1988	12		1871		8	351		451	190	394	3277
1989	48	1	1970		2	508		92	202	332	3155
1990	25	<0.5	1710			412		146	191	364	2848
1991	16	<0.5	2059			379		111	263	476	3304
1992	9	<0.5	2161			345		94	156	454	3246
1993	6		1933			289		104	246	914	3531
1994	15	1	1956			373		134	546	2202	5261
1995	10	1	2033			316	<0.5	112	661	873	4066
1996	20	1	2988		8	381	<0.5	158	576	680	4848
1997	17	1	2599		1	229	<0.5	184	572	1700	5360
1998	18	2	2446		48	273	<0.5	115	489	980	4432
1999	16	2	3312		32	308	<0.5	134	680	1083	5659
2000	17		3925		67	361	<0.5	299	406	974	6051
2001	15	na	3898		87	332	<0.5	256	355	919	5847
2002	21	na	3627		111	326	5	271	500	1047	5882
2003	25	na	4395		180	279	3	274	574	1153	6860
2004	19		4293		210		3	74†	611	1608	6818*
2005		1	5350		197		1	53†	507	1116	7225*
2006			5800*								

[1] Source: Official Statistics

[2] Landings estimated by the Study Group.

[3] Source: 1984-1991 ICES Bulletin Statistique, 1992-2004, States of Jersey Fisheries Department.

[4] Revised figures

*** Provisional**

† Basque data only

Table 4.3.4.1. Nominal landings (t) of bass by country in Divisions IVb,c and VIId.

YEAR	DENMARK[1]	FRANCE	NETHERLANDS[3]	SCOTLAND[1]	UK (ENGL. & WALES)	UNALLOCATED[2]	TOTAL
1984		21			77	577	752
1985		175			76	170	496
1986		151			92	149	485
1987		85			86	194	451
1988		104	8		102	211	527
1989	1	147	2		91	150	482
1990	<0.5	131			71	185	459
1991	<0.5	161			168	212	709
1992	<0.5	180			83	253	599
1993		262			145	346	898
1994	1	260			356	915	1888
1995	1	298		<0.5	413	367	1492
1996	1	417	4	<0.5	318	267	1325
1997	1	290	1	<0.5	321	688	1622
1998	2	369	32	<0.5	282	323	1290
1999	1	628	32	<0.5	335	598	1594
2000		695	61	<0.5	217	378	1351
2001		772	76	<0.5	202	160	1210
2002		914	105	5	242	457	1718
2003		1100	169	2	268	277	1814
2004		937	197	<0.5	307	657	2098
2005	1	1260*		0	273	596	

[1] Source: ICES Bulletin Statistique

[2] Landings estimated by the Study Group.

[3] Official statistics

*** Provisional.**

Table 4.3.4.2. Nominal landings (t) of bass by country in Divisions VIIe,h.

YEAR	CHANNEL ISLANDS[3]	DENMARK[1]	FRANCE	NETHERLANDS[1]	SPAIN[1]	SCOTLAND[1]	UK (ENGL. & WALES)	UNALLOCATED[2]	TOTAL
1984	25		171				39	283	518
1985	18		98				19	213	348
1986	15		128				22	99	264
1987	14		744				16	209	983
1988	12		228				30	103	373
1989	48	1	131				39	55	274
1990	25		157				91	59	332
1991	16		202				45	80	343
1992	36		337				40	54	467
1993	45		252				50	88	435
1994	49		163				66	422	700
1995	69		269				100	112	550
1996	56		959	4		<0.5	162	49	1230
1997	74		774				150	439	1437
1998	79		580	16			162	88	925
1999	108		756			<0.5	311	94	1269
2000	19		684	<0.5	1		139	172	1015
2001	15		786	4			72	233	1110
2002	44		624	2		<0.5	127	206	1003
2003	49		1050	5			233	310	1647
2004	19		1225				230	275	1749
2005			1550*		<0.5†		160	156	

[1] Source: ICES Bulletin Statistique

[2] Landings estimated by the Study Group.

[3] Source: 1984-1991 ICES Bulletin Statistique; 1992-2004, States of Jersey & Guernsey Fisheries Department.

Provisional.

Basque data only

Table 4.3.4.3. Nominal landings (t) of bass by country in Divisions VIIa,f&g.

YEAR	FRANCE	IRELAND[1]	SCOTLAND[1]	UK (ENGL. & WALES)	UNALLOCATED[2]	TOTAL
1984	1			8	203	212
1985	13			11	90	114
1986	2			11	245	258
1987	24	3		23	257	307
1988	7			43	80	130
1989	14			62	127	203
1990	14			27	120	161
1991	75			27	184	286
1992	43			24	147	214
1993	14			32	480	526
1994	9			110	735	854
1995	40		<0.5	141	264	445
1996	41		<0.5	82	234	357
1997	31		<0.5	88	443	562
1998	195		<0.5	42	439	676
1999	28		<0.5	32	391	451
2000	70		<0.5	50	424	544
2001	53			81	410	544
2002	80			131	213	424
2003	40		<0.5	73	382	495
2004	53		2	74	676	805
2005	113		1	73	364	551

[1] Source: ICES Bulletin Statistique

[2] Landings estimated by the Study Group.

***Provisional.**

Table 4.3.4.4. Nominal landings (t) of bass by country in Divisions IVa, VIa, VIIb,c,j&k and XII.

YEAR	DENMARK[1]	FRANCE	IRELAND[1]	NETHERLANDS[1]	PORTUGAL	SCOTLAND[1]	SPAIN[1]	SPAIN (BC)[2]	UK (ENGL. & WALES)	TOTAL
1984		1							0	1
1985		<0.5							<0.5	<0.5
1986		<0.5							0	<0.5
1987		<0.5	1						<0.5	1
1988		<0.5		3					0	3
1989		0.5	1						0	1.5
1990	<0.5	<0.5	1						0	1
1991	<0.5	1							<0.5	1.5
1992		1.5							1	2.5
1993		0.7							1	1.7
1994	<0.5	<0.5							<0.5	1
1995	<0.5	<0.5				<0.5			8	8
1996		0.5			3	<0.5			5	8.5
1997	<0.5	<0.5							<0.5	<0.5
1998	<0.5	0.5				<0.5	40		10	51
1999	<0.5	0				<0.5	1		1	2
2000		3				<0.5		<0.5	<0.5	0.5
2001		1						<0.5		1
2002							1	<0.5		1
2003						<0.5		<0.5		<0.5
2004						<0.5		<0.5		<0.5
2005							0† Basque			

[1] **Source: ICES Bulletin Statistique**

[2] **Estimates for Spain (Basque Country).**

***Provisional.**

† **Basque data only**

Table 4.3.4.5. Nominal landings (t) of bass by country in Division VIIIa,b&d.

YEAR	FRANCE	SPAIN[1]	SPAIN (BC)[2]	UK (ENGL. & WALES)	UNALLOCATED[3]	TOTAL
1984	381	0		0		381
1985	805	0		1		806
1986	1478	0		4		1482
1987	1547	0		5		1552
1988	1512	0		15		1527
1989	1673	0		10		1683
1990	1407	0		2		1409
1991	1611	17		23		1651
1992	1601	14		9		1624
1993	1404	14		19		1437
1994	1393	17	60	14	130	1554
1995	1283	0	29	7	130	1420
1996	1344	0	51	14	130	1488
1997	1345	0	42	12	130	1487
1998	1142	27	50	3	130	1302
1999	1602	11	57	2		1672
2000	1824	50	58	0		1932
2001	1855	2	42			1899
2002	1618	15	50			1683
2003	2300	39	38			2377
2004	2072		65			2137*
2005	2250*		43			2293*

[1] Source: ICES Bulletin Statistique

[2] Estimates for Spain (Basque Country).

[3] Landings estimated by the Study Group.

***Provisional.**

Table 4.3.4.6. Nominal landings (t) of bass by country in Division VIIIc.

YEAR	FRANCE	PORTUGAL	SPAIN[1]	SPAIN (BC)[2]	UK (ENGL. & WALES)	TOTAL
1984	0		180			180
1985	0		200			200
1986	5		206			211
1987	3		208			211
1988	12	<0.5	358			370
1989	1	1	325			327
1990	1		395			396
1991	9	1	300			310
1992	0		254			254
1993	0	<0.5	247			247
1994	0	1	306			307
1995	1	<0.5	334		<0.5	335
1996	1	<0.5	376			377
1997	0	<0.5	290			290
1998	0	<0.5	258			258
1999	9	<0.5	221			222
2000	20			5		25
2001	1		122	8		131
2002	1		107	14		122
2003	0		152	8		160
2004				8		>3
2005				9		

[1] **Source: ICES Bulletin Statistique**

[2] **Estimates for Spain (Basque Country).**

Table 4.3.4.7. Nominal landings (t) of bass by country in Division IXa.

YEAR	PORTUGAL*	SPAIN	TOTAL
1984		250	250
1985		164	164
1986	181	182	363
1987	127	194	321
1988	351	93	444
1989	507	92	599
1990	412	146	558
1991	378	111	489
1992	345	94	439
1993	289	104	393
1994	372	134	506
1995	316	112	428
1996	378	158	536
1997	229	184	413
1998	273	115	388
1999	308	134	442
2000	361	83	444
2001	332	102	434
2002	326	49	475
2003	279	83	362
2004			
2005			

***revised data set 2004**

Table 4.4.1. Recruitment indices available for bass.

	NETHERLANDS	GERMANY	UK (ENGLAND AND WALES)						IRELAND
AREA	WESTERSCHELDE	CODS	THAMES ESTUARY	THAMES ESTUARY	SOUTH (SOLENT)	SOUTH (TAMAR)	WEST (CAMEL)	WEST (SEVERN)	
DIVISION	IVC	IVB	IVC	IVC	VIID	VIIE	VIIF	VIIF	VII
YEAR CLASS	0 GROUP BEAM TRAWL SURVEY	0-2 GROUP NO/TOW	0 GROUP PS SCREENS[2]	0-3 GROUP TRAWL SURVEY	2-4 GROUP TRAWL SURVEY	0-GROUP SEINE SURVEY	0-GROUP SEINE SURVEY	0 GROUP PS SCREENS[1]	0 GROUP SEINE/STOP-NET SURVEY
1972	1							3	
1973	0							4	
1974	0							1	
1975	0		78					15	
1976	1		100					127	
1977	0		6		11			-	
1978	0		5		20			-	
1979	1		5		165			-	
1980	1		37		31			9	
1981	0		21		77		0.02	216	
1982	0	0	56		137		1.23	83	
1983	0	0	83		171		0.30	226	
1984	4	0	62		10		1.34	8	
1985	0	0	76		1	2.13	0.22	11	
1986	0	0	14		5	0.02	0.01	3	
1987	0	0	116		34	0.10	0.31	96	
1988	1	0	54		79	4.77	0.48	98	
1989	0	0	610		424	7.54	1.12	446	
1990	3	0	433		60	3.33	0.89	25	
1991	1	0	64		49	0.24	0.50	300	
1992	31	0	104		57	7.12	0.25	280	
1993	3	0	131		30	3.25	0.22	202	
1994	414	0	26	0.89	122	3.75	1.34	-	
1995	49	0	27	0.01	227	7.44	-	-	
1996	4	1			20	0.33	1.19	242	0.15
1997	15	0		0.16	313	3.59	1.02	-	0.01
1998	33	1		0.31	78	6.69	2.64		0.05
1999	156	0		1.19	142	3.90	0.56		0.02
2000	110	0		0.44	57	1.09	1.33		0
2001		1		1.37	47	1.13			0.03
2002		1		2.24	75	6.74			
2003		2		2.00	104	3.10			
2004		1		1.24	86	4.67			
2005				0.26*		1.24			

[1]**discontinued 1998**

[2]**discontinued 1996**

*** Provisional.**

Table 4.5.2. Number of age samples (all metiers combined) collected by Cefas for bass for 1976–2005 by ICES Division for the UK (E&W) fishery.

	IVB	IVC	VIIA	VIID	VIIE	VIIF	VIIG	VIIH	VIIJ	TOTAL
1976				15						15
1983					333					333
1984		95		178	401	152				826
1985		219	162	311	159	168				1019
1986	9	99		546	94	269				1017
1987		373	90	412	309	150		27		1361
1988		203	117	446	329	349				1444
1989		490	135	534	403	293	23			1878
1990		412	22	813	710	136	38			2131
1991		635	139	1036	865	796		1		3472
1992		480	448	2286	638	5	210			4067
1993	1	380	179	2213	1185	711	11	4		4684
1994	28	1064	35	4146	961	478	2			6714
1995	44	235	250	1897	562	628	91	33		3740
1996	37	64	290	1783	1170	508	154			4006
1997	38	246	67	2217	1251	566	360	11		4756
1998	33	603	118	1198	891	399	247	14		3503
1999	5	524	137	1071	1305	283	73			3398
2000		460	312	1410	2228	417	29		6	4862
2001	72	830	382	1982	1396	893	78		85	5718
2002	213	1704	78	2528	722	638	15		12	5910
2003	566	196	274	1190	1103	593				3922
2004	210	161	4	777	891	396	15	18		2472
2005	120	356	7	247	787	305	49			1871

Table 4.6. Proportion mature and mean weight-at-age for bass (combined sex; after Pawson and Pickett, 1996), as used in the separable analyses.

AGE	PROPORTION MATURE	MEAN WEIGHT-AT-AGE (KG)
3	0.03	0.462
4	0.23	0.578
5	0.43	0.683
6	0.57	0.878
7	0.9	1.112
8	1	1.460
9	1	1.568
10	1	1.756
11	1	2.194
12	1	2.424
13	1	2.710
14	1	3.066
15+	1	3.469

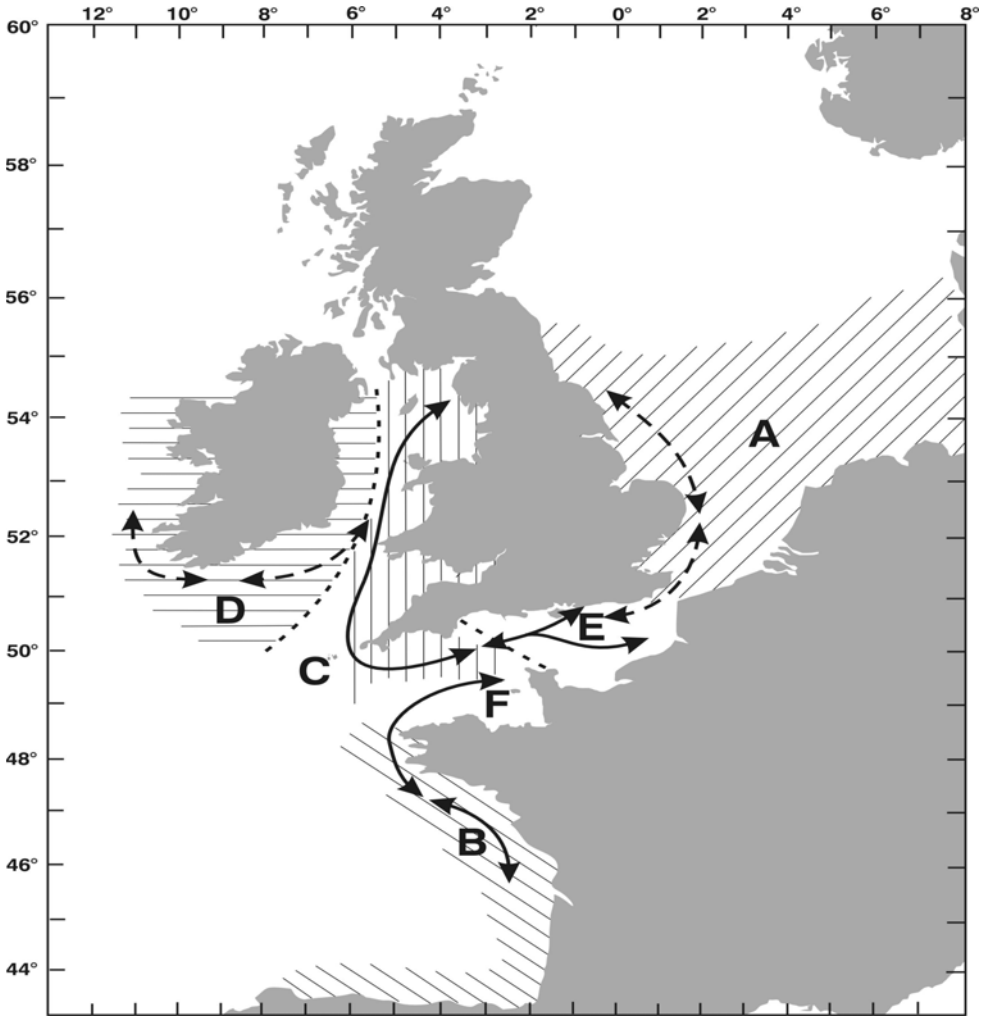

Figure 4.2. Proposed 'stock' areas within which fishery and biological data could be used in assessments of bass populations and for which management advice may be given. These 'stocks' are based on the current patterns of seasonal movements of bass (indicated by arrows) and the characteristics of the seasonal fisheries taking bass. North Sea (IVa,b,c); eastern Channel (VIId); western Channel (north part of VIIe); west coast of UK (VIIa,f,g); Irish coastal waters; Biscay (VIIIa,b,c) and south part of VIIe.

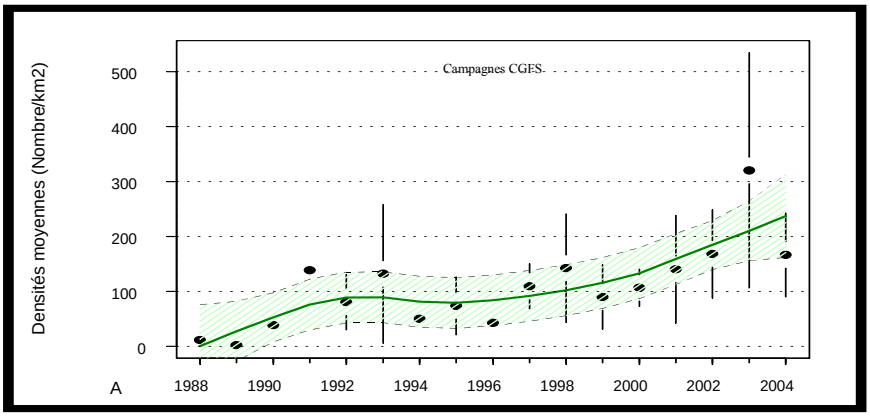

Figure 4.4.1. The average density of bass from all statistical rectangles fished by a French bottom trawl survey (CGFS) in VIId.

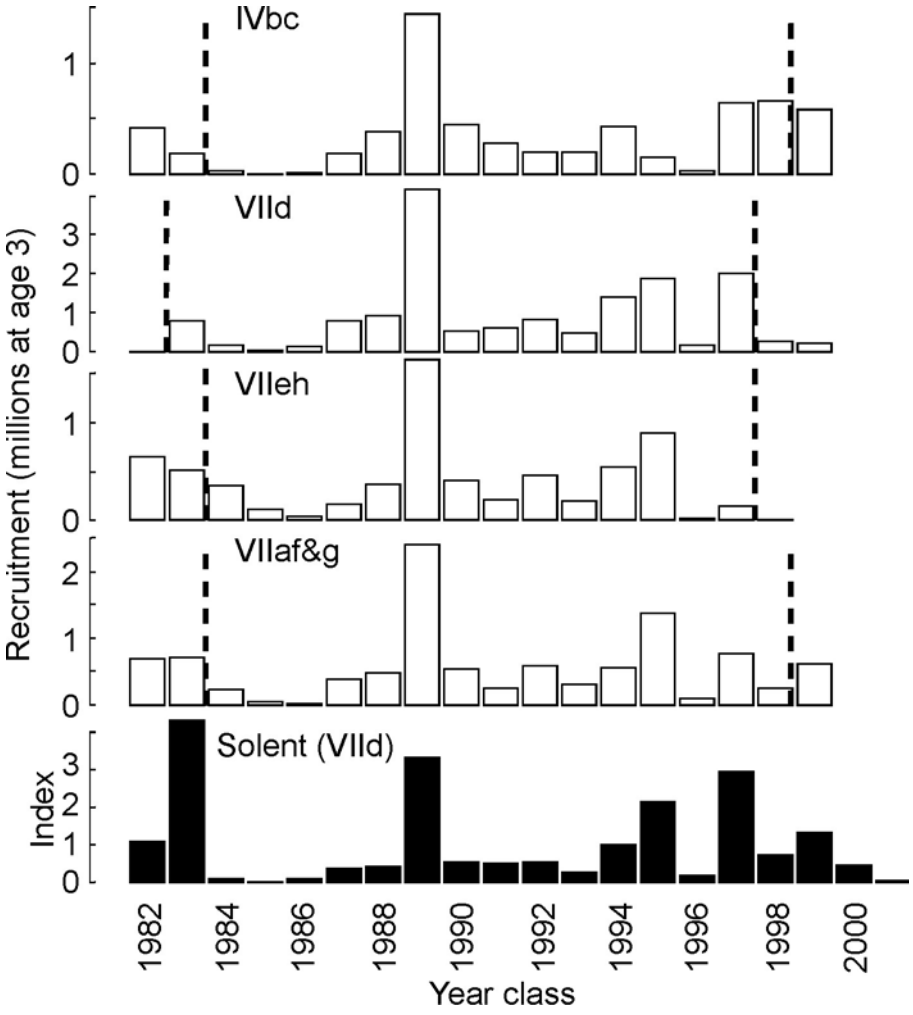

Figure 4.7.1. Recruitment estimates for bass at age 3 in Divisions IVb, c, VIId, VIIe, h, and VIIa, g, and abundance indices (age 2–4) derived from the Solent survey in VIId, 1983–2001 year classes.

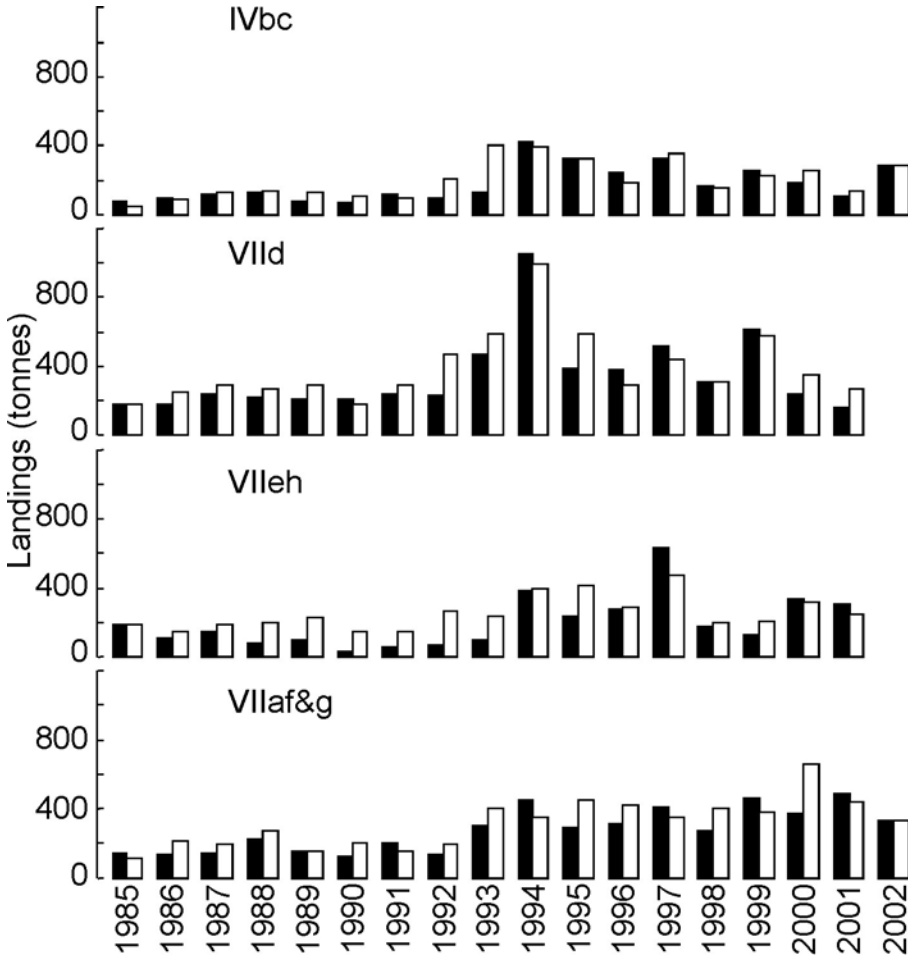

Figure 4.7.2. Model estimates (closed bars) and observed (open bars) landings of bass in English inshore fisheries in IVb, c, VIId, VIIe, h, and VIIa, f, g, 1985–2004.

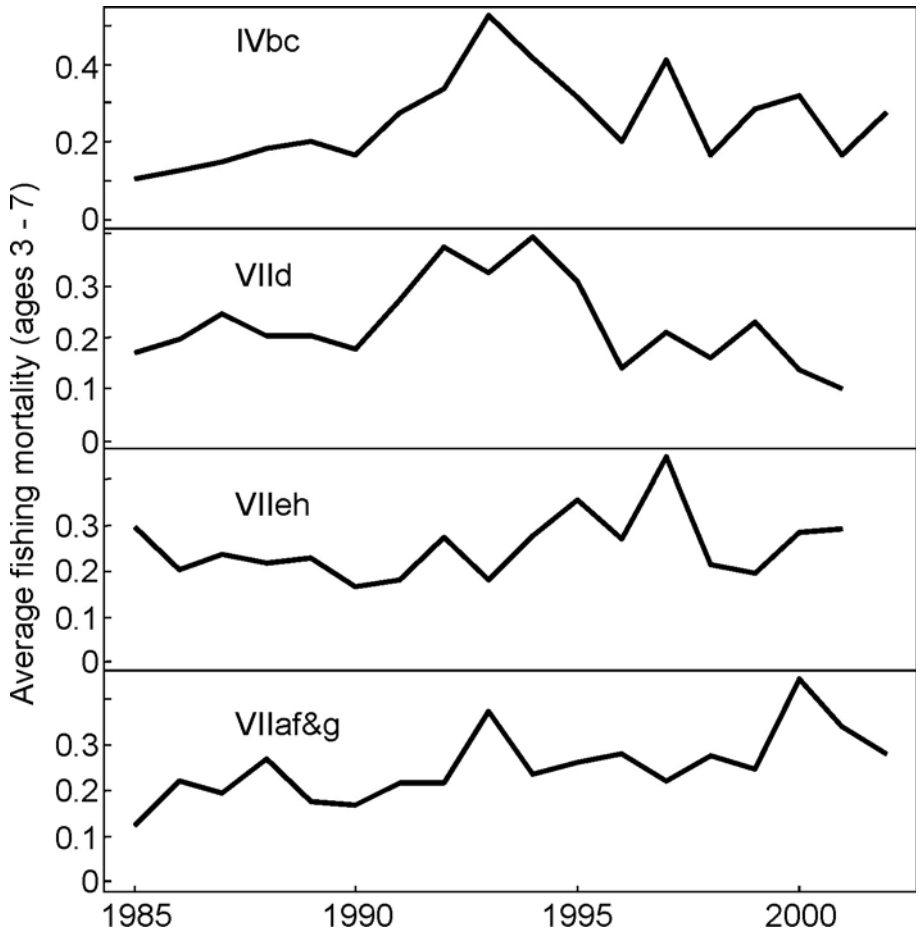

Figure 4.7.3. Model estimates of fishing mortality on bass in IVb, c, VIId, VIIe, h, and VIIa, f, g, 1985–2004.

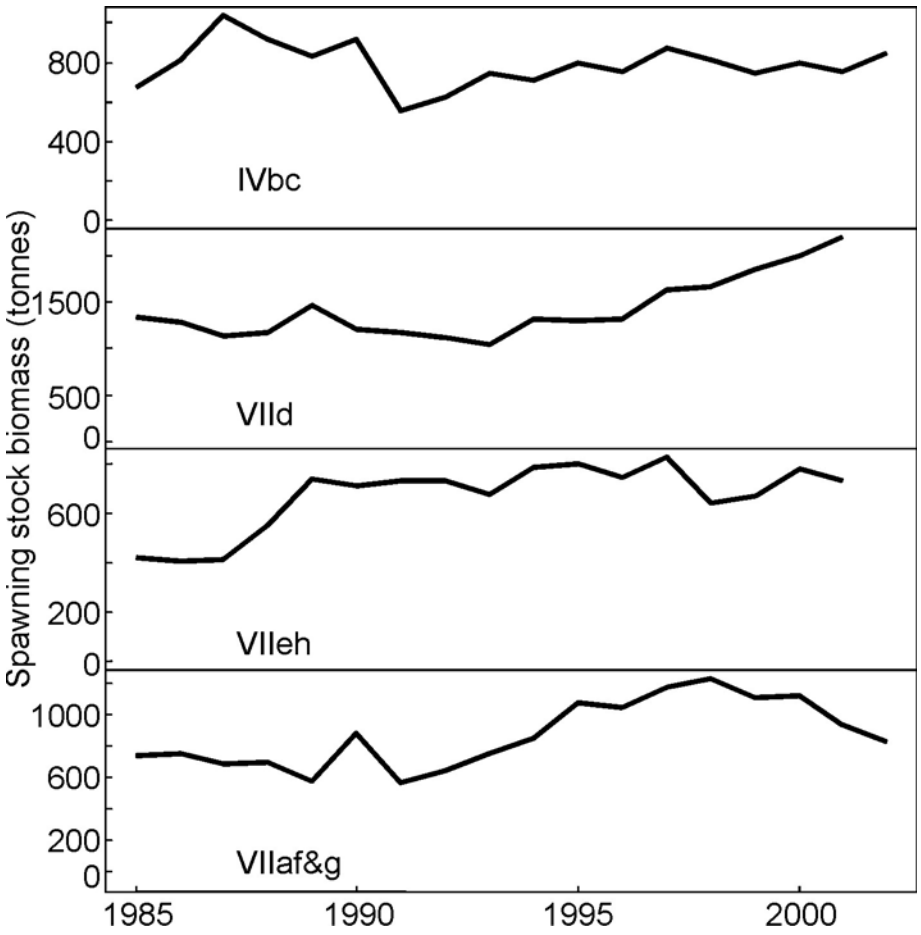

Figure 4.7.4. Model estimates of spawning stock biomass (SSB, t) of bass in IVb, c, VIId, VIIe, h, and VIIa, f, g, 1985–2004.

5 Striped red mullet

5.1 General biology

The striped red mullet *Mullus surmuletus* is characterized by a high and short head with two long barbs under the chin. The mouth does not reach the edge of the eye, under which there are two big scales (suborbitaries scale). The colour of the back and the sides goes from red to scarlet. Three horizontal yellow bands (stripes) are visible along the lower flanks.

The striped red mullet is found along the European coasts from southern Norway (Wheeler, 1978) and north Scotland (Gordon, 1981) including the Faeroes (Blacker, 1977), south to the Strait of Gibraltar, and also in the north part of western Africa and in the Mediterranean and Black Seas (Fage, 1909; Quéro 1984; Hureau, 1986; Bauchot, 1987; Quéro and Vayne, 1997). It is infrequent off Norway, around Ireland, the north coasts of England and West of Scotland (Pethon, 1979; Minchin and Molloy, 1980; Davis and Edward, 1988; Gibson and Robb, 1997).

Analysis of British commercial landings revealed a strong concentration of this species in the central pit of the western Channel during winter (Dunn, 1999; Delpech and Coppin, 2001). The scientific survey CGFS (Channel Ground Fish Survey), carried out every year by Ifremer in the eastern Channel since 1988, shows that the young individuals are distributed in coastal areas, while the adults have a more offshore distribution in the eastern part (Carpentier and Coppin, 1999; Delpech and Coppin, 2001). Finally, nurseries are located in the Bay of Saint-Brieuc and Falklands coasts (Morizur *et al.*, 1996).

The striped red mullet is a benthic schooling species. It seems to prefer deep water and elevated temperatures, and tolerates weak and high salinity (corresponding respectively to the habitats of the juveniles and adults) and is rarely found in the transition zones of intermediate salinity. This species prefers sandy sediments (Carpentier *et al.*, 2005).

Previous studies in the Northeast Atlantic Ocean show that, for a given age, the female is heavier and longer than the male (Desbrosses, 1935; Bougis, 1952; Hashem, 1973; Gharbi & Ktari, 1979; Andaloro and Giarritta, 1985; N'Da, 1992; Reñones *et al.*, 1995). The same phenomenon was observed in the eastern Channel and North Sea (Mahé *et al.*, 2005). The food of striped red mullet primarily consists of crustaceans and molluscs.

5.2 Stock identity and possible assessment areas

From the presence of striped red mullet in catches all year-round, Dunn (1999) suggested that a single stock exists within the English Channel, although he could not determine whether this was distinct from other more westerly stocks. He also suggested that there might be a newly established stock in the North Sea.

A study using the geometrical morphometry in the Eastern English Channel and the Bay of Biscay was carried out in 2004 and 2005 and presented (cf Working Document in Annex 3). The results of this study show that there is a morphological difference between the striped red mullets of the Eastern English Channel and of the Bay of Biscay. The Working Group noted that the year 2001 for the CGFS was different from other years and that more morphological work was needed before the results could be considered conclusive. Moreover, according to these first results these studies should be supplemented by genetics studies for the identification of the stocks.

5.3 Fishery data

5.3.1 Catch and effort data by sea area and country

According to ICES statistics, the main country that catches striped red mullet is France. The striped red mullet is a target species for this country and is mainly caught (> 90%) by bottom trawlers with a mesh size of 70–99 mm.

The three main areas for the exploitation of the striped red mullet are areas IV, VIId,e and VIIIa,b. For the entire zone, the French catches are the most important. Other important countries are the Netherlands and the United Kingdom with regard to the English Channel (VIId,e) and the North Sea (IV) where the catches are concentrated in the south (IVb,c). The north of the Bay of Biscay (VIIIa,b) is exploited by France and Spain. The southern part of the Bay of Biscay (VIIIc) is only exploited by Spain. Other countries with small catches are Germany, Scotland, Denmark and Ireland. For this species, therefore, three areas should be considered: IV, VIId,e, and VIIIa,b.

The species is not discarded by French vessels in the Eastern English Channel (VIId) or in the southern North Sea (IVc). More investigations on discarding should be carried out in these areas for the other countries and in the other areas (IVb ; VIIe ; VIIIa,b).

5.4 Survey data

A part of the analysis is presented in the 2005 WGNEW report. To date, the French EVHOE survey index for the Bay of Biscay (VIII) has not been used for this species.

5.4.1 Channel Ground Fish Survey

Table 5.4.1 and Figure 5.4.1 show the yearly variation and average map of abundance of striped red mullet for the period 1988–2006. The time series of abundance shows a period of high abundance between 1995 and 1998 and a peak in 2003. The high index observed in 2003 is due to high recruitment but not followed by an increased abundance of older fish in 2004 and 2005. This could be explained by the strong exploitation of the species over all length groups. The 2006 index shows a small increase compared to 2005. The good 2003 index is mainly explained by age group 0 (0 to 16 cm). Thus, the year 2003 constitutes the best recruitment observed during the time series (1988–2006). During the whole time series, there are large fluctuations in abundance.

During the meeting, a cohort consistency analysis applied to CGFS data was presented (see Working Document). It is important to underline that only one age/length key (for 2004) was applied to the length distributions for all years. Thus, it is necessary to continue the age determination in order to create a time series of survey abundance at age data. The WG agreed with the conclusions of the working document, namely that the lack of consistency in the cohort indices may be explained by exchanges of striped red mullet between the Eastern English Channel and adjacent areas. The CGFS only covers the Eastern English Channel.

5.4.2 International Bottom Trawl Survey

An analysis of the distribution of striped red mullet based on IBTS and CGFS data shows a distribution concentrated in southern North Sea and the Eastern English Channel during the second, third and fourth quarter. During the first quarter striped red mullet is localized to the east of Scotland and in the Skagerrak. There are no data for the Channel during this quarter. The geographical distribution of cpue shows a continuum between the southern of North Sea and the eastern English Channel.

Table 5.4.1 provides quarter 1 IBTS indices for the North Sea since 1988 and quarter 3 indices since 1991. The indices for the IBTS Q3 survey are quite consistent with the CGFS time series.

The average catch-rate in IBTS Q1 is small compared to those observed in CGFS and IBTS Q3. However, the three highest indices observed in the fall of 1989, 1997 and 2003 in IBTS Q3 and CGFS surveys are also seen in the IBTS Q1 of the following year (Table 5.4.1). The IBTS Q1 catches mainly represent 0-group individuals, the 2005 index being the highest observed in the 1990–2005 time series (Figure 5.4.3).

5.4.3 UK Surveys

Although all fish caught are routinely measured during Cefas surveys, biological information is not collected for striped red mullet. A summary of the numbers of fish measured in four Cefas survey series and the abundance (number per 30 minute tow) is given in Table 5.4.2 for the Irish Sea (VIIa,f,g) beam-trawl survey, the Channel (VIId) beam-trawl survey, the Carhelmar (VIIe) commercial beam-trawl survey and the English groundfish (IVb,c) GOV trawl survey. As can be seen, striped red mullet are generally uncommon in these surveys.

5.5 Biological sampling

UK (England) and the Netherlands do not routinely carry out market sampling for this species. An inventory of the French data collected is given in Tables 5.5.1 and 5.5.2.

A French study on the sampling optimization (IVc; VIId) was presented. The results show that there is a good yearly adequacy between sampling and catches. The WG suggests continuing this study but to improve the sampling of category 40 (slightly under-sampled) and the temporal allocation (WD in annex).

5.6 Population biology and a summary of other research

5.6.1 Length-weight relationships

The data are presented in the report of the WGNEW 2005. Since 2003, the data are usually collected by France for the Eastern English Channel and the southern North Sea. France started to collect data for VIIIa,b at the end of 2006. The Spanish landings are significant in this area, and some biological sampling should be carried out.

5.6.2 Age structure and growth

The methods are presented in the report of the WGNEW 2005. Since 2004, data are collected by France for the eastern Channel and the southern North Sea. France started to collect data for VIIIa,b at the end of 2006.

5.6.3 Comparison between scales and otholits

The data are presented in the report of WGNEW 2005. There is no significant difference in the age/length curves constructed from ageing scales or otoliths.

5.6.4 Maturity identification

Maturity stages are described in the report of WGNEW 2005. Since 2004, France collects data for the eastern English Channel and the southern North Sea (Table 5.5.3).

5.6.5 Relation with the ecosystem

The optimal habitat of the red mullet in autumn is characterized by sediments composed of fine and coarse sands, by a weak bedstress, and by temperatures of between 16 and 17°C. The model is presented in the report of WGNEW 2005 (ICES, 2006).

5.7 Conclusions

The morphometric study shows differences between the striped red mullet of the eastern English Channel and the Bay of Biscay. However, this study must be supplemented on the one hand by increasing the number of samples from these two areas and on the other hand by studying other areas (the central North Sea, IVb; Western English Channel, VIIe). Moreover, the morphometric results must be supplemented by a genetic study. The Working Group recommends that such a study which proposes to identify various stocks from the North Sea to the Bay of Biscay be included in a pilot project. The results of the cohort consistency analysis carried out on the CGFS data suppose exchanges of striped red mullet with adjacent areas and this reinforces the need for this type of study.

As can be seen in Table 5.3.1, France is the main contributor in the fishery of striped red mullet in the three areas where this species is found (IV, VIId,e, VIII). High catch rates have been recorded in VIII since 1973. Targeting striped red mullet started in 1994 in IV and VIId and exploitation has been increasing since then. Recently, a study was done to improve the biological knowledge on this species (Mahé *et al.*, 2005).

French data are collected in Ivc and VIId under the Data Collection Regulation since 2003 for length, and since 2004 for age and sexual maturity. French data began since the end of 2006 for the Bay of Biscay (VIIIa,b). There are no biological data for the Western English Channel (VIIe).

The precision analysis shows that length sampling in the Eastern English Channel (VIId) and the southern North Sea (Ivc) must be continued at the current level with some minor adjustments. This type of analysis should also be carried out concerning age data. For the western English Channel (VIIe), it would be necessary to do a follow-up within the framework of the DCR on the level carried out in Eastern English Channel (VIId) and southern North Sea (Ivc). Indeed, without a study on stock identification, it appears difficult to apply the biological results obtained in Ivc and VIId. In the Bay of Biscay (VIIIa,b) the biological follow-up which has just started, should be continued for France and it is suggested that Spain starts collecting similar data since Spanish catches are increasing. For the time being, there are insufficient biological data to carry out an assessment.

5.8 Reference

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Table 5.3.1a. Striped red mullet landings by France (Source : ICES statistics, t.).

FRANCE	VIID	VIIE	VIIF	VIIG	VIIH	IVC	IVB	VIIIB	VIIIA	VIII
1973	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0
1975	140	70	0	0	0	0	0	0	0	182
1976	156	141	0	10	0	0	0	56	540	0
1977	272	234	1	0	0.3	7	0	43	176	0
1978	204	295	0.3	1	25	3	0	84	118	0
1979	206	157	1	3	15	6	0	21	213	0
1980	86	187	0.3	1	26	0	0	52	281	0
1981	44	98	6	0	0	0	0	0	0	277
1982	32	101	3	0	0	0	0	0	0	250
1983	206	226	1	0	0	26	0	119	361	0
1984	182	124	1	0	0	22	0	86	469	0
1985	128	123	1	1	29	7	0	156	552	0
1986	80	92	1	1	29	4	0	122	533	0
1987	35	177	2	2	20	5	0	187	586	0
1988	31	164	4	1	24	4	0	165	572	0
1989	34	111	2	0	21	3	0	154	530	0
1990	491	258	0	1	30	32	1	153	535	0
1991	185	261	6	3	53	23	0	107	582	0
1992	404	253	10	3	31	27	0	182	651	0
1993	456	327	9	2	25	60	0	85	443	0
1994	254	211	7	1	26	54	0	138	471	0
1995	1 495	274	4	1	27	521	0	125	436	0
1996	1 531	578	7	3	48	254	0	72	441	0
1997	606	525	12	7	58	123	2	71	454	0
1998	2 230	560	8	8	69	365	3	75	342	0
1999	-	-	-	-	-	-	-	-	-	-
2000	1 979	630	8	10	58	607	4	129	510	107
2001	1 045	711	16	10	64	359	13	116	488	118
2002	1 034	528	10	5	65	302	10	70	492	109
2003	2 244	546	10	8	69	488	18	222	640	5
2004	3 685	860	18	12	97	491	28	240	874	2
2005	3761	795	34	18	91	260	61	194	947	7

Table 5.3.1b. Striped red mullet landings by Spain (Source : ICES statistics, t.).

SPAIN	VIII	IXA	IX	VIIIA	VIIIB	VIIIC
1973	86	0	241	0	0	0
1974	34	0	291	0	0	0
1975	129	0	367	0	0	0
1976	722	0	190	0	0	0
1977	119	0	101	0	0	0
1978	0	0	0	0	0	0
1979	73	0	3	0	0	0
1980	156	0	2	0	0	0
1981	0	0	2	0	0	0
1982	149	0	81	0	0	0
1983	168	0	50	0	0	0
1984	240	0	21	0	0	0
1985	135	0	85	0	0	0
1986	171	0	87	0	0	0
1987	175	0	145	0	0	0
1988	141	0	82	0	0	0
1989	0	87	0	0	0	165
1990	0	92	0	0	0	170
1991	0	118	0	8	22	150
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	0	0	0	0	0	0
1996	0	192	0	0	0	100
1997	0	192	0	0	0	108
1998	0	7	0	10	14	93
1999	0	0.3	0	20	95	8
2000	0	14	0	23	217	21
2001	0	36	0	23	216	58
2002	0	5	0	36	123	27
2003	0	9	0	54	209	42
2004	0	46	0	178	445	167
2005	-	207	-	232	200	199

Table 5.3.1c. Striped red mullet landings by UK (Source : ICES statistics, t.).

UNITED KINGDOM	VIID	VIIE	IVB	IVC	VIIH	VIIF	VIII
1973	0	0	0	0	0	0	0
1974	0	0	0	0	0	1	0
1975		16	0	0	0	1	0
1976	0.3	35	1	0.3	0	2	0
1977	1	44	0.3	0	0	1	0
1978	1	62	2	0.3	0	1	0
1979	0.3	31	11	0.3	0.3	2	0
1980	0.3	20	4	0.3	0	2	0
1981	0.3	18	1	0.3	0	1	0
1982	1	14	1	0.3	0	1	0
1983	1	49	0.3	0.3	0	2	0
1984	3	52	0.3	0.3	0	2	1
1985	2	53	2	0.3	0	2	0.3
1986	2	46	1	0.3	0	2	3
1987	3	26	0	0	4	3	0
1988	2	49	1	1	5	3	0
1989	3	46	1	1	2	4	0
1990	13	86	0.3	0.3	10	2	2
1991	8	88	0.3	3	3	6	15
1992	11	51	1	2	5	5	29
1993	15	60	1	2	7	6	83
1994	10	51	1	3	23	7	33
1995	57	75	1	5	52	9	14
1996	28	92	4	3	25	7	10
1997	35	92	11	2	15	6	7
1998	77	60	17	2	10	5	6
1999	37	63	31	1	7	2	2
2000	53	106	36	3	6	8	0.3
2001	101	137	22	2	8	10	0
2002	23	105	18	1	12	11	0
2003	53	94	12	1	10	6	15
2004	53	147	14	2	10	6	38
2005	26	134	46	1	16	6	6

Table 5.3.1d. Striped red mullet landings by the Netherlands (Source: ICES statistics, t.).

NETHERLANDS	VIID	VIIE	IVB	IVC
1973	0	0	0	2
1974	0	0	1	0
1975	0	0	0	0
1976	0	0	1	2
1977	0	0	6	6
1978	0	0	14	11
1979	0	0	17	15
1980	0	0	11	14
1981	0	0	8	11
1982	0	0	10	8
1983	0	0	4	11
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	1	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	6	0	68	161
2001	151	12	194	188
2002	92	11	133	101
2003	166	25	134	96
2004	460	59	157	187
2005	286	94	146	168

Table 5.4.1. Survey abundance index (Nb/hr).

YEAR	IBTS Q1	IBTS Q3	CGFS
1988	0.00		0.71
1989	0.00		46.11
1990	0.42		3.21
1991	0.00	0.14	1.53
1992	0.06	1.88	10.95
1993	0.00	0.56	3.56
1994	0.00	17.81	6.70
1995	0.05	8.75	11.02
1996	0.08	1.88	9.49
1997	0.04	27.71	26.14
1998	1.54	4.66	19.88
1999	0.25	3.82	6.45
2000	0.57	2.69	8.73
2001	0.23	1.50	2.62
2002	0.32	5.54	8.29
2003	0.67	21.20	57.86
2004	1.59	12.79	13.40
2005	2.76		7.09
2006			18.45

Table 5.4.2. The number of striped red mullet measured and average abundance (number caught per 30 minute tow) annually for Cefas Irish Sea (VIIa, f, & g) beam trawl, Channel (VIId) beam trawl, Carhelmar (VIIe) and English Groundfish (EGFS, Ivb & c) surveys.

	IRISH SEA		CHANNEL BEAM		CARHELMAR		EGFS	
YEAR	NO.	ABUNDANCE	NO.	ABUNDANCE	NO.	ABUNDANCE	NO.	ABUNDANCE
1989	20	0.26	36	0.55	70	1.25		
1990	10	0.13	11	0.16	30	0.54		
1991	2	0.03	0	0.00	15	0.30		
1992	1	0.01	3	0.04	24	0.43	44	0.59
1993	2	0.03	10	0.13	42	0.76	1	0.01
1994	2	0.03	2	0.02	28	0.48	4	0.05
1995	11	0.14	8	0.08	44	0.83	667	7.76
1996	10	0.13	1	0.01	54	0.93	79	0.96
1997	18	0.23	6	0.06	48	0.82	15	0.23
1998	1	0.01	8	0.08	27	0.47	21	0.28
1999	28	0.36	10	0.11	123	2.11	21	0.28
2000	18	0.23	5	0.04	58	1.00	16	0.21
2001	34	0.44	5	0.04	117	2.01	108	1.44
2002	3	0.04	17	0.16			58	0.77
2003	101	1.31	21	0.20	216	3.72	44	0.58
2004	24	0.32	2	0.02			158	2.07
2005			0	0.00			35	0.51

Table 5.5.1. Summary of French biological data available on striped red mullet.

DATA TYPE	DATA AVAILABLE
Biological information	Total length, total weight, sexual maturity, otoliths since 2004 for ICES Divisions VIId and Ivc. Total length, otoliths since end 2006 for ICES Divisions VIIIa,b.
Length distribution data	Length frequency data from market sampled individuals from ICES Divisions VIId and Ivc are regularly available since 2003. Length frequency data from market sampled individuals from ICES Divisions VIId and Ivc are regularly available since end 2006.
Commercial landings	Commercial landings and effort data for 1982 – 2006

Table 5.5.2. Biological sampling in France.

			LENGTH		AGE		MATURITY		INDIVIDUAL WEIGHT	
YEAR	LANDINGS VIID (T)	LANDINGS IV (T)	FISH NUMBER	SAMPLE NUMBER	FISH NUMBER	SAMPLE NUMBER	FISH NUMBER	SAMPLE NUMBER	FISH NUMBER	SAMPLE NUMBER
1985	128.65	16.25	-	-	-	-	-	-	-	-
1986	77.45	9.81	-	-	-	-	-	-	-	-
1987	31.37	5.33	-	-	-	-	-	-	-	-
1988	41.43	3.49	-	-	-	-	-	-	-	-
1989	37.99	3.86	-	-	-	-	-	-	-	-
1990	372.22	33.91	-	-	-	-	-	-	-	-
1991	202.93	23.96	-	-	-	-	-	-	-	-
1992	403.30	27.72	-	-	-	-	-	-	-	-
1993	479.45	60.66	-	-	-	-	-	-	-	-
1994	300.47	54.93	181	23	-	-	-	-	-	-
1995	1976.37	521.52	246	32	-	-	-	-	-	-
1996	1745.16	254.64	-	-	-	-	-	-	-	-
1997	693.96	126.37	-	-	-	-	-	-	-	-
1998	2652.38	367.34	-	-	-	-	-	-	-	-
1999	1038.87	211.10	-	-	-	-	-	-	-	-
2000	2354.54	582.04	-	-	-	-	-	-	-	-
2001	1185.47	353.56	-	-	-	-	-	-	-	-
2002	1151.89	290.88	65	9	-	-	-	-	-	-
2003	1282.89	342.66	147	17	-	-	-	-	-	-
2004	3685.74	500.42	142	17	372	12	620	12	1401	12
2005	2154	645	536	10	301	3	196	3	301	3
2006	?	?	1941	10	646	4	646	4	646	4

Table 5.5.3. Striped red mullet maturity ogive in 2004 to the Eastern English Channel and the south of the North Sea.

AGE	1	2	3	4	5	6	7
%Mature	54.17	65.47	100	100	100	100	100

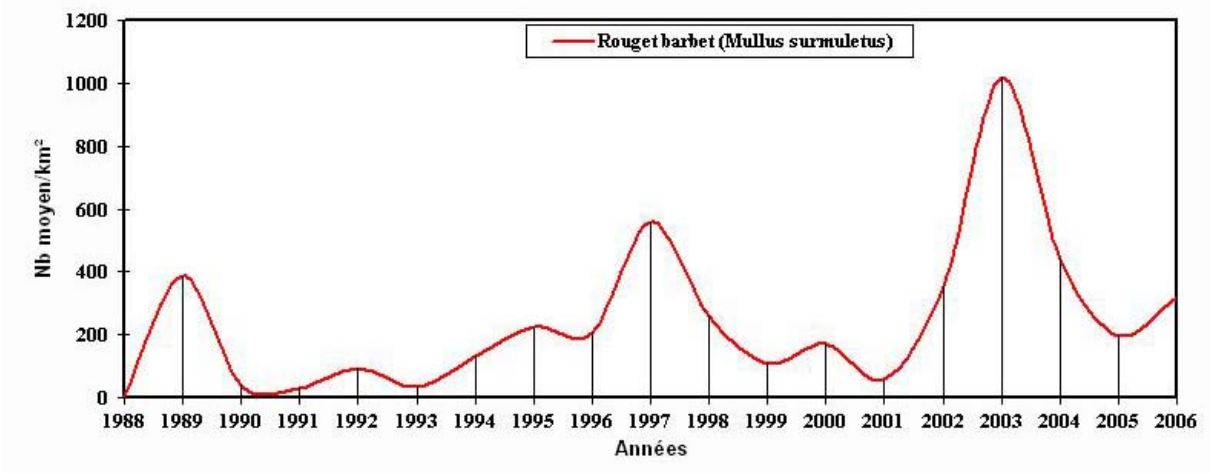

Figure 5.4.1. Time series of abundance of striped red mullet in the eastern Channel base on CGFS data (Nb/km²) from 1988 to 2006.

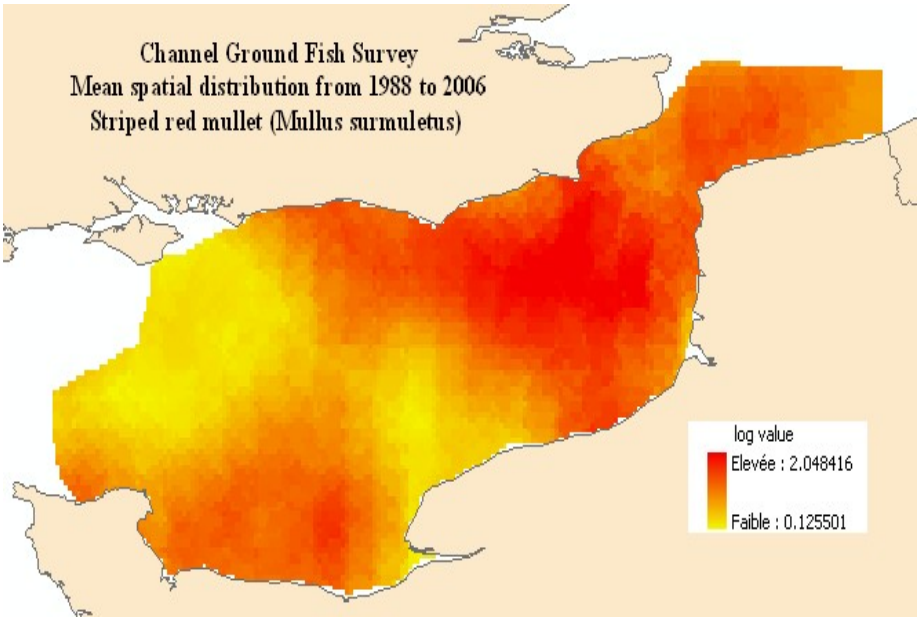

Figure 5.4.2. Mean spatial distribution of striped red mullet in the eastern Channel based on CGFS data (Nb/km²) from 1988 to 2006.

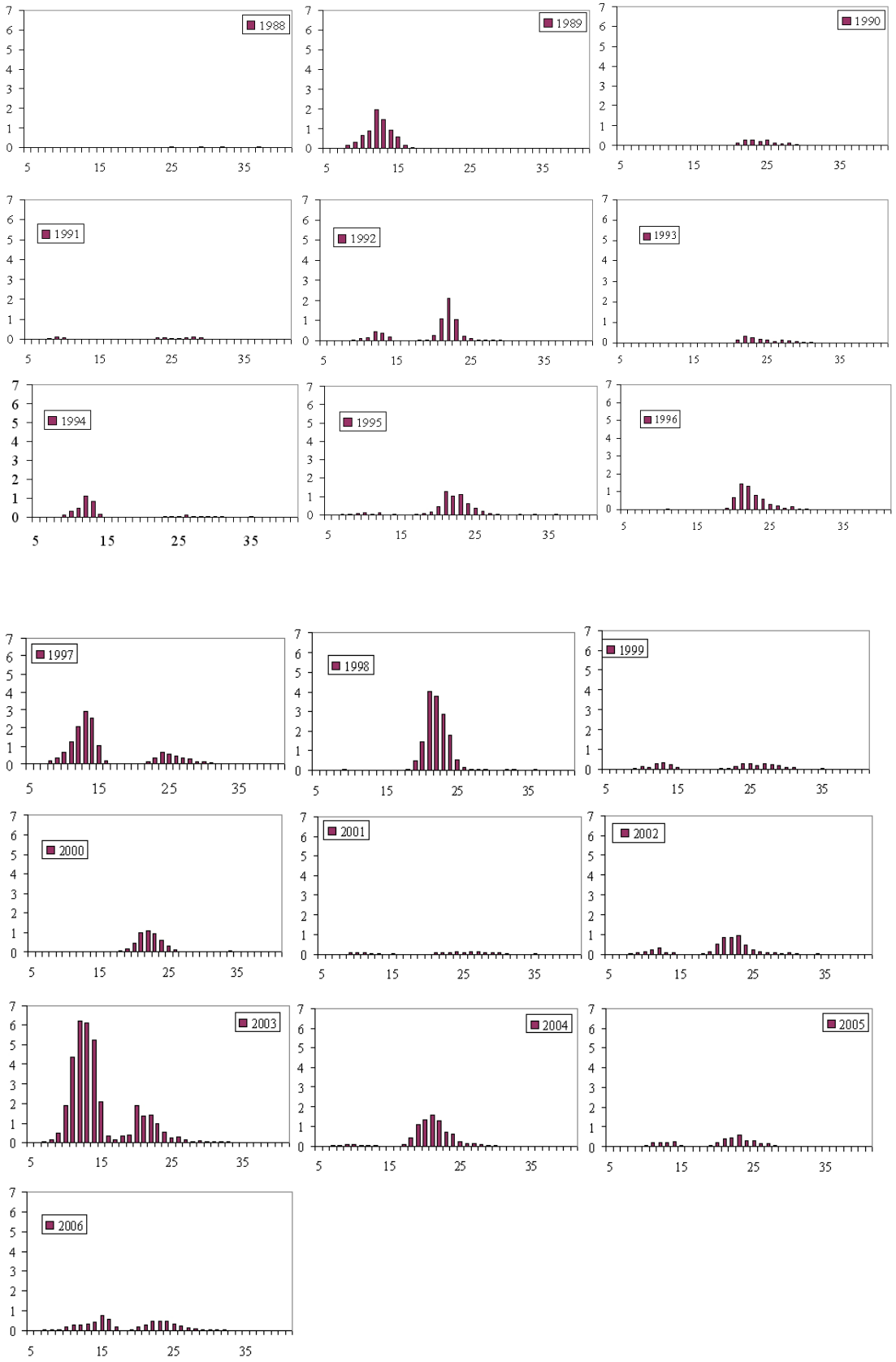

Figure 5.4.2. Abundance indices (Nb/30 min Trawl) of striped red mullet per size class (Length, cm.) during CGFS from 1988 to 2006.

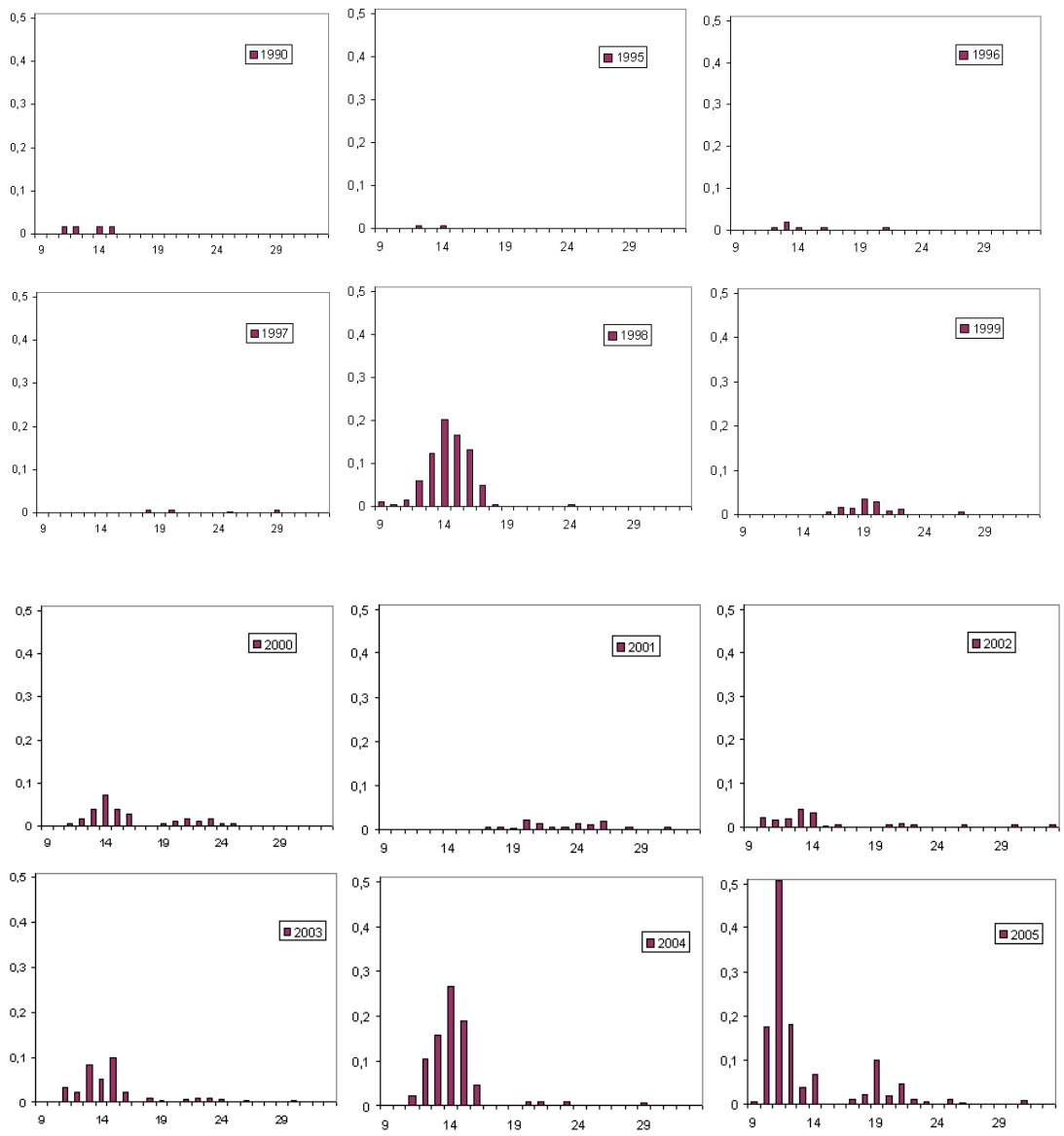

Figure 5.4.3. Abundance indices (Nb/30 min Trawl) of striped red mullet per size class (Length, cm) during IBTS (Q1, all countries) from 1990 to 2005.

6 Red gurnard

6.1 General biology

Red gurnard (*Aspitrigla cuculus* or *Chelidonichthys cuculus*) is widely distributed in the North-East Atlantic from southern Norway and north of the British Isles to Mauritania (Quéro 1984). Hureau (1986) indicates that this species is scarce in the North Sea. Red gurnard is also present in the Mediterranean Sea and off Western Africa to the latitude of the Canary Islands.

This benthic species occurs on grounds between 20 and 250 m. As with other gurnards, red gurnards are able to make audible sounds to help schooling during the spawning period (Wheeler, 1969). In the western Channel (VIIe), concentrations occur close to the Central Deep, limited to 90 m depth (Theret, 1983).

Survey results and commercial fisheries data have shown that the species occurs from the southern North Sea to the Celtic Sea (Anon., 1993). October CGFS surveys by France carried out since 1988 have confirmed that in Division VIId, red gurnards mainly occur in the central area (Carpentier and Coppin, 2000). This species is considered common in autumn as it was present in around 50% of the hauls. It is not found in bays and estuaries (Dauvin, 1988) and also when salinity is below 34°/$_{00}$. Adults are found mainly in the south of Division VIId, off Normandy (Delcour, 1996; Carpentier *et al.*, 1997, Carpentier and Coppin, 2000). This species is usually fished on gravel or coarse sands. On the other hand, results of French IBTS surveys in the North Sea have shown that this species is scarce, with a few fish caught on rocky grounds offshore in Scottish waters (Verin and Dufour, 1999).

Théret (1983) has suggested a spawning area in Division VIIe, between Ouessant Island and the Isle of Wight.

Observations on maturity stages showed that maturing started in December and that the spawning season could start by the end of February and end in June. Quéro (1984) and Hureau (1986) indicated that summer should be the spawning season. Studying all species of gurnards in the Bay of Douarnenez (west of Britany), Baron (1985) indicated that the spawning season is long (6 months) and set a mean birthday at the 1st of March for red gurnard by analogy with grey gurnard but based on a poor sample size. The same author has provided some data on the size at first maturity (L_{50} = 27 cm for males and 28,4 cm for females). The mean size at first maturity could be set at 25 cm in a range of 26–29 cm at 3 years old (Forest, 2001).

There have been no tagging studies of migration.

6.2 Stock identity and possible assessment areas

In the English Channel, a stock structure within Divisions VIId and VIIe has not been established and Dunn *et al.* (1996) recommended not to aggregate biological parameters from the two divisions.

Data available are not sufficient to decide on stock identity for red gurnard from the southern North Sea, the English Channel and Celtic Sea, though data from IVc and VIId, e were aggregated because fish are present all through the year in these divisions (Forest, 2001).

6.3 Fisheries data

6.3.1 Historical landings

Available ICES statistics show that gurnards are not always distinguished by species and data for Triglidae also occurred. Table 6.1 shows the landings by country and areas for red gurnard: the series starts in 1977 and shows a lack of data in 1999. In Division VIIa, landings have fluctuated at less than 100 t. France seemed the main contributor to international

landings except in area VIII, but Spanish data were not available. The bulk of the landings come from Divisions VIId,e at around 4000 t. Landings in VIIf–k leveled at around 500 t. In VIII, landings fluctuated at around 200 t since the beginning of the 1990s.

French data from the fish markets network (RIC) showed that total landings of gurnards were above 10 000 t from 1999 to 2002 and dropped to around 6000 t since then. Over the same period, landings from total logbooks available indicated that they have remained at a level of around 5000 t (Table 6.2). At the time of the WG meeting, these discrepancies had not been explained.

The Working Group decided not to use the official statistics available at ICES. The data by country available to the Working Group should be aggregated and checked during the inter session by the co-ordinator for this species.

Based on French data available from the fish markets network, the main species of gurnards landed in France have been red gurnard and tub gurnards (Figure 6.1).

A small series 1988–2004 is available for France in Divisions IVc, VIIa, VIId, VIIe and VIIf-k and Sub-area VIII using a data series published in Forest (2001) and recent data from 1999 (Table 6.3 and Figure 6.2). Landings have mainly been from VIId+VIIe+ VIIf-k. Detailed data from the Celtic Sea have shown that landings are mainly from Division VIIh. In Division IVc, after the highest value in 1988, landings have remained at a low level, fluctuating between 50 and 120 t. In Division VIId, landings fluctuated around 1200 t in the period 1989–1996, declined to 670 t in 2003, and increased to the maximum of the series in 2004 (1400 t). Over the time series, French landings from VIIe have increased with fluctuations to 2700 t in 2004. In VIIf–k, there has been an increasing trend up to 1000 t in 2004. In Subarea VIII the production has been marginal, fluctuating between 40 and 130 t.

For UK (E+W) and Spain, landings reported by ICES Divisions are mainly available for all species of gurnards combined and not specifically for red gurnard.

6.3.2 Discards

In France, discarding occurs in several metiers in the western Channel (Morizur *et al.*, 1996).

- Gillnet with small meshes set inshore and targeting crayfish, monkfish, sole and hake for a minor part,
- Gillnet with large meshes targeting crabs have shown limited discarding of red gurnard in winter,
- Red gurnard from coastal otter trawlers is more discarded in the western part of the area than in the eastern part where gurnards are used for baiting crabs pots,
- Offshore otter trawlers have been discarding around 50% of red gurnard catches when they fished in the north of VIIe and on the Smalls grounds and Bristol Channel (VIIf,g).

In Figure 6.3a&b observations carried out under the DCR are summarized of catches from French bottom trawlers in 2005 and 2006. Except in VIId&e, red gurnards are almost all discarded. One can note that in VIIe in 2006, only one haul has been sampled and the discarded part of the catch has probably not been measured.

6.3.3 Catch and effort data by sea area and country

The most important French fishery is in the Eastern Channel where the market for gurnards is well established for gurnards. The main metier is offshore otter trawl (single trawl) and target species are gadoids, mackerel, plaice and gurnards. In the 1990s, this metier landed around 80% of the international landings of red gurnard from Division VIIe. Boulogne sur mer, Port en Bessin and Cherbourg still are the main fish markets for red gurnard (Forest, 2001). In

recent years, following the decrease of the quotas for cod and whiting and the extending area of red mullet and squid to the North Sea, the group of targeted species has changed and is now composed of red mullet, squid, lemon sole and red gurnard.

In the 1990s in Division VIIe, the main metier was also offshore otter trawl targeting red gurnard, mainly landing in Port en Bessin, Cherbourg and harbours of North Brittany.

Using French logbooks, in 2003, 99% of red gurnard landings were by single otter trawlers in VIId–e. In the same year, 85% of landings in VIIa,f–j were by single otter trawlers and 14% by twin trawlers. Landings from Division VIIk have always been very low.

Dunn (1996 *et al.*) indicated that catches of gurnards (mixed species) in Division VIIe mainly came from otter trawlers and partially by beam trawlers in UK (E+W). In VIId, gurnards were harvested by otter trawlers. A part of the production was directly sold to potters for baiting and might not be recorded. It was also mentioned that red gurnard was poorly represented.

Quarterly lpue in kg/h from French trawlers and cpue from French surveys by ICES rectangle have provided seasonal distribution and abundance indices for red gurnard (Anon., 1993). Mean seasonal variations over the series 1988–1992 showed that red gurnard is abundant in spring in the English Channel but, in summer and autumn, fish seemed to migrate outside or became inaccessible for the fleet. The results are shown in Figure 6.4.

Information from other countries was not available at the time of the Working Group meeting.

Series available

It has been proposed to build a series of catch and effort data in VIId,e with landings by French single otter trawlers (single trawl). As the catch and effort were at a low level in Divisions VIIa and VIIjk, another series has been built for the main area of the Western Approaches, in VIIf–h, starting in 1999 (Figure 6.5).

In VIId,e, fishing effort has shown a slight increase in recent years. In Divisions VII f-h, the same trend has been observed at lower values. One can note that the similar trends in both areas could be a consequence of the input from logbooks. Some fishermen probably describe their catch using the generic term “gurnards” and not by specific species names.

lpue has decreased in Divisions VIId,e at around 7 Kg/h over the short series and increased since 2004. The same trend has been observed in Divisions VIIf-h.

Delcour (1996), in a series 1988–94 in VIId only, has shown that lpue was at a level of 1kg/h for otter trawlers (Figure 6.5). The series in VIId shows that lpue have recently fluctuated at around four times the value of the early 1990s.

6.4 Survey data, recruit series

Multi-annual surveys have been carried out by several countries and could provide an abundance index. The UK Western Channel Grounfish Surveys (UK-WCGFS) are operated in VIIe-h and in the northern part of VIIIa. International Bottom Trawl Surveys (IBTS) cover the North Sea. French Channel Groundfish Surveys (FR-CGFS) cover Division VIId and French “Evaluation Halieutique à l’Ouest de l’Europe” (FR-EVHOE) surveys cover the Bay of Biscay and the Celtic Sea out to 11°W. None of them is especially designed to target gurnards, but data available could provide long time series of abundance and length distributions.

From the 1997–2004 autumn FR-EVHOE surveys, higher abundance is observed west of Brittany up to almost 9°W (Figure 6.7). In the same way, results from FR CGFS surveys from 1988 to 1999 shown in Figure 6.8 have indicated that higher abundance occurred in the central area along a southwest- northeast axis between Cotentin (FR) and Kent (UK).

Annual length distributions are available from EVHOE surveys for Bay of Biscay and Celtic Sea since 1997 (Figure 6.10a&b). These length distributions are strata-area weighed mean numbers per 30 min. haul. In the Bay of Biscay, very low abundance was observed in 1999 and 2000. In the Celtic Sea, abundance was higher between 2001 and 2005.

Age distributions from FR CGFS surveys 1988–2000 show that recruitment (ages 0 and 1) is highly variable. In later years, ageing has not been carried out but length distributions are available (1988–2006). An index of the ratio total number/ number per 30 min haul is shown in Figure 6.8. In 1994, the higher value at modal length suggests that fish of age 1 dominated the catches (length range of age 1 is 15–30 cm) and year class 1993 could be the strongest of the series. Also the 1996 year-class seemed a strong year class. All results are shown in Figure 6.10 and 6.11.

6.5 Biological sampling

There is a lack of regular sampling data for red gurnard both in commercial landings and discards to provide series of length or age compositions that could be used for an assessment. For surveys, length data are available. Sampling should be established in areas where the species is most abundant (VIId,e and VIIf-h).

For Division VIId, quarterly length data have been collected from French landings for the period 1995–1998 (Coppin, 1998). An example of length compositions in quarter 2 1995 is shown in Figure 6.12. Modal length was at 29 cm and the size range was 19–44 cm.

From 1988 to 2000, otoliths were sampled during FR CGFS surveys and used to produce age/length keys. A preliminary observation is that fish of age 0 had a length of 7-19 cm and age 1 a length of 15–30 cm.

6.6 Population biological parameters and other research

Growth parameters available from several authors are summarized in Table 6.4. They vary considerably and an update should be made for the main exploited areas. Maximum length is lower for males.

Available length-weight relationships are shown in Table 6.5 but these should also be updated.

A maturity ogive is not available, but a knife-edge maturity at age 3 is assumed.

Natural mortality has not been estimated in the North East Atlantic.

Results of FR-CGFS surveys in the Eastern Channel have suggested that recruitment is highly variable.

6.7 Analyses of stock trends

Based on length abundance indices of the FR-CGFS surveys, the population in VIId has fluctuated at higher values up to 1997. After the lowest value observed in 1998, indices have shown an increasing trend with fluctuations.

In the Celtic Sea, length abundance indices from FR-EVHOE surveys have remained at lower values up to 2000 and then they peaked in 2004. In the last three years, the trend in the Celtic Sea is the opposite of the trend observed in the Eastern Channel.

In the Bay of Biscay, indices from FR-EVHOE surveys have fluctuated at values around six times lower than those of Celtic Sea.

6.8 Conclusions

Red gurnard is mainly caught in a mixed fishery by otter trawlers using a single bottom trawl.

There are uncertainties in landings data for several countries and red gurnard has been landed mixed with other gurnards in UK (E+W) and Spain. Discard data in recent years have shown that except in VIId,e most of the catch is discarded. Recent changes in fisheries strategies in line with more restrictive quota for gadoids (cod and whiting) and flatfish could have modified discarding in the different metiers. France lands most red gurnard.

French landings are mainly from the western English Channel (Division VIIe) and are more than 2000 t since 1997.

No country has a regular sampling programme for length and age of this species. In the DCR no level of sampling has been defined for this species. Developing a sampling strategy for this species should be part of a pilot project of sampling for New MoU species.

There is a lack of information on biological parameters.

Last year, a pragmatic approach led to propose a management area for Divisions IVc, VIId-h. The preliminary analysis of the survey data available this year has shown opposite trends in recent years and suggests to disconnect the Eastern Channel (VIId) and the Celtic Sea (7f–h) populations but the data for 1998–2000 show a lower abundance in both areas. In Division VIIe, there are no survey data available yet to provide information on the area where the bulk of the landings has been harvested.

6.9 Reference

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Table 6.1. Total landings in tonnes of red gurnard (*Aspitriga cuculus* of syn. *Chelidonichthys cuculus*) by main areas as reported at ICES.

UK										
Total	184	29	53	24	0	78	135	74	85	40
IV	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Belgium	74	61	107	59	19	11	20	19	14	17
France	77	68	111	136	65	58	81	75	71	75
Netherlands										
UK			7	24	25	30	28	32	42	23
Total	151	129	225	219	109	99	129	126	127	115
IV	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	
Belgium	10	12				42	41	83	33	
France	48	70		54	111	43	59	27	26	
Netherlands				45	1642	51	41	48	44	
UK	6			4	150	217	253	222		
Total	64	82		103	1903	353	394	380	103	
VIIa	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**
Belgium									32	
France	134	58	113	79	0	30	14	21	49	36
Ireland										
Netherlands										
UK										
Total	134	58	113	79	0	30	14	21	81	36
VIIa	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Belgium	20	13	9	12	5	12	15	16	15	26
France	30	15	13	14	50	23	10	8	4	5
Ireland							8			
Netherlands										
UK			2	2	4	3	2	2	3	2
Total	50	28	24	28	59	38	35	26	22	33
VIIa	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	
Belgium	23	21				22	24	8	11	
France	5	2		6	15	12	2		2	
Ireland		10								
Netherlands				1						
UK	2				3	5	12	11		
Total	30	33	0	7	18	39	38	19	13	
VIId-e	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**
Belgium									83	
France	4731	1338	3289	1881	0	2586	3718	2115	2506	3516
Netherlands										
UK							10	5	6	5
Total	4731	1338	3289	1881	0	2586	3728	2120	2595	3521
VIId-e	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Belgium	75	102	110	78	74	104	68	73	72	85
France	3214	3161	2856	2773	3404	3482	3337	3321	3438	3693
Netherlands										
UK	3		3	3		7			6	10
Total	3292	3263	2969	2854	3478	3593	3405	3394	3516	3788
VIId-e	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	
Belgium	74	100				104	186	178	188	
France	3792	3303		3299	3694	4151	3816	2541	3990	
Netherlands					65	2	4	14	16	
UK	8	6	10			15				
Total	3874	3409	10	3299	3759	4272	4006	2733	4194	

Table 6.1. Continued.

VIIf-k	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Belgium									29	
France	1169	430	919	704	0	538	557	187	406	506
Ireland										
UK										
Total	1169	430	919	704	0	538	557	187	435	506

VIIf-k	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	31	21	21	18	11	13	9	9	13	14
France	454	488	413	363	420	390	364	413	451	476
Ireland				8	12	19	3			
UK				1						
Total	485	509	434	390	443	422	376	422	464	490

VIIf-k	1997	1998	1999	2000	2001	2002	2003	2004	2005	
Belgium	18	23				14	24	46	48	
France	482	549		651	719	640	675	916	840	
Ireland		8								
UK	1				20	7	15	1		
Total	501	580		651	739	661	714	963	888	

VIII	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Belgium										
France	237	39	289	106	0	80	183	413	211	241
Netherlands										
UK										
Total	237	39	289	106	0	80	183	413	211	241

VIII	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	2		2			1	2	1	2	3
France	332	274	236	206	189	190	153	224	165	174
Netherlands										
UK										
Total	334	274	238	206	189	191	155	225	167	177

VIII	1997	1998	1999	2000	2001	2002	2003	2004	2005	
Belgium	2	1						2	2	
France	176	191	0	143	141	152	196	169	198	
Netherlands					3					
UK								8		
Total	178	192	0	143	144	152	196	179	200	

Table 6.2. Gurnards (all species). Landings in France from Fishmarkets network (RIC) and logbooks in t.

Year	RIC	Logbooks
1999	10980	4573
2000	11610	5032
2001	12340	5297
2002	14130	5535
2003	6491	5574
2004	6592	5813
2005	7909	6742
2006*	4905	4025

*** up to October 2006.**

Table 6.3. France. Landings of red gurnard in t live weight. Only from logbooks from 1999.

Year	IVc	VIId	VIIe	VIIf-k	VIII
1988	57	720	1848	480	206
1989	124	1166	1615	423	193
1990	136	1394	1347	442	208
1991	70	1295	2073	524	192
1992	56	1358	1748	395	210
1993	82	1132	1690	363	159
1994	76	1122	1561	386	217
1995	71	1235	1580	444	169
1996	76	1417	1625	470	181
1997	49	944	2303	474	177
1998	49	1047	2284	506	162
1999	44	721	2370	324	46
2000	46	598	2353	619	74
2001	95	804	2467	692	43
2002	36	853	2822	624	39
2003	34	843	2728	669	72
2004	26	853	2605	922	88
2005	25	867	3387	956	162
2006*	7	601	2059	531	129

* up to October 2006

Table 6.4. Growth parameters of red gurnard in the English Channel.

AUTHORS	AREA	SEX	NB	L_∞	K (Y^{-1})	T_0 (YEARS)
Baron (1983)	Manche + mer du Nord	M	118	37,1	0,51	-0,08
		F	232	41,7	0,46	-0,05
Dunn *et al.* (1996)	VIId	M	213	35.75	0,232	-3,37
	VIId	F	531	41,05	0,248	-2,57
	VIIe	F	147	NS	0,137	-2,09
Carpentier 1995	VIId ?	M+F	187	36,75	0,597	0,180
Id 1996			94	37,97	0,622	0,149
Id 1997			90	36,67	0,645	0,185
Id 1998			107	36,18	0,613	0,048
Id 1999			122	36,02	0,511	-0,277
Mean 1995-2000			704	36,34	0,543	-0,17

Table 6.5. Length-weight relationships available for red gurnard in English (W = aL^b, W live weight in g and L in cm).

AUTHOR	AREA	MONTH	SEX	NUMBER	A	B
Théret, 1983	English Channel	September	M	31	$1,13.10^{-3}$	3,3854
			F	80	$4,50.10^{-3}$	3,14027
		November	M	33	$3,65.10^{-3}$	3,16261
			F	33	$2,94.10^{-3}$	3,20117
		Décember	M	55	$1,51.10^{-3}$	3,32967
			F	144	$1,05.10^{-3}$	3,38984
		January	M	112	$0,98.10^{-3}$	3,39763
			F	120	$2,19.10^{-3}$	3,25648
		February	M	31	$0,73.10^{-3}$	3,44558
			F	82	$0,88.10^{-3}$	3,41197
Dorel, 1986	idem		M + F	593	$5,61.10^{-3}$	3,16882

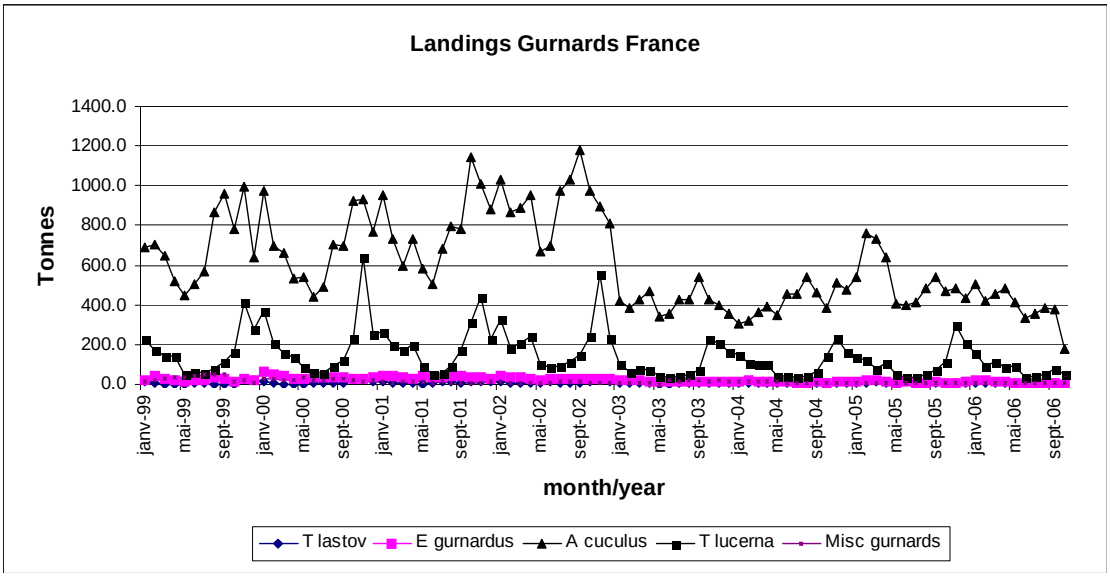

Figure 6.1. France. Seasonnal landings by species from fishmarkets network (RIC).

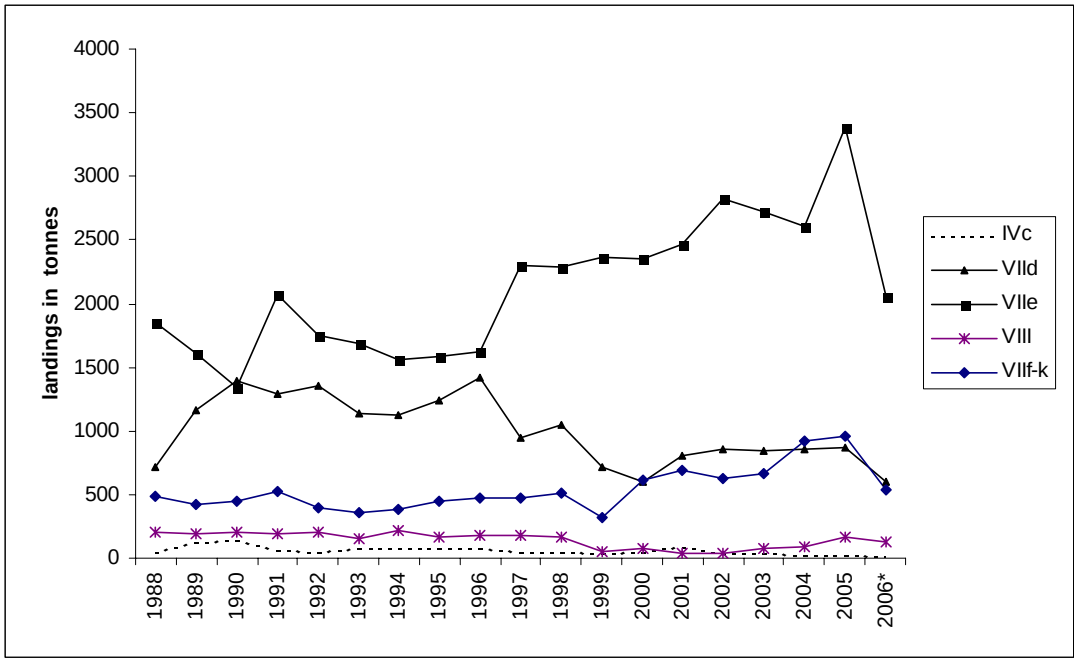

Figure 6.2. France. Trends of landings of red gurnard. Only from logbooks since 1999.

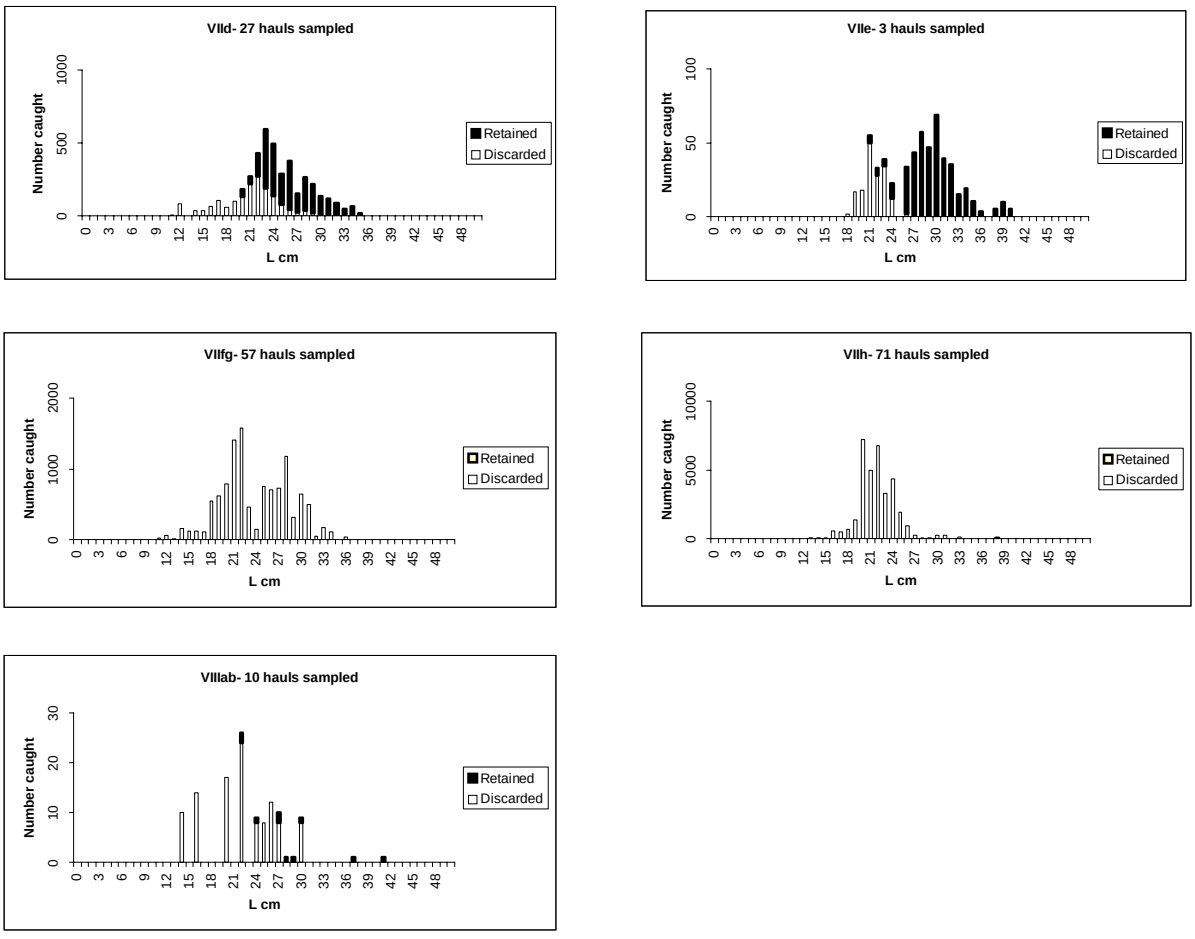

Figure 6.3a. 2005 Length composition of French catches from bottom trawl hauls sampled.

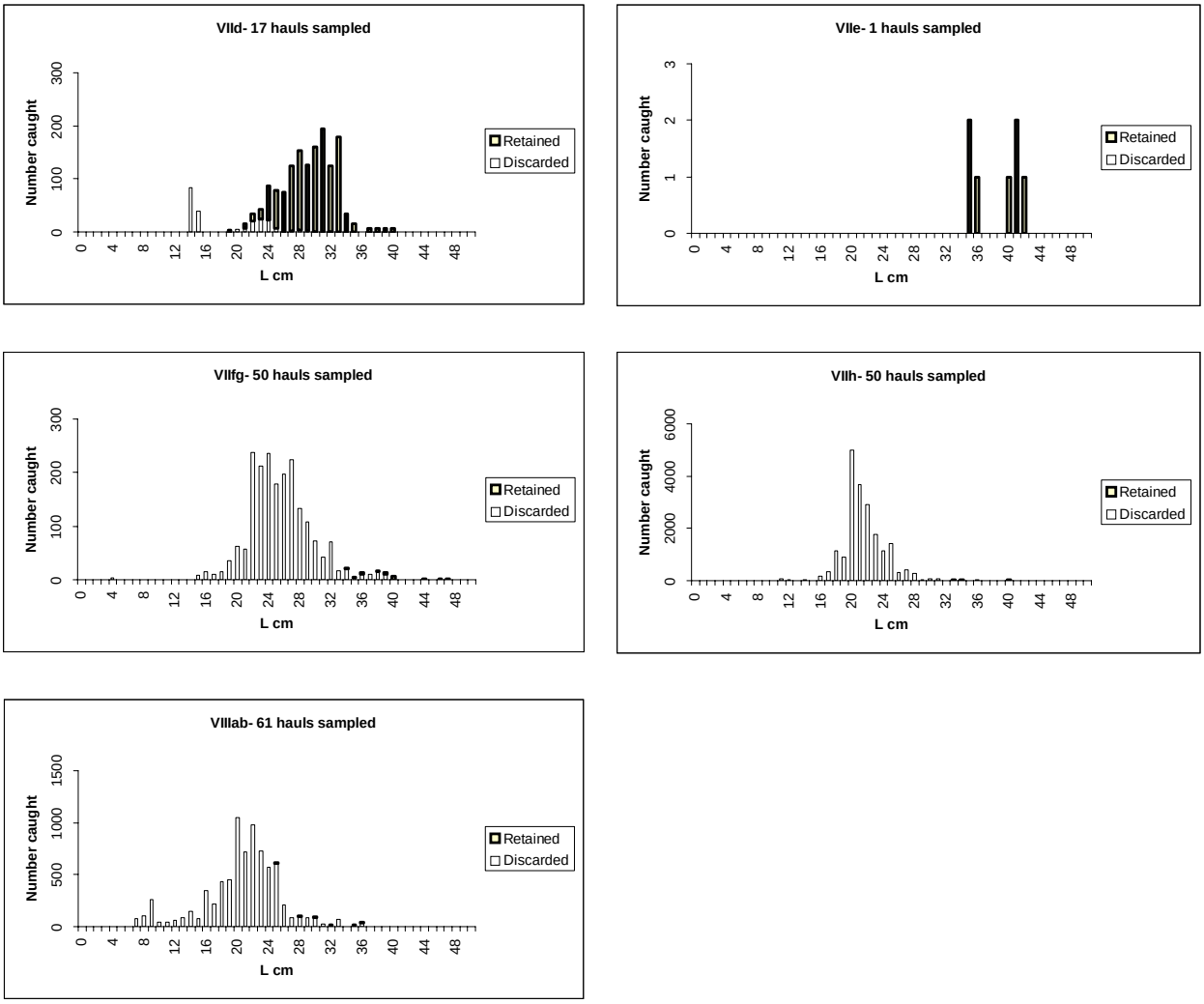

Figure 6.3b. 2006 Length composition of French catches from bottom trawl hauls sampled.

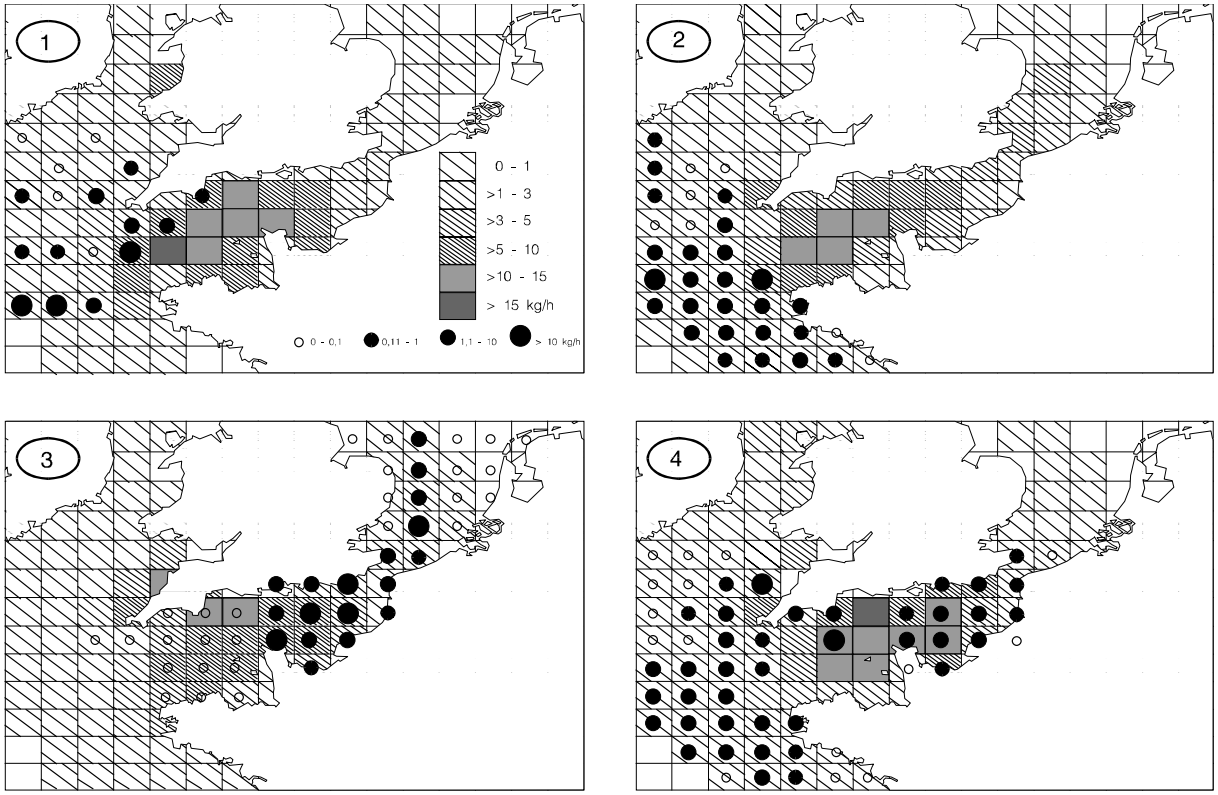

Figure 6.4. Quarterly landings of red gurnard in English Channel and neighbouring areas. cpue in Kg/h from surveys are given as superimposed circles.

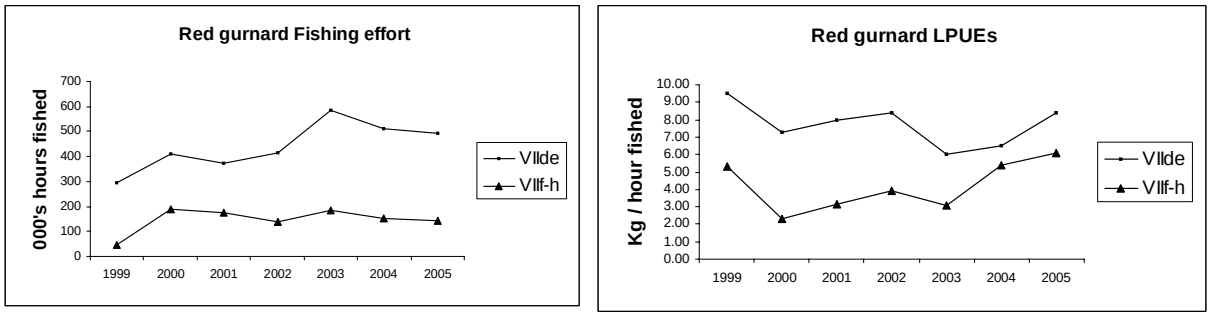

Figure 6.5. Red Gurnard. Trends of fishing effort (000's hours fished) and lpue (kg/h) of French otter trawlers (single trawl) in areas VIId, e and VIIf–h.

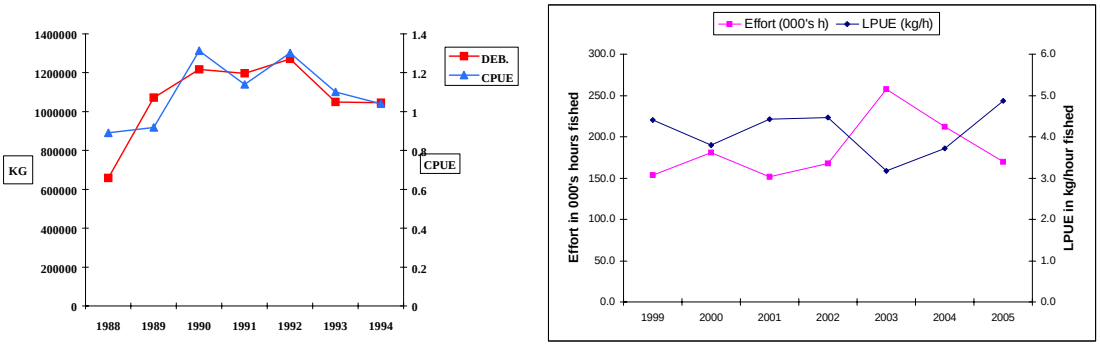

Figure 6.6. France. Trends of lpue in VIId for otter trawlers (single trawl) from Delcour (1996) for years 1988–94 and current estimates for years 1999–2005

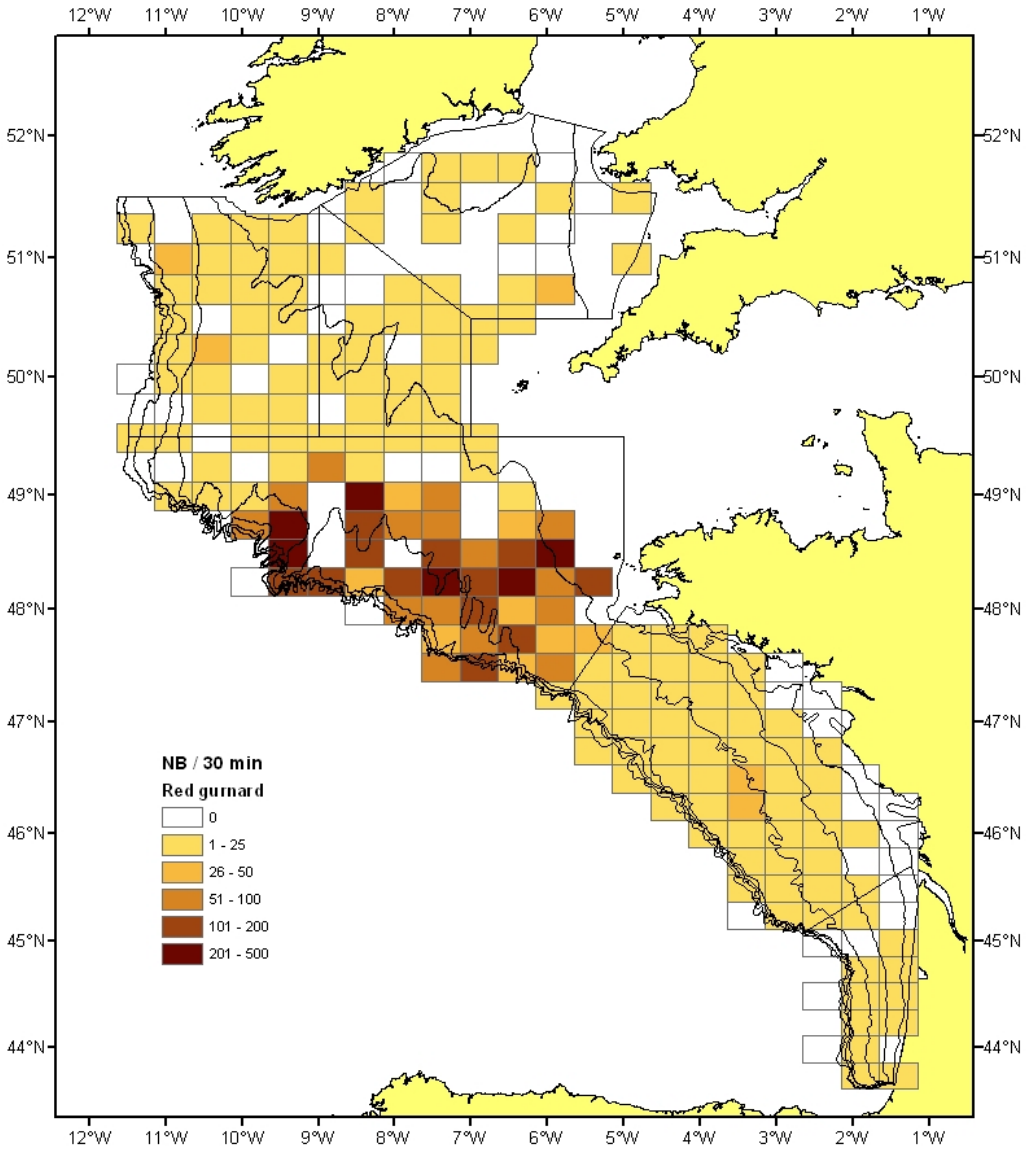

Figure 6.7. Mean abundance of red gurnard over the series 1997–2004 of FR EVHOE survey (autumn).

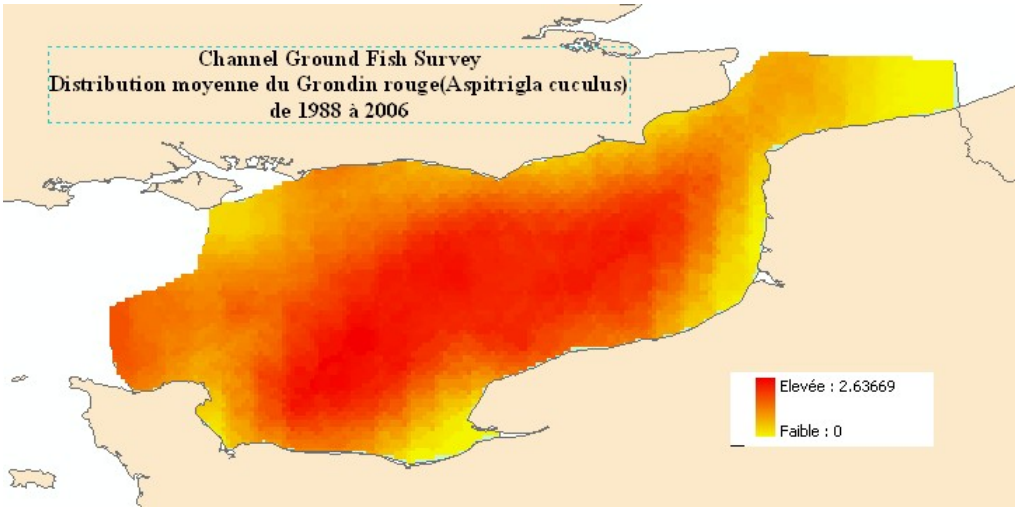

Figure 6.8. FR CGFS surveys series. Geographical distribution of red gurnard in Eastern Channel in October from 1988 to 2006

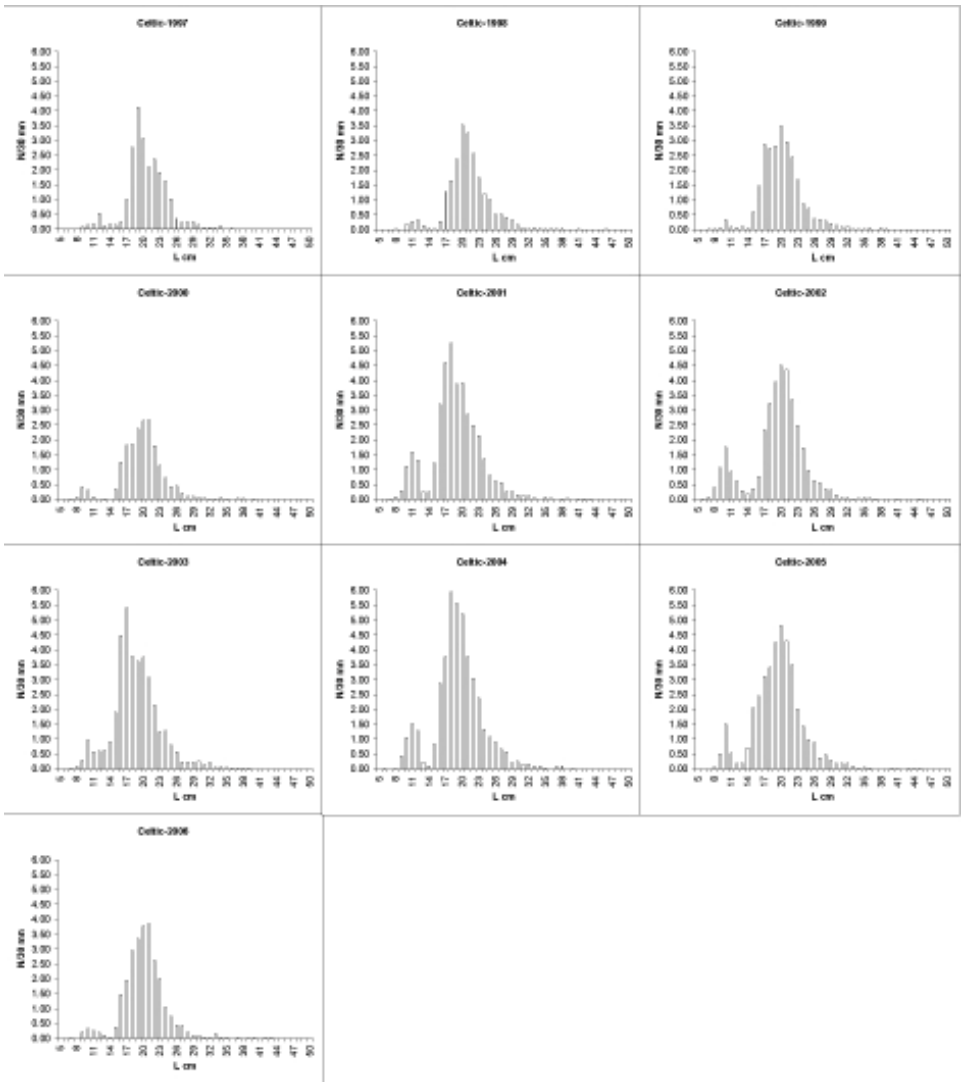

Figure 6.9a. Length abundance index in Celtic Sea from EVHOE surveys series

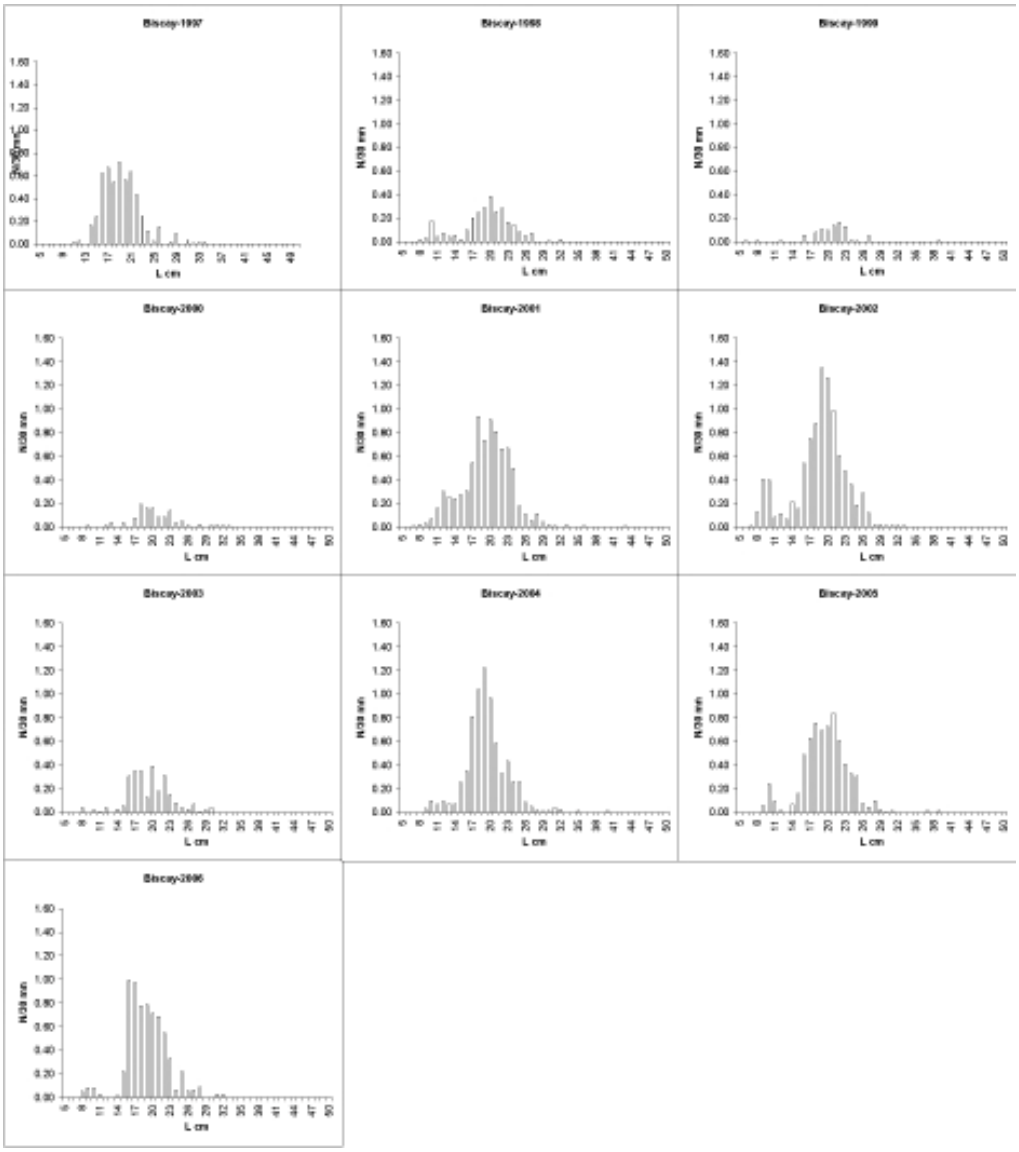

Figure 6.9b. Length abundance index in Bay of Biscay from EVHOE surveys series.

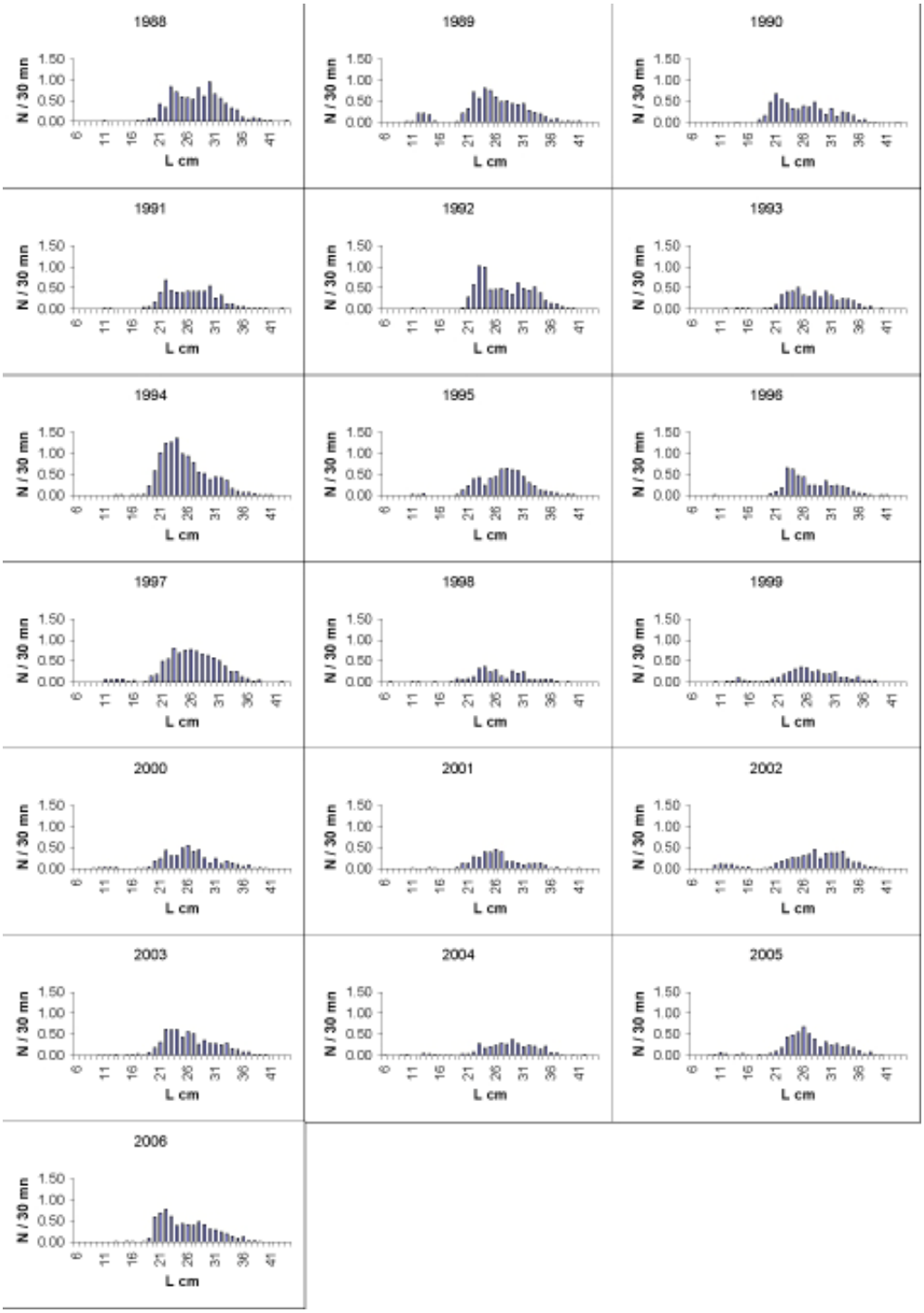

Figure 6.10. Length abundance index in Eastern Channel from CGFS surveys series.

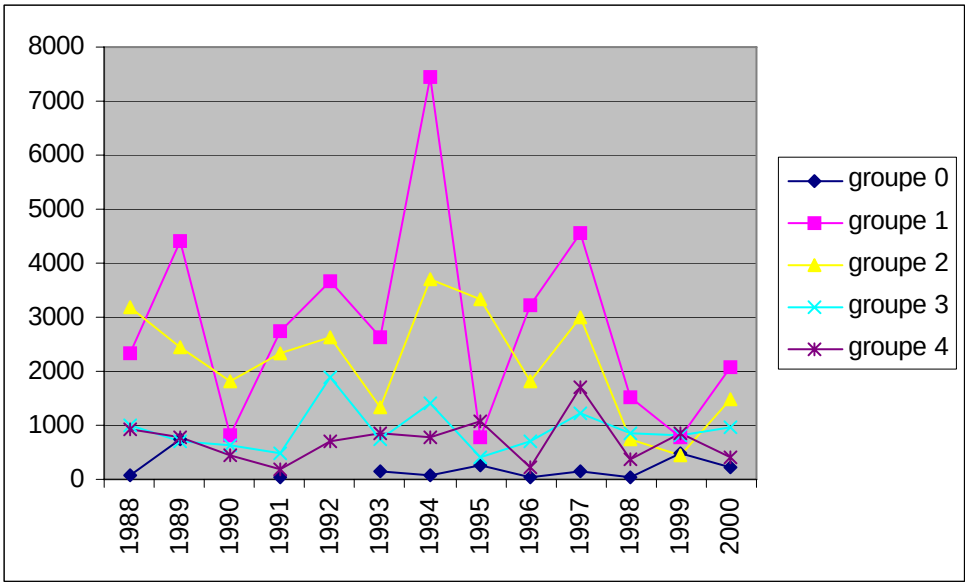

Figure 6.11. Red gurnard. Abundance index per age group from FR CGFS surveys in Division VIId. Numbers per km^2

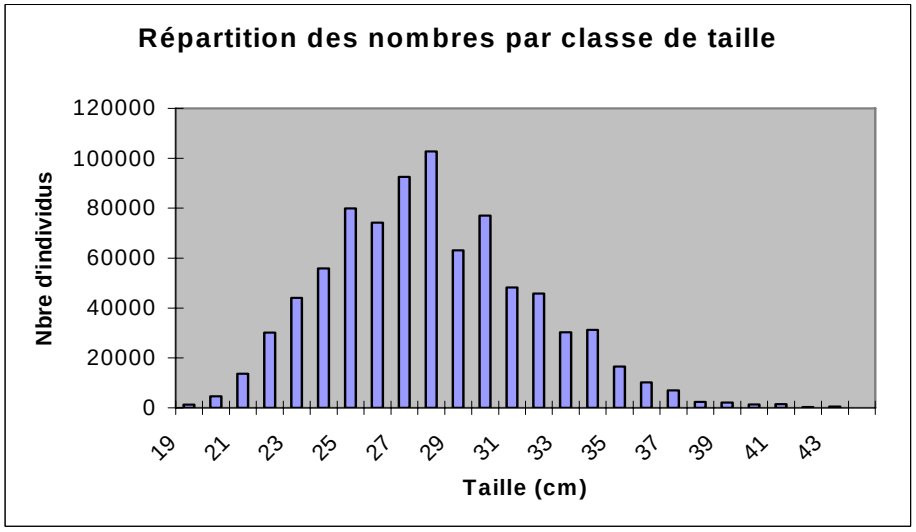

Figure 6.12 Length composition of landings of red gurnard by French trawlers in Division VIId (quarter 2 1995).

7 Tub gurnard

7.1 General biology

Tub gurnard *Trigla lucerna* or *Chelidonichthys lucernus* is a benthic species which occurs in the Eastern Atlantic from Norway to Senegal, in the Mediterranean Sea and also in South Africa (Quero, 1984).

Tub gurnard is relatively abundant in inshore waters of 20–150 m, extending in decreasing numbers to 200 m. Small specimens are frequent in shallow water from 2–20 m. Tub gurnard lives occasionally solitarily, more often in small schools, on mud and muddy-sand bottoms (Wheeler, 1978). It lives up to 300m from the shore and maximum concentrations are located between 50 and 150m away (Quero, 1984).

In summer, tub gurnard occur in inshore waters on sand, muddy sand and gravel grounds. It can occur also in estuaries (Gironde). In winter, it migrates to depths of more than 80 m. Juveniles feed on a variety of small crustaceans, mainly copepods at lengths less than 15 cm, mysids, shrimps and amphipods at length less than 25 cm, also crabs for fish between 20 and 30 cm long. The diet of larger specimens consists mainly of small fish and some cephalopods (Quero, 1984).

Spawning takes place from December till February in the Mediterranean Sea and in May-June in the Celtic Sea. Younger fish migrate to coastal waters at the end of summer (Quero, 1984).

The maximum length is 75 cm. There is no minimum landing size.

It is a by-catch species in demersal fisheries.

7.2 Stock identity and possible assessment areas

No studies are known of the stock ID of tub gurnard.

7.3 Fisheries data

7.3.1 Historical landings

Gurnards are often not sorted by species when they are landed. This is reflected in the catch statistics where different species of gurnards are often reported into one generic category of "gurnards". Only some countries sometimes report landings of "tub gurnard" (see Table 7.1 for ICES landings data). France has reported since 1983 and Denmark, the Netherlands and Portugal since 2000. From the table it is obvious that the catch statistics are incomplete for most years but France seems to be the main contributor.

Tub gurnard is either landed for human consumption or fish could also be used for baiting traps used to harvest large crustaceans.

Data for the period 1988–2005 are available for France for Divisions IVc, VIId, VIIe, VIIf-k and VIII (Table 7.2 and Figure 7.1). The main landings are from VIId and these have increased from 1988, peaked in 1993 at 1400 t and fluctuated around 500 t from 1997 to 2002 and have been slightly increasing since then. In the other Divisions of Area VII, landings have fluctuated at less than 200 t. In Area VIII, landings have been very small.

Historically, tub gurnard is mainly taken as a by-catch in mixed demersal fisheries for flatfish and roundfish.

Discards

In France, several metiers entail discarding in the Western Channel (Morizur *et al.*, 1996).

- Gillnet with small meshes set in inshore area targeting crayfish, monkfish, sole and hake for a minor part,
- Gillnet with large meshes targeting crabs discard small amounts of tub gurnard in winter,
- Tub gurnard from coastal otter trawlers is more discarded in the western part of the area than in the eastern part where gurnards are used for baiting pots for crustaceans,
- Offshore otter trawlers have been discarding around 90% of tub and grey gurnard (unfortunately mixed species) catches when they fished on the Smalls grounds and in the Bristol Channel (VIIf, g).

In Figure 7.2 a and b catches from French bottom trawlers in 2005 and 2006 are summarized. In VIId where the mesh size is 80 mm, almost all tub gurnards below 25 cm have been discarded. In the other parts of Area VII where in general a 100 mm mesh size is used, only big fish have been retained, generally well above 30 cm. One can note that in VIIe there was no sampling in these years.

7.3.2 Catch and effort data by sea area and country

Two small series of effort and lpue have been built for French trawlers using single trawls in areas VIId–e and VIIf–h in the period 1999–2005. Results are shown in Figure 7.3.

From 1999, effort has slightly increased with fluctuations in VIId–e up to 2003 and has declined since then. lpue has increased since 2002; the value in 2005 has been around three times the value in 2002.

In Divisions VIIf–h, effort has remained around the mean since 2000 and lpue has increased in recent years.

7.4 Survey data, recruit series

The French CGFS surveys (Channel Ground Fish Survey) carried out in October which has covered the Eastern Channel (VIId) since 1988 has also provided length abundance indices of tub gurnard. These abundance indices are low; the maximum value has been 0.22 fish/30 min. There are no age/length keys available to produce abundance indices at age.

7.5 Biological sampling

Biological sampling of landings of this species is not known except for the Marmara Sea by Turkey. Only observations at sea conducted under DCR for other species could produce some data for tub gurnard when species of gurnards have been identified by species. As cpues of this species have been increasing since 1995 in the North Sea, the IBTS database should be investigated as well as the UK-WCGFS surveys series in Division VIIe.

7.6 Population biological parameters and other research

Growth parameters available are from a small southern part of Division VIIe (Bay of Douarnenez) and have not been updated since 1985 (Baron, 1985). They are shown in Table 7.3 and 7.4.

7.7 Analyses of stock trends

Beare *et al.* (2004), based on a long series of cpues (1925–2003) from FRS surveys, have suggested that in Division IVb, the abundance of southern species (including tub gurnard) has increased over the last decade.

7.8 Conclusion

Hardly any landings data are available from ICES statistics. Landings reported by UK and Spain have usually been for all species of gurnards combined. The main contributor of the landings from the North Sea is the Netherlands (about 1000–1500 t per year) and France for the English Channel (about 900–1600 t per year). Landings from other areas are small.

Tub gurnard is harvested mainly by bottom trawlers.

Preliminary analysis of some French discards data indicates that discarding can be important in some areas (VIId, VIIg, VIIIa-b). Its level is still unknown in VIIe because studies in the past did not identify different gurnard species.

cpues from French landings have shown an increasing trend in recent years but the series are short.

Abundance indices from FR-CGFS survey in VIId generally show a low abundance at the time when the survey is conducted (October). Other series from IBTS in the North Sea and UK-WCGFS in the Western Channel could be made available in the short term. Standardized survey analysis similar to the one provided by R-SUFI presented during this WG could be used to provide trends of some population indicators.

7.9 References

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Beare, D.J., Burns, F., Greig, A., Jones, E. G., Peach, K., Kienzle, M., McKenzie, E., Reid, D. G. 2004 Long-term increases in prevalence of North Sea fishes having southern biogeographic affinities. Mar Ecol Prog Ser, 284: 269–278.

Morizur, Y., Pouvreau, S., and Guénolé, A. 1996. Les rejets dans la pêche artisanale française de Manche occidentale. Editions Ifremer, 127 pp.

Quéro, J. C. 1984. Les poissons de mer des pêches françaises. Jacques Granchet éd., 394 pp.

Wheeler, A. 1978. Key to the fishes of Northern Europe. Frederic Warnes Ltd Publish., London. 211.

Table 7.1. Total landings in tonnes of tub gurnard (*Trigla lucerna* or syn. *Chelidonichthys lucernus*) by main areas as reported at ICES

IV	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Danemark									35	
France			39		37	24	96	122	73	120
Netherlands										
Portugal										
Total	0	0	39	0	37	24	96	122	108	120

IV	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Danemark								9	8	
France	123	205	160	95	55	101		206	134	203
Netherlands								1134		1414
Portugal										
Total	123	205	160	95	55	101	0	1349	142	1617

IV	2003	2004	2005
Danemark			
France	99	83	109
Netherlands	1169	1407	1488
Portugal			
Total	1268	1490	

VIIa	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Danemark										
France									2	
Netherlands										
Portugal										
Total	0	0	0	0	0	0	0	0	2	0

VIIa	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Danemark										
France						1		3	6	10
Netherlands								17		
Portugal										
Total	0	0	0	0	0	1	0	20	6	10

VIIa	2003	2004	2005
Danemark			
France	4	2	3
Netherlands			
Portugal			
Total	4	2	3

VIId-e	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Danemark										
France	152	798	451	86	376	390	705	1437	1123	1275
Netherlands										
Portugal										
Total	152	798	451	86	376	390	705	1437	1123	1275

VIId-e	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Danemark										
France	1594	1368	1271	965	606	729		855	849	908
Netherlands								13		23
Portugal										
Total	1594	1368	1271	965	606	729	0	868	849	931

VIId-e	2003	2004	2005
Danemark			
France	849	802	978
Netherlands	40	58	58
Portugal			
Total	889	860	1036

Table 7.1. Continued.

VIIf-k	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Danemark										
France	16	1	17	23	25	35	23	18	35	41
Netherlands										
Portugal										
Total	16	1	17	23	25	35	23	18	35	41

VIIf-k	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Danemark										
France	33	34	28	52	58	67		101	121	83
Netherlands										
Portugal										
Total	33	34	28	52	58	67	0	101	121	83

VIIf-k	2003	2004	2005
Danemark			
France	95	92	103
Netherlands			
Portugal			
Total	95	92	103

VIII	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Danemark										
France	5	679	138	2	4	5	5	3	3	6
Netherlands										
Portugal										
Total	5	679	138	2	4	5	5	3	3	6

VIII	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Danemark										
France	2	5	3	5	7	7		32	22	24
Netherlands										
Portugal										
Total	2	5	3	5	7	7	0	32	22	24

VIII	2003	2004	2005
Danemark			
France	45	51	48
Netherlands			
Portugal			
Total	45	51	48

IX	1999	2000	2001	2002	2003	2004	2005
Danemark							
France							
Netherlands							
Portugal	3	5	3	8			
Total	3	5	3	8	0	0	0

Table 7.2. Tub gurnard France: Landings in tonnes live weight.

YEAR	IVC	VIID	VIIE	VIIF–K	VIII
1988	24	329	104	36	6
1989	104	619	75	25	6
1990	121	1152	85	47	5
1991	87	987	185	38	4
1992	120	1095	180	42	7
1993	123	1421	173	35	4
1994	205	1248	114	35	6
1995	161	1145	125	30	6
1996	96	780	183	57	6
1997	67	433	179	69	35
1998	101	575	129	73	26
1999	44	446	150	46	2
2000	170	511	167	93	13
2001	104	470	186	110	8
2002	178	476	164	67	7
2003	92	561	211	96	24
2004	79	699	215	96	29
2005	97	697	250	102	40
2006	8	305	208	60	29

***Only from logbooks in series 1999–Oct. 2006**

Table 7.3. Tub gurnard. Growth parameters in the English Channel.

AUTHORS	AREA	SEX	NB	L∞	K	T_0 (YEAR)
Baron (1985)	VIIe	M	217	48.4	0.462	-0.41
		F	239	66.8	0.32	-0.46

Table 7.4. Tub gurnard. Length-weight relationships. W= live weight in g, L in cm.

AUTHORS	AREA	SEX	NB	A	B
Baron (1985)	VIIe	N	?	0.00431	3.21

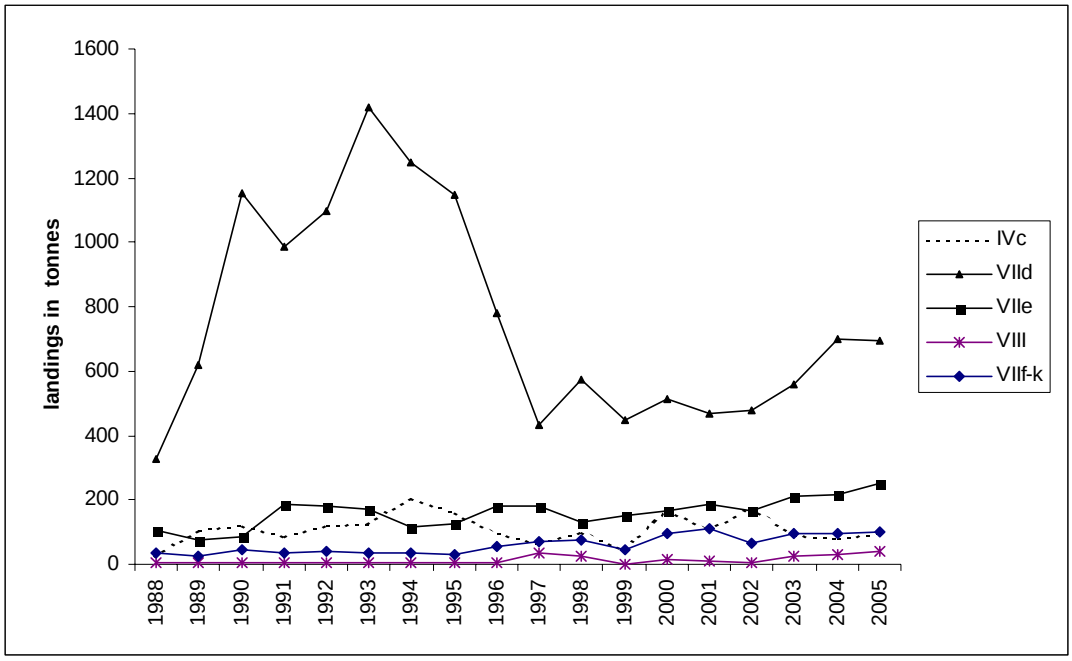
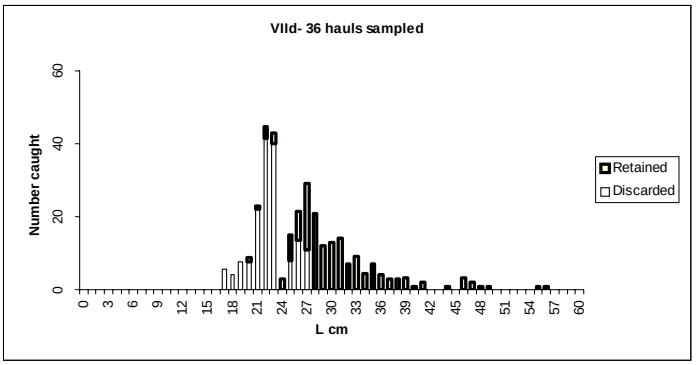
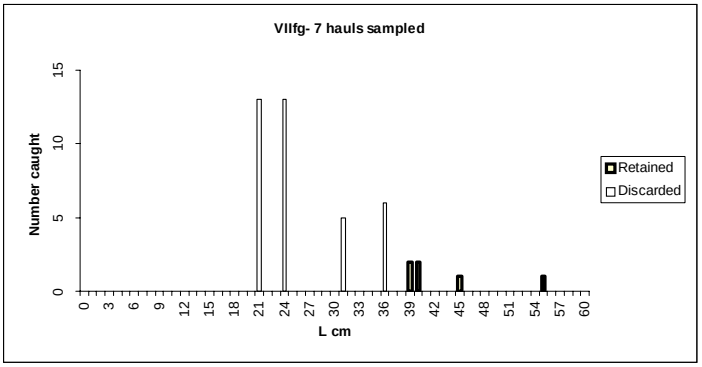
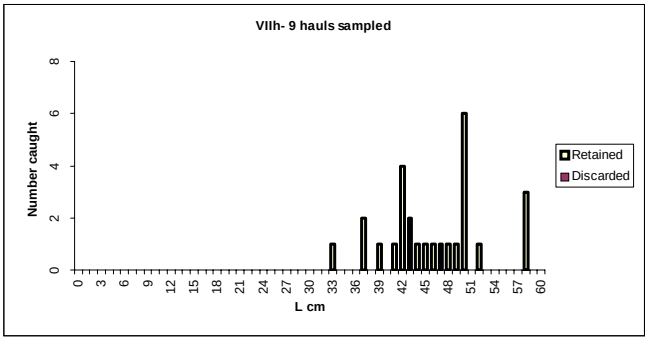


Figure 7.1. Tub gurnard, trends of French landing.







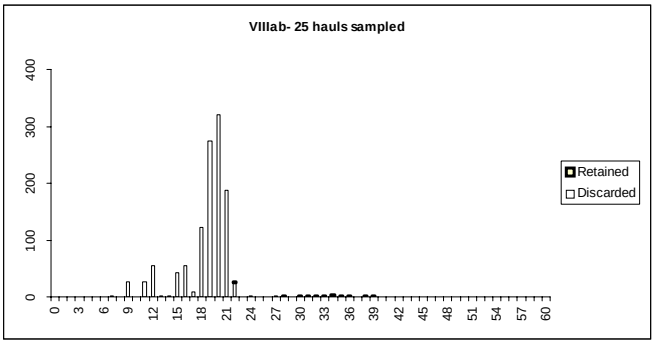


Figure 7.2 a. 2005 Length composition of French catches from bottom trawl hauls sampled.

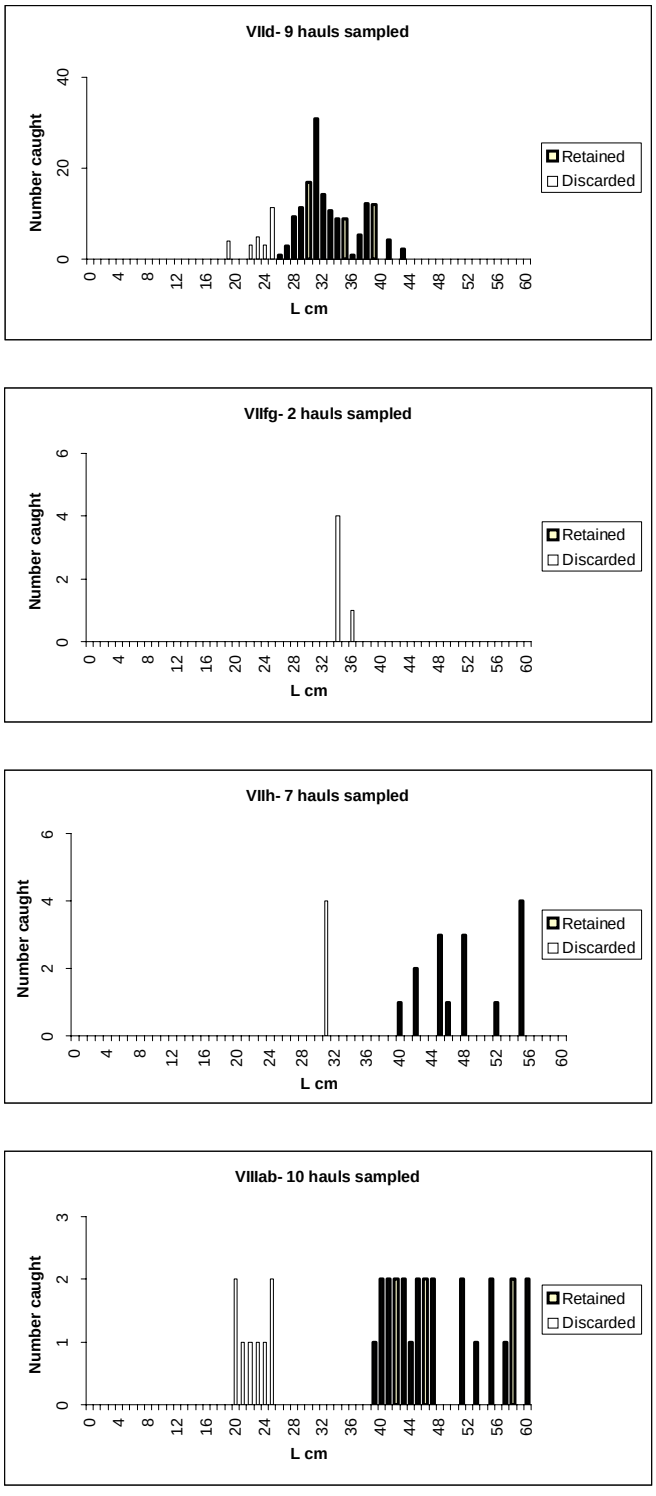


Figure 7.2 b. 2006 Length composition of French catches from bottom trawl hauls sampled.

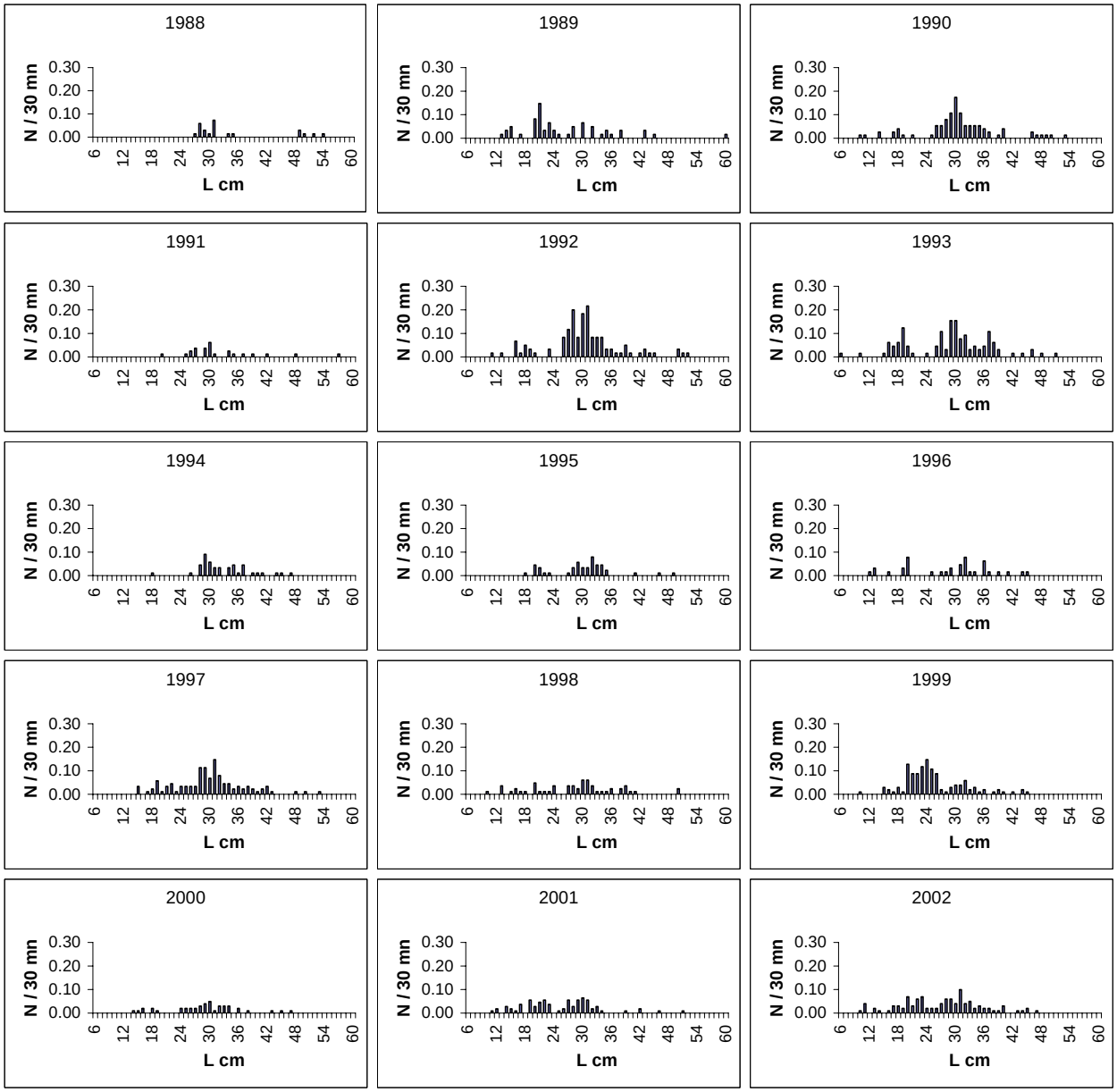


Figure 7.3 a. Length abundance indices of tub gurnard from FR-CGFS surveys in VIId.

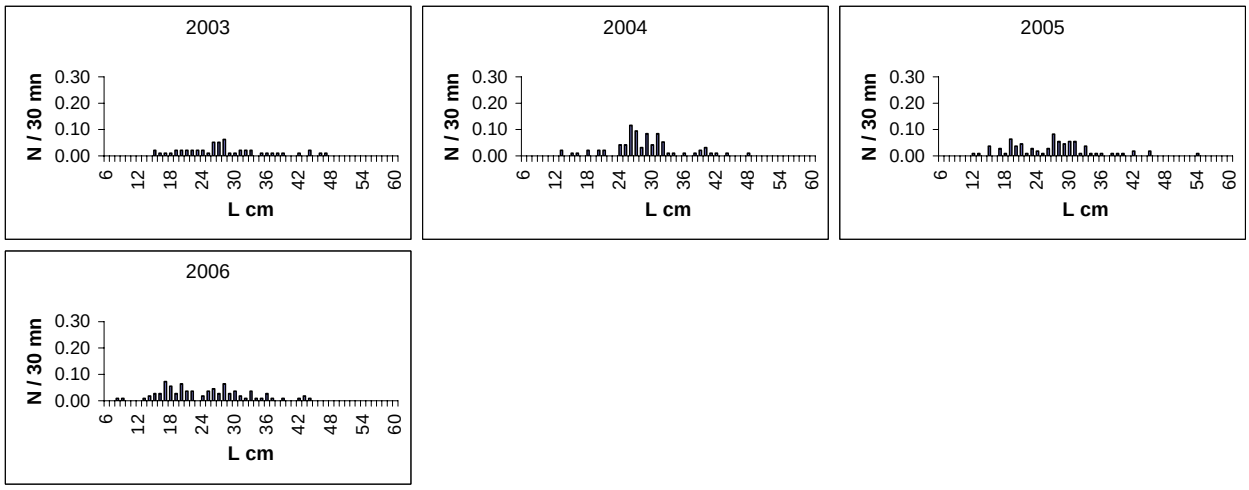


Figure 7.3 b. Length abundance indices of tub gurnard from FR-CGFS surveys in VIId.

8 Grey gurnard

8.1 General biology [1])

Grey gurnard *Eutrigla gurnardus* occurs in the Eastern Atlantic from Iceland, Norway, southern Baltic, and North Sea to southern Morocco, Madeira. It is also found in the Mediterranean and Black Seas.

In the North Sea and in Skagerrak/Kattegat, grey gurnard is an abundant demersal species. In the North Sea, the species may form dense semi-pelagic aggregations in winter to the northwest of the Dogger Bank, in summer it is more widespread. The species is less abundant in the Channel, the Celtic Sea and in the Bay of Biscay.

Grey gurnard is most common on sandy bottoms, but also on mud, shell and rocky bottoms (Wheeler, 1978). Juveniles feed on a variety of small crustaceans. The diet of older specimens consists mainly of larger crustaceans and small fish. Spawning takes place in spring and summer.

The maximum length is 50 cm. There is no minimum landing size.

It is a bycatch species in demersal fisheries. Catches are largely discarded.

8.2 Stock ID

No studies are known of the stock ID of grey gurnard. Based on IBTS survey data Heessen and Daan (1996) suggest that there may be three sub-populations in the North Sea and Skagerrak/Kattegat: one to north-west of the Dogger Bank, one around Shetland and one in the Skagerrak/Kattegat. A more recent distribution map (based on quarter 1 IBTS data for the period 1977–2005) suggests that there is indeed an area with low abundance between the North Sea and the Skagerrak, but that a more or less continuous distribution exists between the central and north-western North Sea. Grey gurnard from the North Sea may well be separated from grey gurnard in the Channel. Figure 8.1 shows that the species is almost absent from the southernmost stations of the Southern Bight. In the eastern Channel abundance of grey gurnard seems to be low compared to the North Sea (Figure 8.2). The distribution in the western Channel is not known. A higher abundance is observed in the Celtic Sea, whereas the species is almost absent from the Bay of Biscay (Figure 8.3).

8.3 Fisheries data

Gurnards are often not sorted by species when landed. This is reflected in the catch statistics where different species of gurnards are often reported into one generic category of "gurnards". Only some countries sometimes report landings of "grey gurnard" (see Table 8.1 for landings data for the last 10 years). From this table it is obvious that the catch statistics are incomplete for most years.

Grey gurnard from the North Sea is mainly landed for human consumption purposes. North Sea landings decreased gradually before World War II. After an initial post-war peak of 4000 t, annual landings stayed well below 2000 t until the early 1980s, when annual catches increased to around 40 000 t (Figure 8.4) because of Danish landings for reduction purposes. In the same period, however, there was some misreporting. The Netherlands did not report gurnards during the years 1984–1999. Landings data for 2004 are not yet complete.

Historically, grey gurnard is mainly taken as a by-catch in mixed demersal fisheries for flatfish and roundfish. However, the market is limited and the larger part of the catch appears

1) Most of the text is copied from the text on grey gurnard in ICES-FishMap (2005)

to be discarded. Data for French discard sampling in 2005 and 2006 in different ICES areas are shown in Figure 8.5. Owing to the low commercial value landings data will usually not reflect the actual catches very well.

Figure 8.6 shows effort data and landings per unit effort for French single otter trawlers in areas VIId,e and VIIf-h for the years 1999 to 2005.

8.4 Survey data

For the North Sea and Skagerrak/Kattegat, data are available from the International Bottom Trawl survey. The IBTS can provide information on distribution and the length composition of the catches.

Grey gurnard occurs throughout the North Sea and Skagerrak/Kattegat. During winter, grey gurnards are concentrated to the northwest of the Dogger Bank at depths of 50–100 m, while densities are low off the Danish coast, in the German Bight and eastern part of the Southern Bight (Figure 8.2). The distribution pattern changes substantially in the spring, when the whole area south of 56°N becomes densely populated and the high concentrations in the central North Sea disappear until the next winter. Many gurnards are also caught in the northernmost part of the area throughout the year.

The near absence of grey gurnard in the southern North Sea during winter and the marked shift in the centre of distribution between winter and summer suggests a preference for higher water temperatures (Hertling, 1924; Daan *et al.* 1990).

During winter, grey gurnard occasionally form dense aggregations just above the sea bed (or even in midwater, especially during night time) which may result in extremely large catches. Within one survey, these large hauls may account for 70 percent or more of the total catch of the species. Bottom temperatures in high-density areas usually range from 8 to 13°C (Sahrhage, 1964).

Patterns in distribution of the small and large fish are similar in space and time (Knijn *et al.,* 1993).

Spawning occurs in spring and summer and, perhaps, in autumn (Russel, 1976), and may also explain the observed seasonal movements (Van der Land, 1990). For instance, the German Bight is invaded from April onwards by fish that apparently spawn there. Emigration to northern, deeper waters commences in September and by November only a few young specimens are left (Hertling, 1924).

8.5 Biological sampling

Biological data for this species are scarce. In the early 1990s some countries collected otoliths and information on maturity stages during the quarterly IBTS surveys. Tables 8.2 and 8.3 provide an age-length key for females and for males based on sampling by CEFAS in the 4th quarter of 1992. For the same fish, Tables 8.4 and 8.5 provide information on maturity-at-length.

8.6 Population biological parameters and other research

The maximum size reported by different authors ranges from 45 (Wheeler, 1978) to 50 cm (N.Daan pers. comm.). In the North Sea, specimens > 45 cm are rarely caught.

The winter catches in the North Sea are dominated by larger specimens, with a maximum abundance at 19–22 cm. In Skagerrak-Kattegat, the length frequency distribution has two clear peaks at 11–12 cm and at 16–18 cm, while larger fish are clearly absent (Figure 8.7). There are no reliable data on the age composition.

The length distributions are remarkably similar from year to year and do not indicate a clear year-class signal: small individuals are never very abundant. The absence of small fish in the North Sea suggests that the IBTS survey does not adequately cover the nursery grounds. It is possible that juveniles concentrate on rough bottoms, which have usually to be avoided to minimise damage to the fishing gear, or that they remain pelagic (ICES-FishMap).

Average length of 1-year-olds was 13-14 cm and of 2-year-olds 19–20 cm in samples collected during the first quarter of 1977–1978. Highest age reported was nine years. The average length of 8-year-old fish has been estimated at 35 cm (Damm, 1987) and 32 cm (MacDonald *et al.,* 1994). Females grow faster and live longer than males (Damm, 1987). This is supported by a survey in May 1992, where all specimens larger than 32 cm were females (Knijn *et al.,* 1993).

Available von Bertalanffy growth parameters are given in the text table below:

Area	L_∞ (cm)	K (yr-1)	t_0 (yr)	Reference
Brittany males	34.4	0.85	0.14	Baron, 1985
Brittany females	38.0	0.77	0.16	Baron, 1985

Sexual maturity is said to be attained at between two and three years of age (Wheeler, 1978; Baron, 1985a, 1985b), but data from the North Sea from the first half of May 1992 show that specimens from about 15 cm onwards can be mature, males at a somewhat smaller length than females (Knijn *et al.,* 1993). The same can be seen in the data for the 4th quarter of 1992 presented in Tables 8.4 and 8.5. This indicates that maturity may even be reached in 1-year old fish.

Studies in the Baie de Douarnenez (Brittany) have shown that the length at which 50% of males and females were mature were 29.4 and 31.2 cm, respectively (Baron, 1985a, 1985b). These values seem very high compared to the North Sea.

The spawning period is from April to August (Wheeler, 1978). Off the English northeast coast eggs are found from May to August (Harding and Nichols, 1987). The pelagic eggs are 1.3–1.5 mm in diameter, and the larvae hatch at a length of 3–4 mm (Russell, 1976).

Seasonal distribution maps indicate a marked seasonal northwest-southeast migration pattern that is rather unusual. The population is concentrated in the central western North Sea during winter and spreads into the south eastern part during spring to spawn. In the Kattegat and the northern North Sea, such shifts appear to be absent. The withdrawal from the colder coastal waters may reflect the southerly origin of the species (ICES-FishMap).

The lower three rays of the pectoral fins of gurnards are separate and well supplied with sense organs. They are used to 'walking' over the substratum and locating prey buried in the sea bed (Wheeler, 1978). Small crustaceans, such as the brown shrimp *Crangon crangon* and small crabs are major food items in terms of weight for small (< 25 cm) individuals, while stomach contents of larger specimens are dominated by a variety of fish species (De Gee and Kikkert, 1993). The fish component of the diet largely consists of juveniles (0- and 1-group) of commercially exploited species such as cod, whiting, sandeel and sole. Off Jutland, grey gurnard appeared to be a major predator on pelagic 0-group cod during June–July (De Gee and Kikkert, 1993). Specimens in Loch Etive (west coast of Scotland) were found to feed almost exclusively on mysids, euphausiids, and decapod crustaceans (Gordon, 1981). Due to their piscivorous behaviour, grey gurnard appears to play an important role in the ecosystem.

8.7 Analysis of stock trends

The status of the stocks in areas IIIa, IV and VIId,e is not known, but catches from the IBTS survey in the North Sea show a marked increase since the late 1980s (Figure 8.8).

8.8 Management

No management measures are in place.

8.9 References (not necessarily all mentioned in the text)

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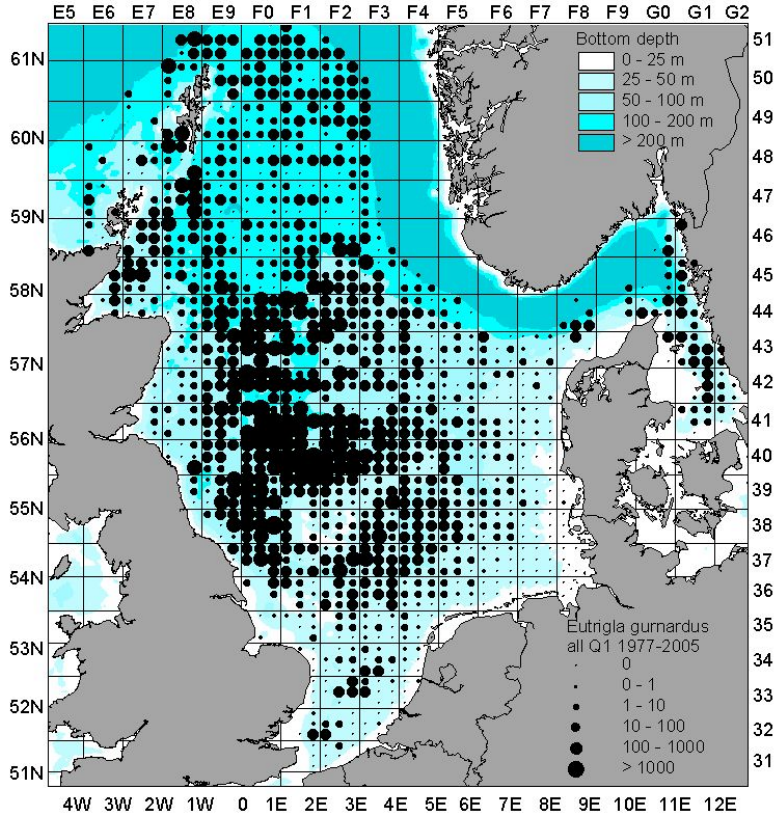

Figure 8.1. Average annual catch (number per fishing hour for all length classes combined) for grey gurnard in the quarter 1 IBTS survey, 1977–2005 (ICES-FishMap).

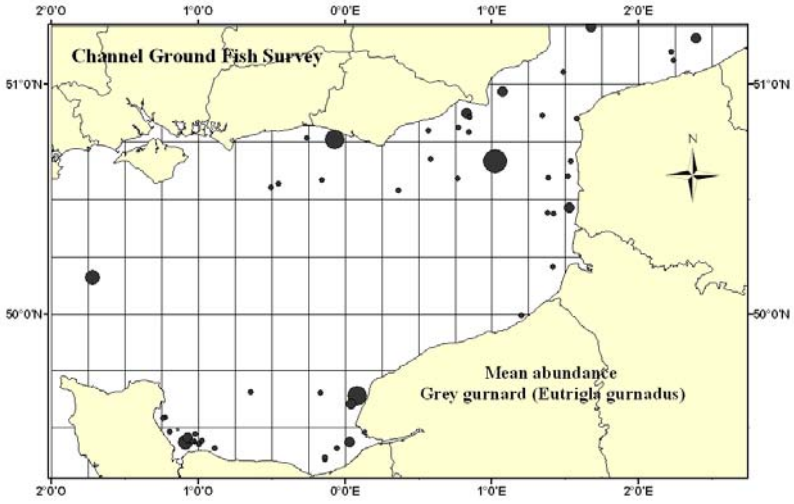

Figure 8.2. Distribution of grey gurnard in the eastern Channel. CGFS survey 1988–2004

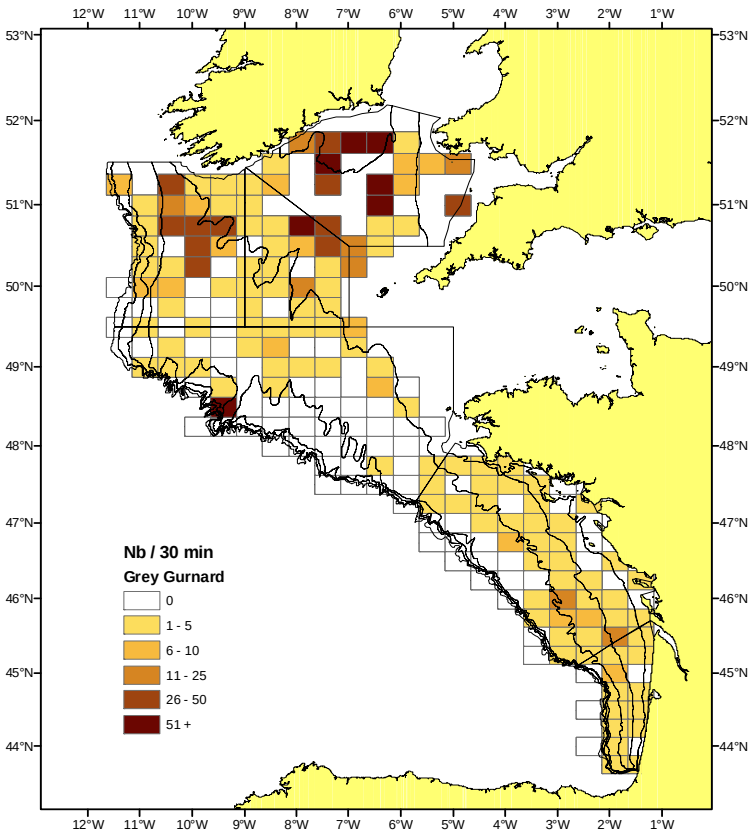

Figure 8.3. Distribution of grey gurnard in the Celtic Sea and the Bay of Biscay. EVHOE survey, 1997–2004.

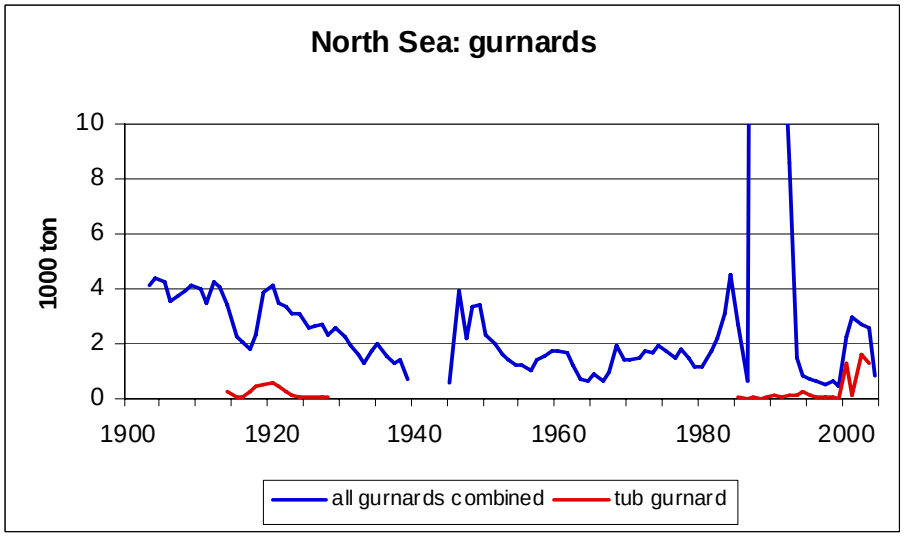

Figure 8.4. Total international landings of gurnards (all species combined and tub gurnard separately) from the North Sea. See text for further explanation.

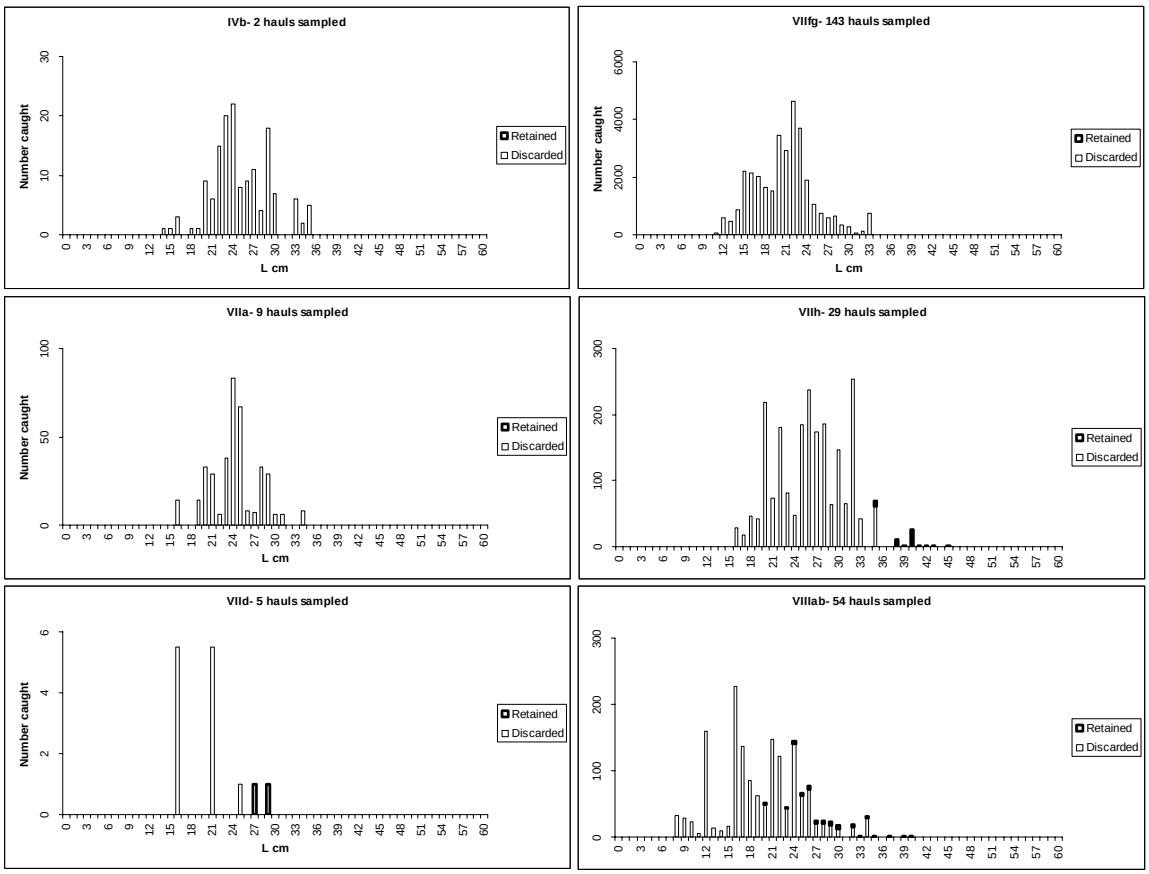

Figure 8.5a. Length composition of French catches of grey gurnard in 2005.

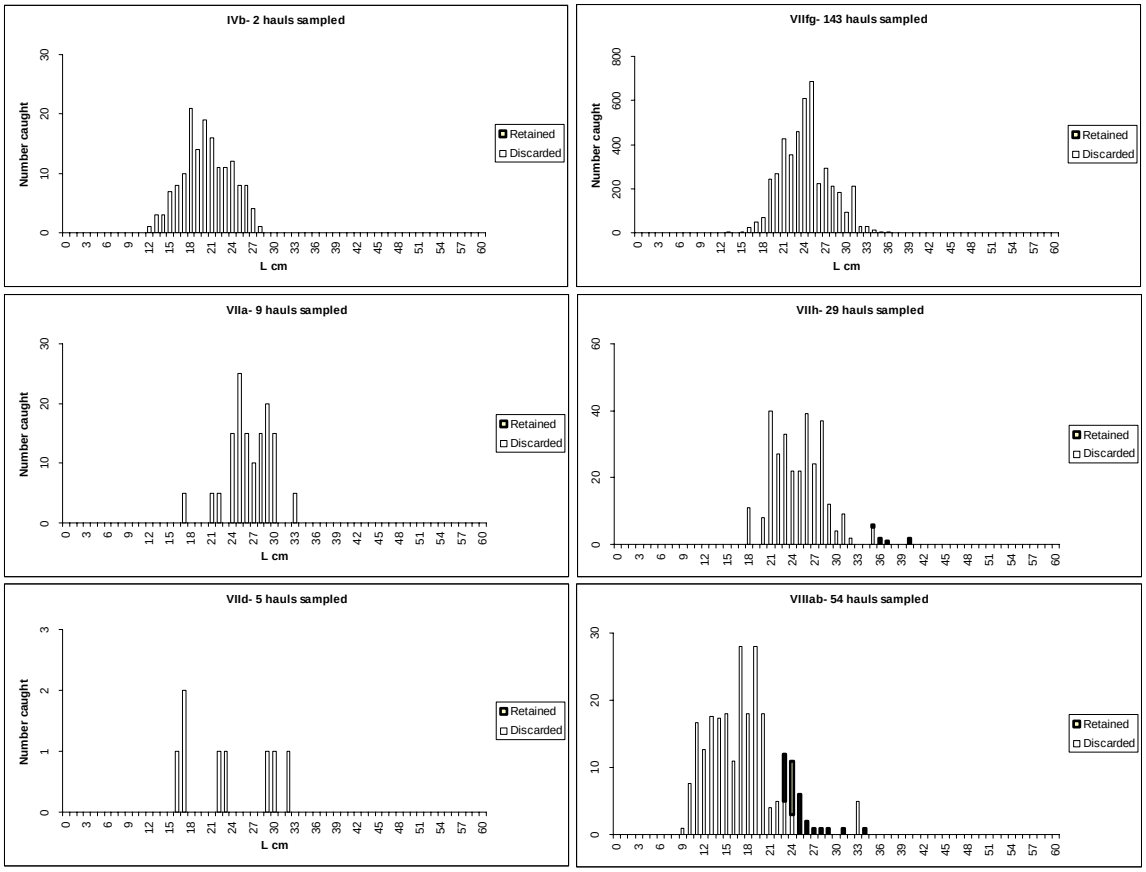

Figure 8.5b. Length composition of French catches of grey gurnard in 2006.

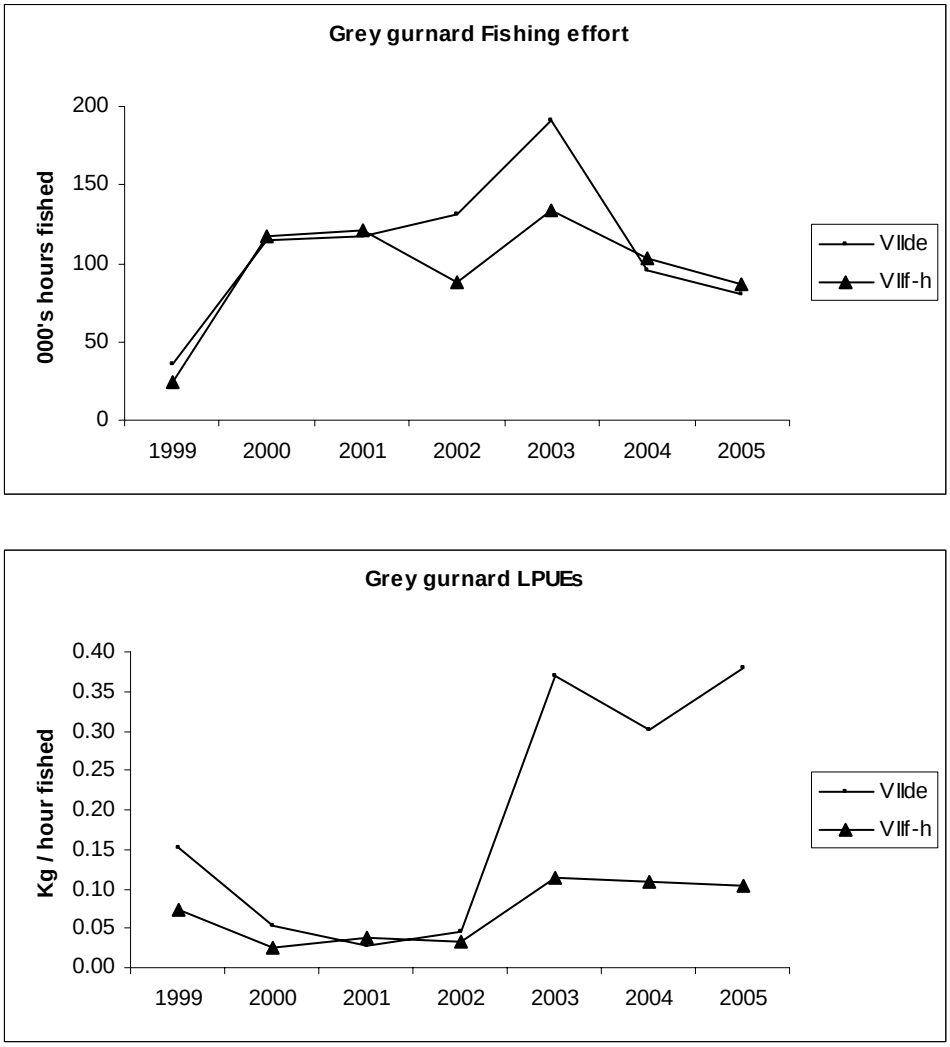

Figure 8.6. Effort and landings per unit of effort for French single otter trawlers for areas VIId,e and VIIf–h for the years 1999 to 2005.

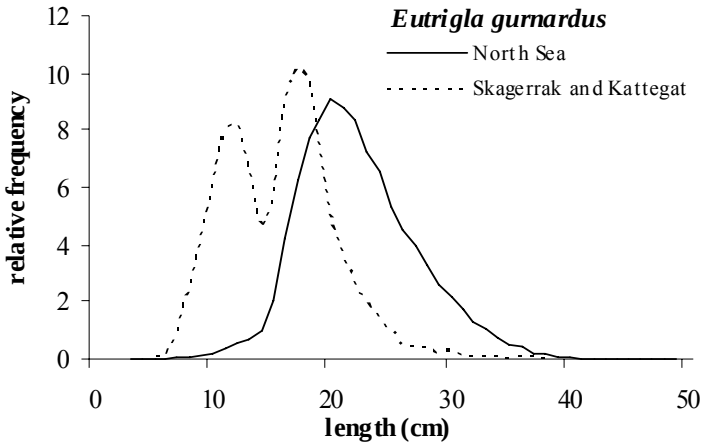

Figure 8.7. Average catch rate (number per hour for all length classes combined) of grey gurnard in the North Sea (excluding Skagerrak and Kattegat), based on the quarter 1 IBTS, 1977–2004 (ICES-FishMap).

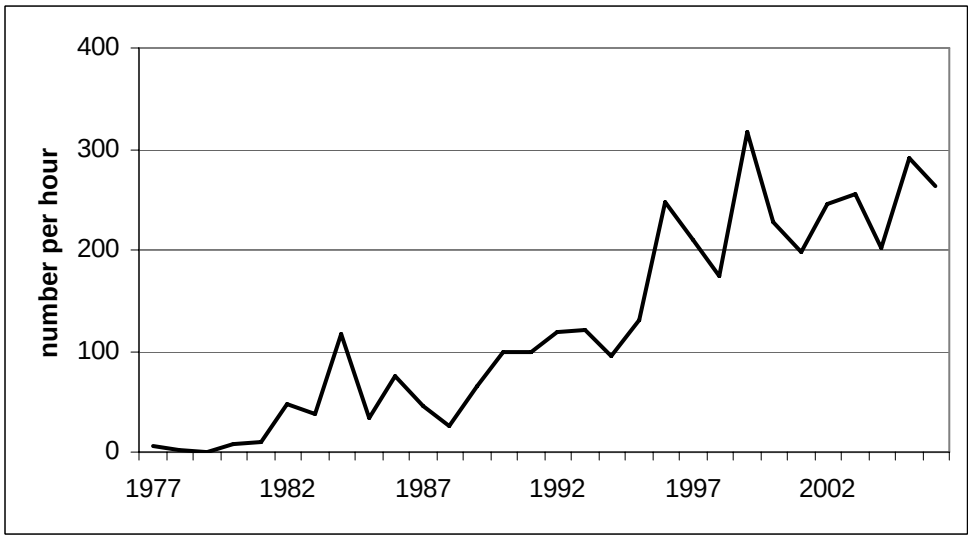

Figure 8.8. Average catch rate (number per hour for all length classes combined) of grey gurnard in the North Sea (excl. Skagerrak and Kattegat), based on quarter 1 IBTS, 1977–2006 (ICES-FishMap).

Table 8.1. Total international landings of grey gurnard from the whole ICES area as reported to FAO for the years 1995–2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Belgium	58	120	62	49	0	0	0	64	38	40	38
Denmark	73	70	36	56	86	96	289	64	92	83	74
Faeroe Islands	0	0	0	0	0	0	0	1	0	0	0
France	204	220	217	159	156	224	216	179	168	132	125
Iceland	0	1	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	38	71	0	0	0	0	0	0
Netherlands	0	0	0	0	0	459	295	286	320	304	246
Russian federation	0	0	0	0	0	26081	3155	60	263	1401	2456
Sweden	6	4	5	8	132	5	4	2	7	5	9
UK	21	56	59	0	0	0	46	41	26	23	22
Grand Total	362	471	379	310	445	26865	4005	697	914	1988	2970

Table 8.2. Age-length key for grey gurnard from the North Sea (1992, quarter 4). Data provided by CEFAS.

FEMALES	AGE											
LENGTH (MM)	0	1	2	3	4	5	6	7	8	9	10+	GRAND TOTAL
110	1											1
120	1											1
130	1											1
150		5										5
160		6	2									8
170		4	4									8
180		2	4		1							7
190		3	3	1	1							8
200		1	5									6
210			1	4								5
220			3	4	1							8
230			1	2	2	1						6
240				1	3							4
250				3	2	1	1					7
260				2	2	2		1				7
270				1	3	3	1					8
280					3	1	1	1			1	7
290					4	1	1	1				7
300					2	1			1			4
310					1		2	1				4
320					1			1	2		1	5
330					1			3	2			6
340					1	1		2		1		5
350						1				2		3
360					1				1		1	3
370							1		1			2
380						2		1		1		4
390							2	1		1	1	5
400												0
410												0
420											2	2
430											1	1
440												0
450												0
460											1	1
Grand Total	3	21	23	18	29	14	9	12	7	5	8	149

Table 8.3. Age-length key for grey gurnard from the North Sea (1992, quarter 4). Data provided by CEFAS.

Males

	AGE											
LENGTH (MM)	0	1	2	3	4	5	6	7	8	9	10+	GRAND TOTAL
140	1											1
150		3										3
160		1	1									2
170		4										4
180		2	5	1								8
190		1	3	1	1							6
200		1	5									6
210			4	3	1							8
220			1	4								5
230			1	3	3							7
240			1	2		1						4
250			1		1	1	1		1	1		6
260					2	2	1					5
270					1					1	1	3
280					2	2					2	6
290						1	1	1			2	5
300				1	1	1	1		1			5
310					1		1					2
320					1	1				1		3
330					1				2			3
340						1			1			2
350							1	1				2
360							1					1
370										1	1	2
380							1			1		2
390											1	1
400											2	2
410											1	1
Grand Total	1	12	22	15	15	10	8	2	5	5	10	105

Table 8.4. Maturity data for grey gurnard from the North Sea (1992, quarter 4). Data provided by CEFAS.

FEMALES

LENGTH	IMMATURE	MATURING	MATURE	SPENT	GRAND TOTAL
110	1				1
120	1				1
130	1				1
150	5				5
160	5	2		1	8
170	8				8
180	5	1		1	7
190	6	1		1	8
200	4	1		1	6
210	2	3			5
220	3	4		1	8
230	2	1		3	6
240	1	1		2	4
250	2	3		2	7
260	1	3		3	7
270	2	3		3	8
280		3		4	7
290	1	4		2	7
300		2		2	4
310		2		2	4
320		3		2	5
330		5		1	6
340		2		3	5
350		3			3
360		1		2	3
370		2			2
380		3		1	4
390		2	1	2	5
420		1		1	2
430		1			1
460				1	1
Grand Total	50	57	1	41	149

Table 8.5. Maturity data for grey gurnard from the North Sea (1992, quarter 4). Data provided by CEFAS.

Males

LENGTH	IMMATURE	MATURING	MATURE	SPENT	GRAND TOTAL
140	1				1
150	3				3
160	2				2
170		4			4
180	6	1		1	8
190	4	1		1	6
200	3	3			6
210	6	2			8
220	3	1		1	5
230	1	2		4	7
240	1	1		2	4
250	1	2		3	6
260	1	1	1	2	5
270		3			3
280	1	3		2	6
290		1		4	5
300	1	2		2	5
310		1		1	2
320	1	2			3
330				3	3
340		2			2
350		2			2
360		1			1
370				2	2
380				2	2
390		1			1
400		2			2
410		1			1
Grand Total	35	39	1	30	105

9 Brill

9.1 General biology

The description on the general biology of brill *Scophthalmus rhombus* is taken from the report on 'Stock discrimination in relation to the assessment of the brill fishery' (Delbare and De Clerck, 1999).

Brill is a shallow-water flatfish found in areas close inshore, usually on sandy, sometimes on gravel and on muddy grounds. Its vertical distribution ranges from 4 meters to 73 meters, although very young fish are mostly common in sand shore pools. Mature brill is rarely observed inshore, whereas immature specimens are often caught near the coast and even in estuaries.

The distribution of brill in the North Eastern Atlantic Ocean is located along the European coastline from the 64° N (the Lofotes), down to northwest Morocco, extending into the Mediterranean and even into the Black Sea (rare) (Nielsen, 1986). Brill is also found in small quantities in the Skagerrak, the Kattegat, the Belt Sea and in the Baltic Sea.

The feeding habits of this species closely resemble those of the turbot and were extensively reviewed by de Groot (1971) and Wetsteijn (1981). The pelagic larvae feed primarily on copepod nauplii (mainly, but not entirely on *Temora sp.*), decapod and mollusc larvae. This diet is maintained until a total length of 10 cm is reached and complemented with larger prey organisms, e.g. polychaets, amphipods, mysids, and larvae of several fish species (e.g. *Mugilidae*). For brill within the size range 10–20 cm, the most important food items are sandgoby, dragonet and other small benthic fishes. A small part of its diet exists of mysids, crabs and shrimps. In this juvenile stage the diet changes gradually. In the size range 20–40 cm brill feeds mainly on sandeel (*Ammodytidae*) and sandgoby. In southern areas the diet is complemented with anchovy and solenette. Crabs are almost the sole invertebrates eaten. With increasing length, the dominant species on its menu changes from sandeels for the size range 30–50 cm to gadoids for the size range > 50 cm, e.g. whiting and cod. Larger brill (41–85 cm) are primarily piscivorous with their diet consisting of gadoids (e.g. poor-cod, pouting, whiting and haddock) and to a lesser extent of sandeels, clupeoids (e.g. sprat) and flatfish. Occasionally invertebrates such as squid and shrimps are eaten. Wetsteijn (1981) however did not find haddock, plaice or sole in the stomachs of brill, which could be explained by a variable diet according to seasonal and geographical patterns.

9.2 Stock identity and possible assessment areas

In the EU funded study on 'Stock discrimination in relation to the assessment of the brill fishery' the following was concluded (Delbare and De Clerck, 1999).

"*Field surveys revealed that brill was widely distributed, but at low densities throughout the south-eastern part of the Atlantic, mainly along the continental coastlines. Aggregations of brill were found in the North Sea in the area of the Wadden Sea and the German Bight, in the Irish Sea in the Cardigan Bay and the Carmathen Bay, and in the English Channel in the vicinity of the Hurd Deep.*

The genetic research carried out in this study revealed a high variation in the sequenced part of the D-loop. Furthermore, only a weak geographical differentiation in the D-loop sequence of brill throughout its distribution area in the North-eastern Atlantic was observed. This was in agreement with the results obtained from the biological parameters, as the composition of commercial Belgian brill landings, growth rate and reproduction characteristics. However, there is an indication that the North-eastern Atlantic brill can separated into two groups. A first group of brill occupying the Bay of Biscay, the English Channel, the Celtic Sea and the Irish Sea, and a second group in the North Sea and Skagerrak & Kattegat. The first group can

further be split up into two subgroups: English Channel-Celtic Sea and Irish Sea-Bay of Biscay.

As a final conclusion, biological parameters (composition of Belgian brill landings, growth rate and reproduction characteristics) and the sequencing of the D-loop resulted in insignificant differences between brill from the different areas. Therefore, arguments favour the hypothesis that brill from the NE Atlantic might be considered to be only one population: the North-eastern Atlantic brill population. Further research on spawning areas and migration through respectively egg surveys and tagging experiments, could generate valuable information about (sub-)population structures of brill throughout its entire distribution area. Therefore it is advisable to extend the sampling area to the Mediterranean Sea and the Black Sea."

9.3 Fisheries data

Landings

Table 9.3.1 summarizes the brill landings by area as reported to ICES (Source: Fishstat database). Recently, the total landings of brill vary between 2000 and 3000 t. The North Sea accounts for the major part of the brill landings.

Fisheries in Belgium

Brill is mainly caught in mid-class (301–900 Hp) and large (> 900 Hp) beam trawlers. These vessels are mostly flatfish directed (particularly towards plaice and sole, together with the associated by-catch species such as turbot, brill, dab, lemon sole, anglerfish and some roundfish), and usually operate in the central and southern North Sea (ICES Sub-areas IVb and IVc), the English Channel (VIId,e), the Irish Sea (VIIa), the Celtic Sea (VIIf,g) and the inner part of the Bay of Biscay (VIIIa,b). Brill is mainly caught in the southern North Sea and the English Channel. Landings from the Bay of Biscay are negligible. The average effort and the average landings of brill for the Belgian beam trawl fleet for the period 1996-2005 is presented in Figure 9.3.1.

Fisheries in France

Bottom trawlers and netters are the main métiers in France. They account for more than 70% of the brill landings from ICES areas VII and VIII. Brill is not targeted, but can be an important by-catch during some seasons and in some fisheries (monkfish nets or sole nets).

Netters using tangle nets or trammel nets with large mesh target monkfish, crayfish, rays and brill (mainly in spring). They also land turbot during summer. Each boat can have between 5 and 50 km of nets at sea. Most boats make daily trips and the immersion time of the nets is usually 3 days. In the 1990s about 100 vessels fished in the western Channel and about 30 vessels fished north to the Seine Bay in area VIId.

The metiers in the English Channel that catch brill are described in Guitton *et al.*, 2003.

In the 1990s, discarding practices in bottom trawling and netting fisheries were studied during the whole year (Morizur *et al.*, 1996). Discarding was low in netting and mainly occurred when the immersion time was too long (e.g. due to bad weather).

The French production in 2004 was around 440 t (logbook data base). The landings mainly originate from area VII.

Fisheries in the Netherlands

Brill is caught as part of the by-catch in the beam trawl fishery for plaice and sole. For brill probably only the very small specimens will be discarded. Discard data have been collected during recent years and an overview on discards can be made.

Fisheries in Spain

The Basque fleet, operating in areas VI, VII and VIII and targeting mainly hake, megrim and monkfish, have a wide range of bycatch species such as sea bass, brill, turbot, gurnards and mullet. Almost all brill is caught by the "baka" otter trawl fleet (Figure 9.3.2).

Fisheries in the UK

Landings by UK, England and Wales (E&W), vessels into and outside of E&W and total E&W landings for brill are given in Tables 9.3.2, 9.3.3 and 9.3.4. The majority of landings are in Divisions VIId, e and f and are landed into the UK. Data by gear group are available.

9.4 Survey data, recruit series

IBTS

The presence or absence of brill in the catches of the IBTS survey, the Dutch contribution to the BTS survey and in some national Dutch surveys is summarized in Figure 9.4.1. Brill is mainly caught in the Southern and Eastern part of the North Sea.

English surveys

Cefas conducts several annual surveys in which brill are routinely measured or biological information is retained. Four of the most important surveys are the Irish Sea (VIIa, f & g) beam trawl survey, the Channel (VIId) beam trawl survey, the Carhelmar (VIIe) commercial beam trawl survey and the English groundfish (IVb & c) GOV trawl survey. All fish caught are routinely measured during Cefas surveys, and for most surveys, biological information is collected for brill. A summary of the numbers of fish measured and the numbers of biological samples (otoliths, length, weight, sex and maturity) in four Cefas survey series Tables 9.4.1 and 9.4.2, respectively.

In addition, data on length distributions, distributions and abundance of brill is available in Cefas technical reports for the Irish Sea beam trawl survey (Parker-Humphreys, 2004a), the English Channel and southern North Sea (Parker-Humphreys, 2004b) beam trawl survey and the Young Fish Survey for the south and east coasts of (Rogers *et al.,* 1998).

9.5 Biological sampling

For the UK, length information from market sampling for brill is available for 1994–1996, and from 2000 onwards. Biological sampling for otoliths, weight, sex and maturity has only been carried out since 2000. A summary of the number of samples available is given in Tables 9.5.1 and 9.5.2. The otoliths collected have not been aged.

France did collect length and age data on brill (demographic structures per metier) in the areas VIId and VIIe during the years 1994–1996. These data were collected under an EU funded project carried out by France and the UK. (Dunn *et al.*, 1996).

The Netherlands did sample North Sea brill for age and length in 1982–1990, 1998 and 2002 onwards. The number of length samples varies between 2000 and 4000 per year, the number of otoliths between 350 and 2000 per year. The relative age distribution for the different sampling periods is presented in Figure 9.5.1. The average age of brill in the landings of the Dutch beam trawl fleet operating in the North Sea has declined from 2.9 in the mid 1980s to 2.3 in the late 1990s and 1.9 at the beginning of this century.

During the mid 1990s, Belgium took age and length samples of brill caught in the North Sea, the Eastern English Channel, the Celtic Sea, and the Irish Sea. The numbers measured, vary between 200 and 600 individuals per year. Since 2002, Belgium samples North Sea brill as part of the DCR, although the sampling intensity has been rather low (< 200 individuals per

year). The relative age distribution of brill in de commercial landings of the Belgian beam trawl fleet for the period 1996–1998 is presented in Figure 9.5.2.

9.6 Population biological parameters and other research

A couple of studies have been carried out on brill e.g. Delbare and De Clerck (1999) and Dunn *et al.* (1996). The reports of these studies include information on growth, maturity and sex ratio of brill.

9.7 Analyses of stock trends

Ulrich (2000) made an assessment of brill in the Channel fisheries using the data sampled under the EU funded project carried out by France and the UK. (Dunn *et al.*, 1996). She concluded that the Channel stock was not heavily overexploited, but that a reduction in fishing effort was required to get an increase of 10% of the observed production. The maximum annual production was found to be around 400 t.

9.8 References

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Table 9.1. Landings of Scophthalmus rhombus as reported to ICES (Source: fishstat database).

	X	II	V	XIV	IIIB-D	BALTIC	VIIB,C	VI	IX	VIII	VIIA	IIIA	VIIG-K	VIID,E	IV	GRAND TOTAL
1973	0	0	20	0	16	0	48	26	0	309	134	134	165	220	1066	2138
1974	0	0	0	0	30	0	20	44	0	0	100	202	80	81	1191	1748
1975	0	0	0	0	43	0	28	41	0	50	117	189	120	137	1242	1967
1976	0	0	1	0	50	0	43	57	0	35	94	227	156	285	1223	2171
1977	0	0	0	0	70	0	35	63	0	261	121	389	241	323	1447	2950
1978	0	1	0	0	43	0	36	53	0	28	113	218	122	411	1418	2443
1979	0	2	1	0	31	0	26	49	0	25	133	184	126	459	1393	2429
1980	0	0	0	0	26	0	32	37	0	50	133	82	213	402	1054	2029
1981	0	0	0	0	23	0	30	31	0	55	106	59	452	490	1226	2472
1982	0	0	0	0	20	0	23	32	0	58	95	74	179	487	1300	2268
1983	0	0	0	0	0	13	19	28	0	71	137	83	206	526	1455	2538
1984	0	0	0	0	1	12	18	39	0	96	148	97	179	531	na	na
1985	0	0	0	0	18	0	25	46	0	91	236	109	187	494	na	na
1986	0	0	0	0	1	19	46	27	10	134	246	106	224	456	na	na
1987	0	0	0	0	2	15	22	30	24	155	252	103	226	493	na	na
1988	0	0	0	0	0	10	16	27	28	199	248	101	206	452	336	1623
1989	0	0	0	0	0	10	12	28	36	214	122	97	185	425	460	1589
1990	0	0	0	0	1	12	10	17	54	188	139	127	229	543	923	2243
1991	0	0	0	0	0	17	10	27	39	131	139	99	230	470	1682	2844
1992	0	0	0	24	2	34	20	43	53	167	174	146	278	463	1810	3214
1993	0	0	0	0	11	35	26	38	64	154	117	212	221	490	2439	3807
1994	1	0	0	0	7	62	25	28	49	137	131	220	269	490	1916	3335
1995	0	0	0	0	5	101	27	25	57	139	132	151	353	558	1434	2982
1996	0	0	0	0	2	62	41	25	498	120	122	111	369	608	1247	3205
1997	0	0	0	0	0	28	50	40	434	125	156	106	397	501	957	2794
1998	0	0	0	0	0	25	18	42	52	112	153	132	260	451	1283	2528
1999	0	0	0	0	1	28	18	30	62	17	131	157	183	240	1280	2147
2000	0	0	0	0	1	33	44	16	63	131	104	142	239	678	1508	2959
2001	0	0	0	0	0	23	21	15	70	122	119	98	251	738	1573	3030
2002	0	0	0	0	2	30	34	12	55	160	107	89	254	716	1302	2761
2003	0	0	0	0	3	40	33	36	45	155	131	129	249	759	1347	2927
2004	0	0	0	0	3	48	21	20	61	165	87	156	293	666	1249	2769
2005	0	0	0	0	0	63	16	13	60	7	101	133	195	344	1153	2085

Table 9.3.2.. Landings (t) of brill by E&W vessels into E&W by ICES Division

	IIA	IVA	IVB	IVC	VA	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIIA	VIIIB	VIIID	VIIJ	VIIK	TOTAL
1982	0	0	1	0	0	0	0	2	0	0	7	3	3	0	0	0	0	0	0	0	17
1983	0	0	7	1	0	0	0	13	0	0	17	73	8	2	0	0	0	0	0	0	120
1984	0	0	16	7	0	1	0	45	0	0	39	147	28	5	8	0	0	0	0	0	295
1985	0	0	24	15	0	1	0	79	0	0	31	145	29	7	8	0	0	0	1	0	339
1986	0	0	26	12	0	0	0	73	0	0	29	117	34	6	14	0	0	0	1	0	313
1987	0	0	32	10	0	0	0	84	0	0	35	106	52	8	22	0	0	0	0	0	350
1988	0	0	19	15	0	0	0	45	0	0	20	113	41	4	21	0	0	0	0	0	278
1989	0	0	15	15	0	0	0	41	0	0	22	84	26	3	4	0	0	0	0	0	211
1990	0	0	24	14	0	0	0	47	0	0	41	130	18	2	45	0	0	0	0	0	321
1991	0	1	48	27	0	0	0	47	0	0	56	73	33	3	26	0	0	0	0	0	314
1992	0	1	91	30	0	1	0	53	0	0	68	78	28	6	15	0	0	0	2	0	375
1993	0	3	70	26	0	1	0	48	0	0	56	88	34	7	15	0	0	0	0	0	349
1994	0	1	63	23	0	1	0	48	0	0	53	108	53	13	52	0	0	0	0	0	417
1995	0	0	34	30	0	1	0	46	0	0	67	124	55	14	115	0	0	0	1	0	489
1996	0	0	33	26	0	1	0	38	0	0	73	175	55	8	80	0	0	0	0	0	490
1997	0	0	29	17	0	1	0	45	0	0	57	132	54	13	84	0	0	0	0	0	433
1998	0	0	24	20	0	1	0	51	0	0	61	108	48	8	19	0	0	0	0	0	339
1999	0	0	23	13	0	0	0	41	0	0	44	80	32	7	10	0	0	0	0	0	251
2000	0	1	26	12	0	0	0	20	0	0	64	146	35	7	10	0	0	0	0	0	322
2001	0	0	27	8	0	0	0	27	0	0	67	176	46	8	15	0	0	0	0	0	375
2002	0	1	12	7	0	0	0	22	0	0	53	168	48	6	20	0	0	0	0	0	336
2003	0	0	8	6	0	0	0	27	0	0	46	183	28	7	13	0	0	0	0	0	319
2004	0	0	12	8	0	6	0	22	0	0	34	181	21	7	15	0	0	0	0	0	306

Table 9.3.3. Landings (t) of brill by E&W vessels into foreign ports by ICES Division.

	IIA	IVA	IVB	IVC	VA	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIIA	VIIIB	VIIID	VIIJ	VIIK	TOTAL
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1986	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
1987	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
1988	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
1989	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
1990	0	0	9	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
1991	0	0	18	20	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	42
1992	0	0	26	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	33
1993	0	0	82	5	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	90
1994	1	0	74	3	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	81
1995	0	0	36	5	0	1	0	0	0	0	3	1	0	0	0	0	0	0	1	4	51
1996	0	0	67	4	0	0	0	0	0	10	1	0	0	0	2	0	0	0	6	22	112
1997	0	0	42	2	0	2	0	0	1	12	1	0	0	0	1	0	0	0	19	17	98
1998	0	0	68	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	71
1999	0	0	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78
2000	0	0	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
2001	0	0	53	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55
2002	0	0	50	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54
2003	1	0	38	8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	48
2004	0	0	62	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	69

Table 9.3.4. Total landings (t) of brill by E&W vessels by ICES Division.

	IIa	IVa	IVb	IVc	Va	VIa	VIb	VIIa	VIIb	VIIc	VIId	VIIe	VIIf	VIIg	VIIh	VIIIa	VIIIb	VIIId	VIIj	VIIk	Total
1982	0	0	1	0	0	0	0	2	0	0	7	3	3	0	0	0	0	0	0	0	17
1983	0	0	7	1	0	0	0	13	0	0	17	73	8	2	0	0	0	0	0	0	120
1984	0	0	16	7	0	1	0	45	0	0	39	147	28	5	8	0	0	0	0	0	296
1985	0	0	24	15	0	1	0	80	0	0	31	145	29	7	8	0	0	0	1	0	340
1986	0	0	27	12	0	0	0	73	0	0	29	117	34	6	14	0	0	0	1	0	314
1987	0	0	33	10	0	0	0	85	0	0	35	106	52	8	22	0	0	0	0	0	351
1988	0	0	20	15	0	0	0	45	0	0	20	113	41	4	21	0	0	0	0	0	280
1989	0	0	18	17	0	0	0	42	0	0	22	84	26	3	4	0	0	0	0	0	215
1990	0	0	33	27	0	0	0	47	0	0	41	131	18	2	45	0	0	0	0	0	344
1991	0	1	66	47	0	0	0	47	0	0	58	74	33	3	27	0	0	0	0	0	356
1992	0	2	117	36	0	1	0	54	0	0	69	78	28	6	15	0	0	0	2	0	408
1993	0	3	152	32	0	1	0	49	0	0	57	89	34	8	15	0	0	0	0	0	439
1994	0	2	138	27	0	1	0	48	0	0	54	108	53	13	52	0	0	0	0	0	497
1995	0	1	70	35	0	2	0	46	0	0	70	125	55	14	115	0	0	0	3	4	539
1996	0	0	100	30	0	1	0	38	0	10	74	175	55	8	81	0	0	0	6	22	602
1997	0	0	71	18	0	3	0	45	1	12	58	132	54	13	85	0	0	0	19	17	531
1998	0	0	92	20	0	1	0	51	0	0	61	108	48	8	21	0	0	0	0	0	411
1999	0	0	100	13	0	0	0	42	0	0	45	80	32	7	10	0	0	0	0	0	329
2000	0	1	75	12	0	0	0	20	0	0	64	146	35	7	10	0	0	0	0	0	372
2001	0	0	80	10	0	0	0	27	0	0	67	176	46	8	15	0	0	0	1	0	430
2002	0	1	62	10	0	0	0	22	0	0	53	168	48	6	20	0	0	0	1	0	390
2003	0	1	46	14	0	0	0	27	0	0	47	184	28	7	13	0	0	0	0	0	367
2004	0	0	74	13	0	6	0	22	0	0	35	182	21	7	15	0	0	0	0	0	375

Table 9.4.1. The number of brill measured each year for four Cefas survey series.

	IRISH SEA AUTUMN	IRISH SEA SPRING	CARHELMAR	CHANNEL	NORTH SEA
1988	12				
1989	22		14	23	
1990	45		9	47	
1991	6		15	17	2
1992	52		14	18	3
1993	65	37	11	19	
1994	35	36	10	27	3
1995	41	31	9	36	
1996	46	14	16	36	1
1997	39	23	13	25	1
1998	31	16	21	23	
1999	29	23	21	25	1
2000	44		19	29	
2001	28		20	29	3
2002	29			31	2
2003	41		17	25	3
2004	31			25	1
2005	29			16	
Total	625	180	209	451	20

Table 9.4.2. The number of brill for which biological data (otoliths, weight, sex and maturity) have been collected from four Cefas survey series.

	IRISH SEA AUTUMN	IRISH SEA SPRING	CARHELMAR	CHANNEL	NORTH SEA
1994	21		9	4	
1995	40	31	9	31	
1996	45	8	15	32	
1997	39	22	12		
1998	30	14			
1999	29				
2000	44				
2001	26		20	28	
2002	19		9	27	
2003	36		4		2
2004				7	1
2005	24			8	
Total	353	75	78	137	3

Table 9.5.1. Number of brill measured during the Cefas biological sampling programme.

	NO OF FISH	NO OF SAMPLES
1994	1778	55
1995	1446	84
1996	422	10
1997		
1998		
1999		
2000	3550	179
2001	3450	117
2002	2044	66
2003	53	4
2004	256	8
Total	12999	523

Table 9.5.2. Number of brill for which biological information has been collected by the Cefas biological sampling programme.

	NO OF FISH	NO OF SAMPLES
1995		
1996		
1997		
1998		
1999		
2000	996	134
2001	1151	143
2002	796	103
2003	37	6
2004		
2005		
Total	2980	386

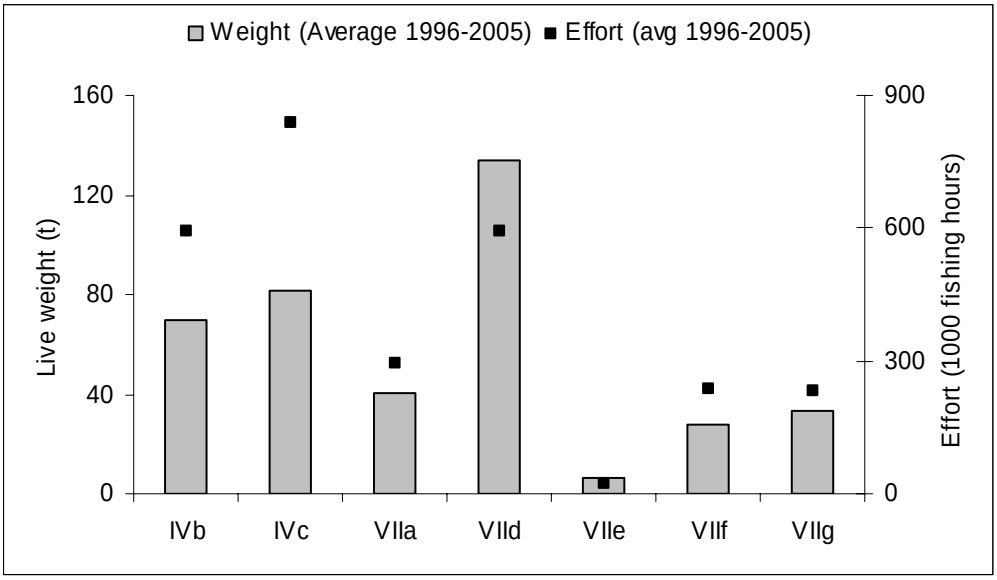

Figure 9.3.1. Average effort and average landings of brill for the Belgian beam trawl fleet for the period 1996–2005.

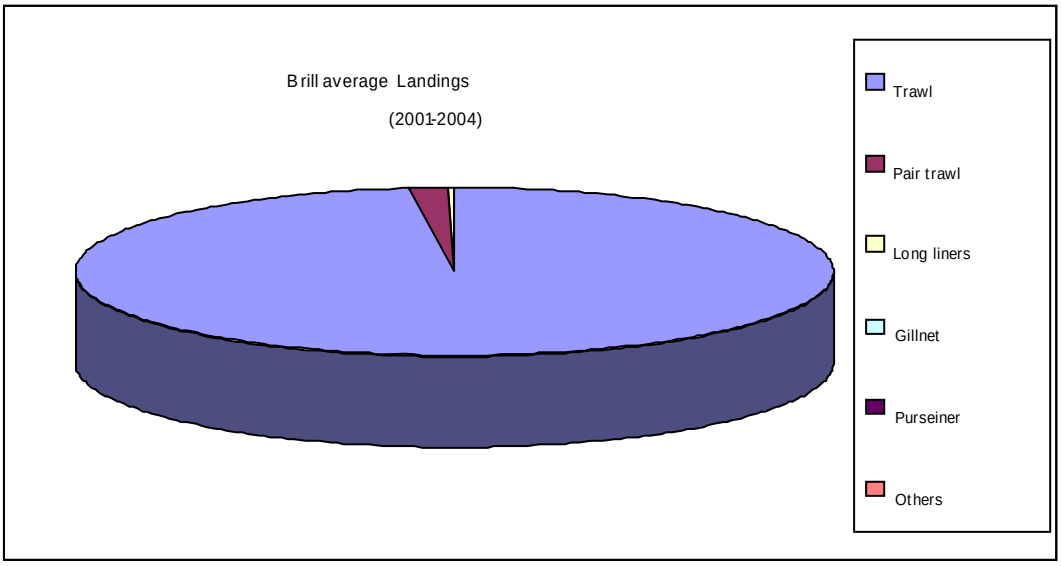

Figure 9.3.2. Origin of the brill landings in the Basque fleet (Spain). Almost all brill is caught by the "baka" otter trawl fleet.

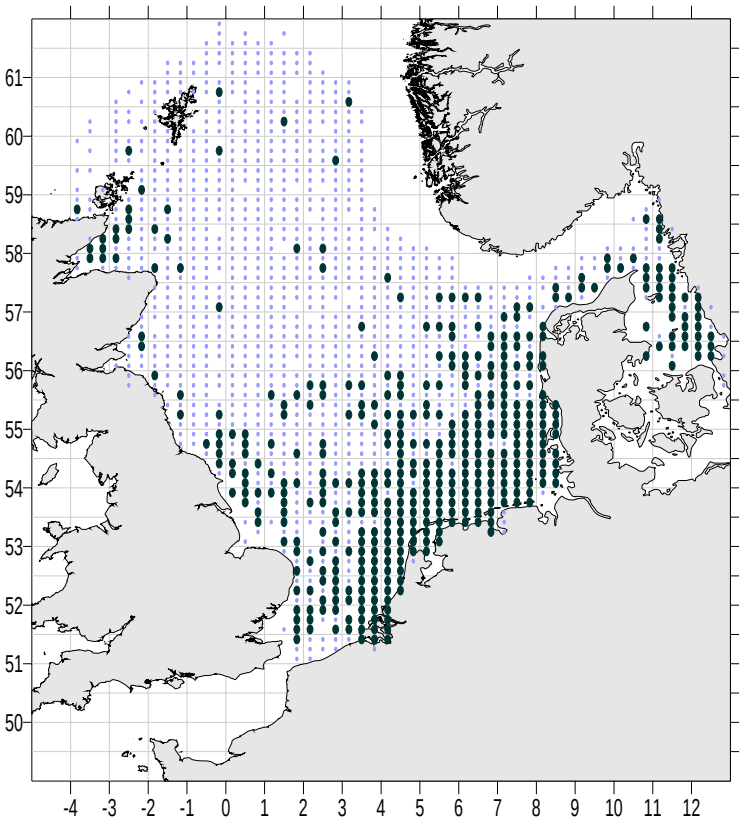

Figure 9.4.1. Brill catches (present or absent) during the IBTS and BTS surveys.

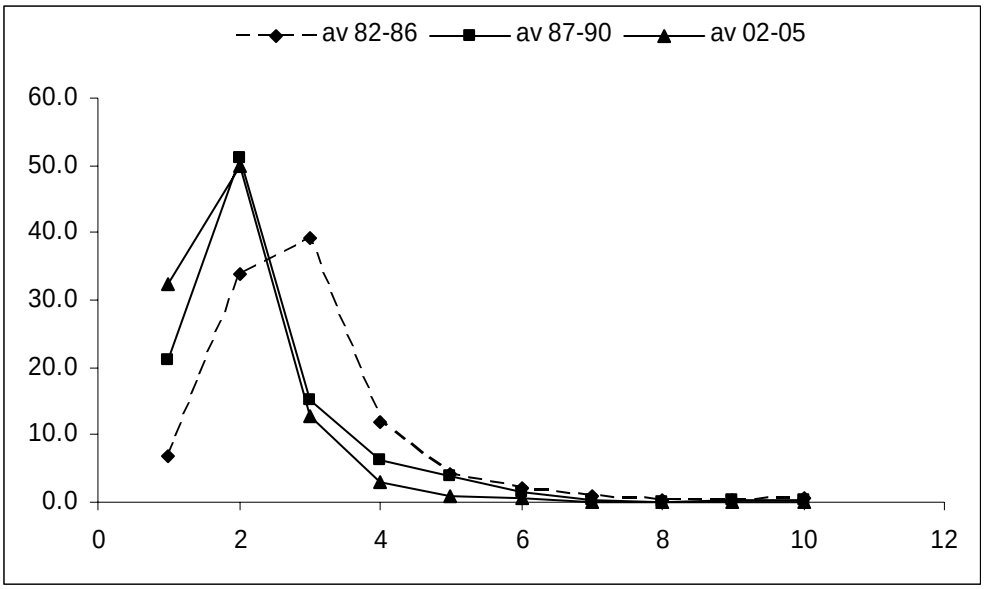

Figure 9.5.1. Relative age distribution of brill in the commercial landings of the Dutch beam trawl fleet averaged over the periods 1982–1986, 1987–1990 and 2002–2005.

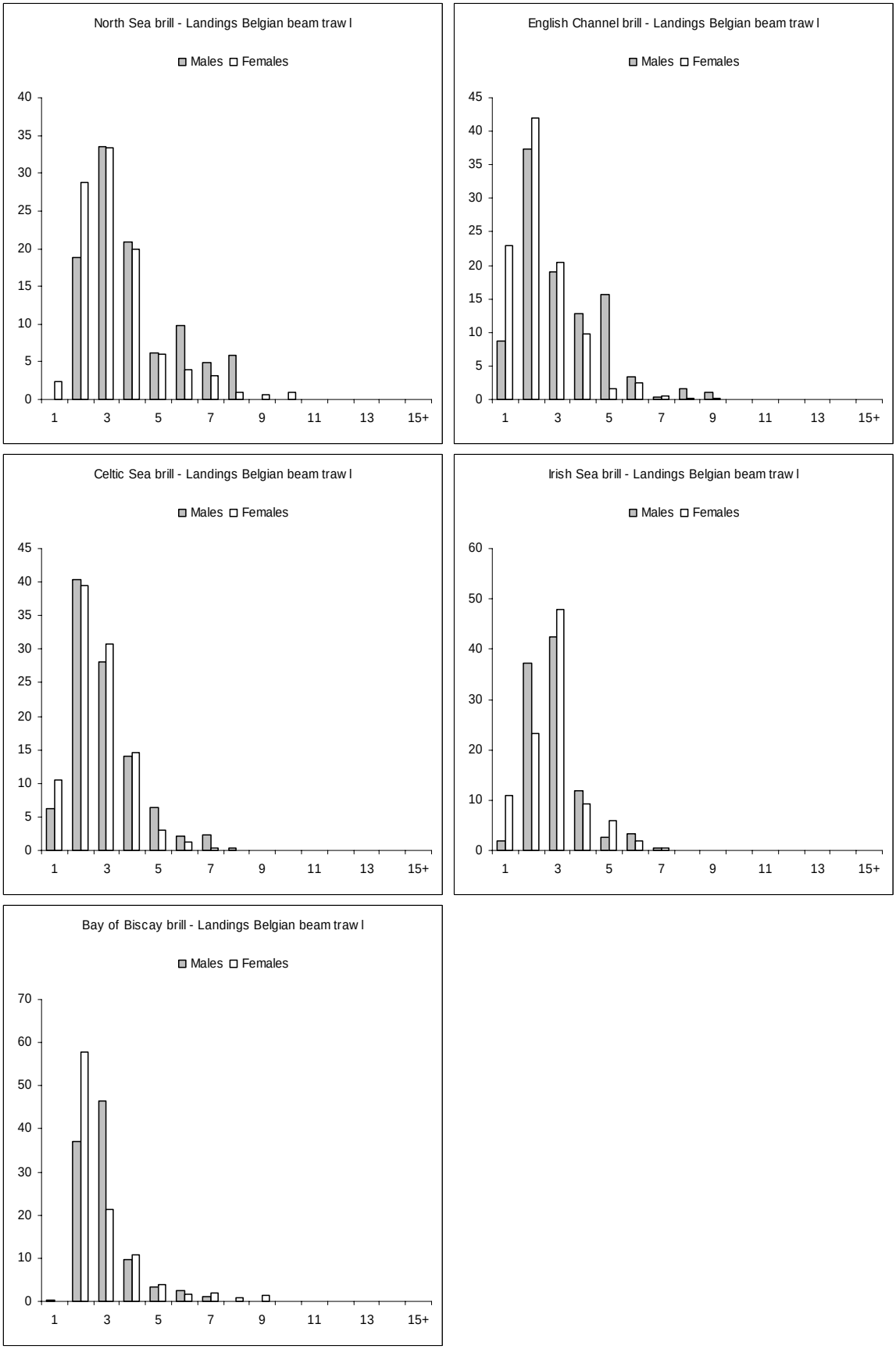

Figure 9.5.2. Relative age distribution of brill in the commercial landings of the Belgian beam trawl fleet for the period 1996–1998.

10 Turbot

10.1 General biology

The description on the general biology of turbot *Psetta maxima* is copied from Annex 4 of the 2005 Report of the Working Group on Environmental Interactions of Mariculture (ICES, 2005).

Turbot is distributed throughout the Northeast Atlantic Ocean along the European coastline and is rarer around the Faroe Islands, Iceland and on Rockall Bank. Turbot is also found in the Skagerrak, the Kattegat, the Belt Sea and in the Baltic Sea, but is very scarce in the Gulf of Bothnia, north of the Aaland archipelago, where salinity levels are below 5 psu. The distribution area also extends into the Mediterranean and Adriatic Sea. It is typically found at a depth range of 10 to 70m. Turbot lives on sandy, rocky or mixed bottoms and is one of the few marine fish species that inhabits brackish waters.

Turbot is one of the fastest growing flatfish. Only halibut grows faster. During the juvenile phase growth rates are high, through which the turbot can reach 30 cm in three years. Females grow faster than males. During the first years of life females grow from 8 to 10 cm a year. Females older than 10 years still grow 1 or 2 cm a year. In male turbot the growth is already reduced to 2 cm a year at the age of 6 years. Males older than 10 grow less than 1 cm a year. The difference in length between the sexes increases from 3 cm in 3-year-old turbot to 9 cm in 10-year-old turbot. The maximum growth rates are obtained in 3, 4 and 5-year-old turbot during the summer (May till October). In these months growth can reach between 2 and 2.6 cm per month. This high rate is comparable with the growth in artificial circumstances. In nature the ultimate growth rate (on year basis) is lower due to the slowing-down of metabolism during winter.

Turbot is a typical visual feeder and feeds mainly on other bottom-living fishes (common gadoids, sand-eels, gobies, soles, dabs, dragonets, sea breams and boarfish), small pelagic fish (sprats, pilchards) and also, to a lesser extent, on larger crustaceans and bivalves. Large turbot (40 to 70 cm) feed from March till May excessive on herring and sprat (Rae & Devlin, 1972; Wetsteijn, 1981), to build up enough reserve for the subsequent spawning season. During the other nine months 50 to 70 % of the animals were found to have empty stomachs. This percentage is much higher than for most flatfish species. For example, a complete time of fasting, which is characteristic in the life cycle of lemon sole, Microstomus kitt is not observed in turbot (Rae & Devlin, 1972). The diet of the juveniles has been shown to consist of copepods, shrimps, barnacle larvae and gastropod mollusc larvae (Jones, 1973).

In general, turbot is rather a sedentary species, but there are some indications of migratory patterns. For example in the North Sea, migrations from the nursery grounds in the south-eastern part to the more northern areas have been recorded, since adult turbot are more tolerant of the colder conditions in the northern areas of the North Sea where temperatures are too low for juveniles to survive. A study in the northern Baltic by Aneer and Weston (1990) also indicated that adult turbot might be considered to be very stationary. In this project a large number of turbot were tagged and released. After recapture the average distance between first capture and recapture appeared to be very short: only 6 km. Furthermore, more than 90% of the recaptured turbot were caught less than 20 km away from the point of first capture.

10.2 Stock identity and possible assessment areas

The following text is copied from Annex 4 of the 2005 Report of the Working Group on Environmental Interactions of Mariculture (ICES, 2005).

Compiling all data from different studies, it becomes clear that there are distinct turbot populations in the Baltic Sea and in the Irish Sea. Furthermore there are indications that

turbot from the North Sea, the southern coast of Iceland, the western coast of Scotland and Ireland, and the Celtic Sea (including the Western Approaches - 51°N, 10°W) forms another stock, the northern Atlantic stock, which is different from the stock originating from the Bay of Biscay and the Atlantic side of southern Europe, the southern stock. Transition zones between the northern stock and the southern stock are found in the English Channel and between the northern stock and the Baltic Sea in Kattegat and the Belt Sea. The situation of turbot stocks in the Mediterranean is still unclear, although there are indications that samples from the Aegean Sea are genetically different from those originating from other areas (Figure 10.2.1).

10.3 Fisheries data

Fisheries in the North Sea, and western European waters

Landings

Table 10.3.1 summarizes turbot landings by area as reported to ICES (Source: Fishstat database). Recently, the total landings of turbot are between 4500 and 6000 tonnes. The North Sea accounts for the major part of the turbot landings.

Fisheries in Belgium

Turbot is mainly caught in mid-class (301–900 Hp) and large (> 900 Hp) beam trawlers. These vessels are mostly flatfish directed (particularly towards plaice and sole, together with the associated bycatch species such as turbot, brill, dab, lemon sole, anglerfish and some roundfish), and usually operate in the central and southern North Sea (ICES Sub-areas IVb and IVc), the English Channel (VIId,e), the Irish Sea (VIIa), the Celtic Sea (VIIf,g) and the inner part of the Bay of Biscay (VIIIa,b). The average effort and the average landings of turbot for the Belgian beam trawl fleet for the period 1996–2005 is presented in Figure 10.3.1.

Fisheries in Denmark

Except for some gillnet fisheries in the North Sea mainly targeting cod and turbot, turbot is taken only as bycatch in Danish fisheries. In the North Sea, where most of the Danish landings of turbot are taken, the gillnet fishery accounts for almost half of the landings (2004 figures), see Figures 10.3.2. In IIIa the main gears are beam trawl and Nephrops trawl.

In the Belt Sea and Western Baltic turbot is taken as by-catch in the fisheries for cod and other flatfish, in gillnets, as well as trawls. In the central Baltic this species is mainly taken in near shore local gillnet fisheries, but in small quantities.

Fisheries in France

Bottom trawlers and netters are the main métiers in France. They account for more than 70% of the brill landings from ICES areas VII and VIII. The species is targeted by beam trawlers and some large mesh netters in area VII. In area VIII, turbot is not targeted, but can be an important by-catch in the sole net fishery and in bottom trawl fisheries.

Beam trawlers from Dunkerque (27 meters long) operate in area IVc and VIId. Smaller boats (14 meters long) from Cherbourg target turbot in area VIId during some seasons. These vessels also catch dab.

Netters using tangle nets or trammel nets with large meshes target monkfish, crayfish, rays and brill (mainly in spring). They also land turbot during summer. Each boat can have between 5 km and 50 km of nets at sea. Most boats make daily trips and the immersion time of the nets is usually 3 days. In the 1990s about 100 vessels fished in the western Channel and about 30 vessels fished north to the Seine bay in area VIId.

The metiers in the English Channel that catch turbot are described in Guitton *et al.*, 2003.

In the 1990s, discarding practices in bottom trawling and netting fisheries were studied during the whole year (Morizur *et al.*, 1996). Discarding was low in netting and mainly occurred when the immersion time was too long (e.g. due to bad weather).

The French landings in 2004 were around 540 t (logbook data base). The landings mainly originate from area VII. Catches from area VIII were less than 80 t.

Fisheries in the Netherlands

Turbot, brill, lemon sole, dab and flounder are caught as part of the by-catch in the beam trawl fishery for plaice and sole, with turbot by far the most important species. For turbot, brill and lemon sole probably only the very small specimens will be discarded. Discard data have been collected during recent years and an overview on discards can be made.

Fisheries in Spain

The Basque fleet operating in areas VI, VII and VIII, and targeting mainly hake, megrim and monkfish have a wide range of bycatch species such as sea bass, brill, turbot, gurnards and mullet. Long liners account for the major part of the turbot landings.

Fisheries in the UK

Landings by UK, England and Wales (E&W), vessels into and outside of E&W and total E&W landings for turbot are given in Tables 10.3.2, 10.3.3 and 10.3.4. The majority of landings are in Divisions IVb and VIIf and are landed into the UK. Data by gear group are available.

10.4 Survey data, recruit series

IBTS

The presence or absence of turbot in the catches of the IBTS survey is summarized in Figure 10.4.1. Turbot is mainly caught in the southern and eastern part of the North Sea.

English surveys

Cefas conducts several annual surveys in which turbot are routinely measured or biological information is retained. Four of the most important surveys are the Irish Sea (VIIa, f & g) beam trawl survey, the Channel (VIId) beam trawl survey, the Carhelmar (VIIe) commercial beam trawl survey and the English groundfish (IVb & c) GOV trawl survey. All fish caught are routinely measured during Cefas surveys, and for most surveys, biological information is collected for turbot. A summary of the numbers of fish measured and the numbers of biological samples (otoliths, length, weight, sex and maturity) in four Cefas survey series is given in Tables 10.4.1 and 10.4.2, respectively.

In addition, data on length distributions, distributions and abundance of turbot is available in Cefas technical reports for the Irish Sea beam trawl survey (Parker-Humphreys, 2004a), the English Channel and southern North Sea (Parker-Humphreys, 2004b) beam trawl survey and the Young Fish Survey for the south and east coasts (Rogers *et al.*, 1998).

10.5 Biological sampling

Biological samples of turbot from the Danish fisheries in the North Sea and in IIIa have been taken both from landed catches and through the national at-sea-sampling programme. Turbot is sampled from the Danish catches from the Baltic.

UK length information from market sampling for turbot is available for 1994–1996, and from 2000 onwards. Biological sampling for otoliths, weight, sex and maturity has only been carried out since 2000. A summary of the number of samples available is given in Tables 10.5.1 and 10.5.2. The otoliths collected have not been aged.

France did collect length and age data on turbot (demographic structures per metier) in the areas VIId and VIIe during the years 1994–1996. These data were collected under an EU funded project carried out by France and the UK (Dunn *et al.*, 1996).

The Netherlands did sample North Sea turbot for age and length in 1982–1990, 1998 and 2002 onwards. The number of length samples varies between 3500 and 5500 per year, the number of otoliths between 400 and 2500 per year. The relative age distribution for the earliest sampling period is presented in Figure 10.5.1. The average age of turbot in the landings of the Dutch beam trawl fleet operating in the North Sea was 3.8 year in the period 1982-1985 and 3.4 in the period 1986–1990.

During the mid 1990s, Belgium took age and length samples of turbot caught in the North Sea, the Eastern English Channel, the Celtic Sea, the Irish Sea, and the Bay of Biscay. The numbers measured vary between 200 and 600 individuals per year. Since 2002, Belgium samples North Sea turbot as part of the DCR, although the sampling intensity has been rather low (< 200 individuals per year). The relative age distribution of turbot in de commercial landings of the Belgian beam trawl fleet for the period 1996–1997 is presented in Figure 10.5.2.

10.6 Population biological parameters and other research

A couple of studies have been carried out on turbot,e.g. Boon *et al.* (2000), Dunn *et al.* (1996), and Ongenae and De Clerck (1998). The reports of these studies include information on growth, maturity and sex ratio of turbot.

10.7 Analyses of stock trends

Dunn (1999) made an assessment of that species in the Channel fisheries (UK and FR) by using a Pella-Tomlinson model to a cpue time series of the English beam trawlers (1984–1995). They concluded that fishing mortality has increased from 1984 to 1989 from 1 to 1.5 and decreased thereafter to 0.7 in 1995. The MSY was given by Dunn (1999) to be between 300 and 400 t, which was lower than the observed catches (550 t /year). Ulrich (2000) found a maximum sustainable production of 440 t/year.

10.8 References

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Table10.3.1. Landings of *Psetta maxima* as reported to ICES (Source: fishstat database)

	X	XII	V	II	I	VIIB,C	VI	VIIA	IX	IIIB-D	BALTIC	IIIA	VIII	VIIG-K	VIID,E	IV	GRAND TOTAL
1973	0	0	1	0	0	19	70	125	94	90	-	100	0	107	58	4212	4876
1974	0	0	2	0	0	21	86	127	65	99	-	117	201	250	187	4116	5271
1975	0	0	3	0	0	31	94	120	79	143	-	183	206	214	284	4588	5945
1976	0	0	3	5	0	48	122	110	109	127	-	383	140	263	388	4814	6512
1977	0	0	3	0	0	35	131	114	92	150	-	736	1187	300	438	4484	7670
1978	0	0	1	17	2	25	100	113	74	120	-	525	126	285	618	5034	7040
1979	0	0	2	8	0	29	86	116	94	126	-	406	264	263	461	6364	8219
1980	0	0	1	0	0	34	82	102	111	124	-	233	373	314	392	5485	7251
1981	0	0	20	0	0	60	103	96	106	160	-	207	388	311	450	4755	6656
1982	0	0	0	0	0	80	174	93	210	139	-	182	166	294	390	4453	6181
1983	0	0	0	2	0	52	162	117	215	60	50	209	221	324	609	4575	6596
1984	0	0	0	1	0	36	138	191	182	67	61	188	190	334	575	1497	3460
1985	0	0	0	0	0	39	112	140	192	167	27	241	270	379	547	1588	3702
1986	0	0	0	0	0	56	102	177	256	129	151	193	342	450	452	1453	3761
1987	0	0	0	0	0	46	118	273	254	161	192	161	369	443	511	1511	4039
1988	0	0	0	0	0	31	160	285	265	198	176	138	493	544	598	4041	6929
1989	0	0	0	0	0	31	162	156	199	170	188	184	453	464	670	4927	7604
1990	0	0	0	0	0	45	103	130	184	234	227	386	354	452	653	5750	8518
1991	0	0	0	0	0	29	100	91	211	270	257	276	255	436	726	6340	8991
1992	0	0	0	0	0	45	98	112	255	352	312	309	311	432	619	5933	8778
1993	0	0	0	13	320	42	98	163	291	337	209	351	347	508	682	5546	8907
1994	0	0	1	11	0	33	96	134	238	266	340	353	1171	551	586	5244	9024
1995	0	0	1	6	0	46	124	122	176	320	399	301	357	596	585	4671	7704
1996	0	0	2	6	0	60	141	107	137	145	600	210	326	675	490	3644	6543
1997	0	3	0	6	0	51	128	149	265	187	492	220	214	657	362	3382	6116
1998	0	0	0	6	0	46	124	147	160	73	541	164	199	457	354	3086	5357
1999	0	3	0	6	0	64	81	112	169	188	377	156	95	423	115	3187	4976
2000	0	0	1	7	0	89	48	106	104	162	273	193	230	528	445	4025	6211
2001	0	0	1	7	0	67	43	106	119	187	160	238	228	510	481	4100	6247
2002	1	0	2	4	0	55	31	132	89	130	166	222	174	621	543	3749	5919
2003	0	0	10	5	0	69	48	209	74	65	160	159	215	548	588	3374	5524
2004	0	0	2	7	0	101	52	100	78	49	196	147	205	607	606	3317	5467
2005	0	0	0	7	0	36	27	102	91	-	281	127	21	354	224	3177	4447

Table 10.3.2. Landings (t) of turbot by E&W vessels into E&W by ICES Division.

	IIA	IVA	IIIA	IVA	IVB	IVC	VA	VB	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIIA	VIIIB	VIIIC	VIIID	VIIJ	VIIK	XIVB	TOTAL
1982	0	0	0	0	2	0	0	0	0	0	0	0	0	6	8	10	0	0	0	0	0	0	0	0	0	27
1983	0	1	0	0	47	1	0	0	0	0	4	0	0	17	66	12	4	1	0	0	0	0	0	0	0	155
1984	1	19	0	0	142	9	0	0	3	0	16	0	0	20	123	38	26	8	0	0	0	0	12	0	0	417
1985	0	14	0	0	141	14	0	0	1	2	25	0	0	18	120	40	12	10	0	0	0	0	1	0	0	398
1986	0	4	0	0	161	7	0	0	1	1	24	0	0	11	108	53	12	18	0	0	0	0	3	0	0	404
1987	0	12	0	0	183	7	0	0	1	1	47	0	0	14	96	104	16	24	0	0	0	0	1	0	0	507
1988	0	15	0	0	146	12	0	0	2	1	33	0	0	9	119	82	55	50	0	0	0	0	1	0	0	524
1989	0	9	0	0	117	8	0	0	1	0	27	0	0	15	76	35	17	10	0	0	0	0	0	0	0	316
1990	0	6	0	0	146	11	0	0	0	0	24	0	0	23	99	25	6	29	0	0	0	0	0	0	0	370
1991	0	14	0	0	200	22	0	0	0	0	22	0	0	30	43	32	11	11	0	0	0	0	1	0	0	385
1992	0	15	0	0	258	22	0	0	1	0	20	0	0	40	55	34	39	14	0	0	0	0	8	0	0	506
1993	0	18	0	0	229	13	0	0	1	0	61	0	0	36	82	51	67	41	0	0	0	0	23	0	0	621
1994	0	10	0	0	221	16	0	0	1	0	29	0	0	27	127	99	50	124	0	0	0	0	9	0	0	714
1995	0	17	0	0	132	16	0	0	1	0	23	0	0	34	123	69	36	128	0	0	0	0	18	0	0	597
1996	0	13	0	0	128	14	0	0	1	0	16	0	0	33	132	82	31	92	0	0	0	0	4	0	0	546
1997	0	16	0	0	99	5	0	0	1	0	16	0	0	21	94	77	36	111	0	0	0	0	3	0	0	480
1998	0	16	0	0	81	8	0	0	0	0	18	0	0	23	68	73	32	30	0	0	0	0	5	0	0	355
1999	0	13	0	0	63	7	0	0	0	0	16	1	0	21	45	43	46	17	0	0	0	0	6	0	0	280
2000	0	10	0	0	73	7	0	0	0	0	13	0	0	29	73	43	33	27	0	0	0	0	3	0	0	312
2001	0	9	0	0	95	3	0	0	0	0	13	0	0	29	99	43	28	21	0	0	0	0	9	0	0	351
2002	0	15	0	0	57	3	0	0	0	0	19	0	0	23	133	65	124	47	0	0	0	0	4	0	0	490
2003	0	0	0	0	29	3	0	0	0	0	72	0	0	24	101	35	57	23	0	0	0	0	4	0	0	348
2004	0	0	0	0	28	2	0	0	4	0	13	0	0	21	122	37	57	19	0	0	0	0	3	0	0	307

Table 10.3.3. Landings (t) of turbot by E&W vessels into foreign ports by ICES Division.

	IIA	IVA	IIIA	IVA	IVB	IVC	VA	VB	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIIA	VIIIB	VIIIC	VIIID	VIIJ	VIIK	XIVB	TOTAL
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
1985	0	0	0	2	4	2	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	11
1986	0	0	0	0	4	2	0	0	0	0	0	2	0	0	0	2	1	0	0	0	0	0	1	0	0	13
1987	0	0	0	2	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
1988	0	0	0	1	12	0	0	0	0	0	1	1	0	0	0	1	0	0	6	0	0	0	0	0	0	23
1989	0	0	0	2	50	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68
1990	0	0	0	1	74	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108
1991	0	0	0	0	140	40	0	0	0	0	0	0	0	5	1	0	2	2	0	0	0	0	0	0	0	191
1992	0	0	0	5	232	16	0	0	0	0	0	0	0	2	1	0	4	0	0	0	0	0	13	0	0	275
1993	0	0	0	5	290	9	0	0	0	0	1	10	0	3	0	1	1	0	0	0	0	0	8	0	0	328
1994	0	0	0	9	220	4	0	0	0	0	0	0	0	2	1	0	10	1	0	0	0	0	12	3	0	263
1995	0	0	0	2	220	6	0	0	0	1	0	0	0	3	1	0	1	0	1	0	0	0	28	0	0	263
1996	0	0	0	1	195	6	0	0	0	1	0	2	17	2	0	0	1	1	0	0	0	0	12	22	0	259
1997	1	2	0	2	175	2	0	0	1	2	0	1	10	1	0	0	0	0	0	0	0	0	32	8	0	238
1998	0	0	0	0	162	1	0	0	0	0	1	3	4	0	0	0	1	3	0	0	0	0	11	0	0	186
1999	0	0	0	0	152	0	0	0	0	0	1	3	1	0	0	0	1	2	0	0	0	0	12	6	0	178
2000	0	0	0	0	170	1	0	0	0	1	1	3	0	0	0	0	0	0	0	0	0	0	11	6	0	194
2001	0	0	0	0	216	4	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0	9	16	0	253
2002	0	0	0	1	147	3	0	0	0	1	0	0	1	0	0	0	3	1	0	0	0	0	18	1	0	177
2003	0	0	0	8	142	8	0	0	0	1	0	1	0	0	0	0	0	2	1	0	0	0	23	0	0	186
2004	0	0	0	3	170	7	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	2	0	0	186

Table 10.3.4. Total landings (t) of turbot by E&W vessels by ICES Division.

	IIA	IVA	IIIA	IVA	IVB	IVC	VA	VB	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIIA	VIIIB	VIIIC	VIIID	VIIJ	VIIK	XIVB	TOTAL
1982	0	0	0	0	2	0	0	0	0	0	0	0	0	6	8	10	0	0	0	0	0	0	0	0	0	27
1983	0	0	0	1	47	1	0	0	0	0	4	0	0	17	66	12	4	1	0	0	0	0	0	0	0	155
1984	1	0	0	20	142	9	0	0	3	0	16	0	0	20	123	38	26	8	0	0	0	0	13	0	0	419
1985	0	0	0	17	145	16	0	0	2	2	26	0	0	18	120	40	13	10	0	0	0	0	1	0	0	409
1986	0	0	0	4	165	10	0	0	1	1	24	2	0	11	108	55	13	18	0	0	0	0	5	0	0	417
1987	0	0	0	14	186	8	0	0	1	1	47	0	0	14	96	104	16	24	0	0	0	0	1	0	0	513
1988	0	0	0	16	158	13	0	0	2	1	34	1	0	9	119	83	56	50	6	0	0	0	1	0	0	547
1989	0	0	0	11	167	25	0	0	1	0	27	0	0	15	76	35	17	10	0	0	0	0	0	0	0	384
1990	0	0	0	7	220	44	0	0	0	0	24	0	0	23	99	25	6	29	0	0	0	0	0	0	0	479
1991	0	0	0	14	340	62	0	0	0	0	22	0	0	35	43	32	12	13	0	0	0	0	1	0	0	576
1992	0	0	0	20	490	38	0	0	1	0	20	0	0	42	56	34	43	14	0	0	0	0	21	0	0	780
1993	0	0	0	23	520	22	0	0	1	0	62	10	0	38	82	51	67	41	0	0	0	0	30	0	0	949
1994	0	0	0	19	441	20	0	0	1	0	29	1	0	29	127	99	60	125	0	0	0	0	21	3	0	977
1995	0	0	0	19	352	22	0	0	1	1	23	0	0	37	124	69	36	128	1	0	0	0	46	0	0	859
1996	0	0	0	14	324	19	0	0	1	1	16	2	17	35	132	82	32	93	0	0	0	0	16	22	0	805
1997	1	2	0	18	274	7	0	0	2	2	16	1	10	22	94	77	37	111	0	0	0	0	36	8	0	717
1998	0	0	0	16	242	8	0	0	1	0	18	3	4	23	68	73	33	34	0	0	0	0	16	0	0	540
1999	0	0	0	13	215	7	0	0	1	0	17	4	1	21	45	43	47	20	0	0	0	0	18	6	0	458
2000	0	0	0	11	243	8	0	0	0	1	14	3	0	29	73	43	33	27	0	0	0	0	14	6	0	505
2001	0	0	0	9	311	7	0	0	0	1	14	1	5	29	99	43	28	21	0	0	0	0	18	16	0	603
2002	0	0	0	16	203	7	0	0	0	1	20	0	1	24	133	65	127	48	0	0	0	0	21	1	0	667
2003	0	0	0	8	170	11	0	0	0	1	72	1	0	24	101	35	57	24	1	0	0	0	27	0	0	534
2004	0	0	0	3	198	9	0	0	4	0	13	0	0	21	123	37	58	21	1	0	0	0	5	0	0	493

Table 10.4.1. The number of turbot measured each year for four Cefas survey series.

	IRISH SEA AUTUMN	IRISH SEA SPRING	CARHELMAR	CHANNEL	NORTH SEA
1988	5				
1989	23		3	14	
1990	11		2	13	
1991	9		2	10	11
1992	20		1	15	4
1993	19	5	3	8	2
1994	23	5	2	10	7
1995	28	3	3	14	
1996	19	3	3	8	3
1997	8	9	3	6	3
1998	16	5	2	4	4
1999	39	3	4	12	6
2000	27		4	16	1
2001	16		6	9	9
2002	31			8	6
2003	23		4	22	4
2004	20			15	6
2005	27			24	15
Total	364	33	42	208	81

Table 10.4.2. The number of turbot for which biological data (otoliths, weight, sex and maturity) have been collected from four Cefas survey series.

	IRISH SEA AUTUMN	IRISH SEA SPRING	CARHELMAR	CHANNEL	NORTH SEA
1994	18		1	3	
1995	28	3	3	10	
1996	19	3	3	7	
1997	8	9	3		
1998	15	5		4	
1999	39				
2000	26				
2001	15		6	9	
2002	28		2	8	
2003	40		6		4
2004				2	6
2005	14			21	14
Total	250	20	24	64	24

Table 10.5.1. Number of turbot measured during the Cefas biological sampling programme.

	NO OF FISH	NO OF SAMPLES
1994	1128	55
1995	821	69
1996	222	10
1997		
1998		
1999		
2000	4231	113
2001	6336	112
2002	3813	66
2003	1	1
2004		
Total	16552	426

Table 10.5.2. Number of turbot for which biological information has been collected by the Cefas biological sampling programme.

	NO OF FISH	NO OF SAMPLES
1995	2	1
1996		
1997		
1998		
1999		
2000	1017	121
2001	1087	137
2002	748	103
2003	13	5
2004		
2005		
Total	2867	367

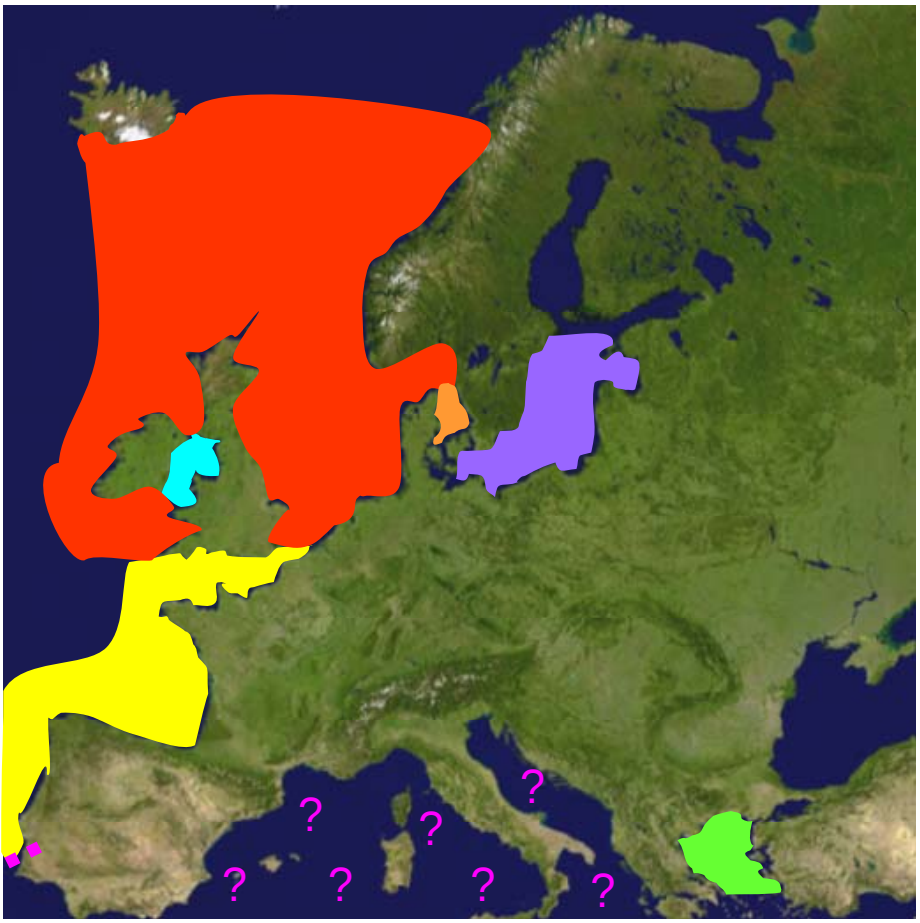


Figure 10.2.1. Preliminary map of the population structure of turbot (From Annex 4, ICES, 2005).

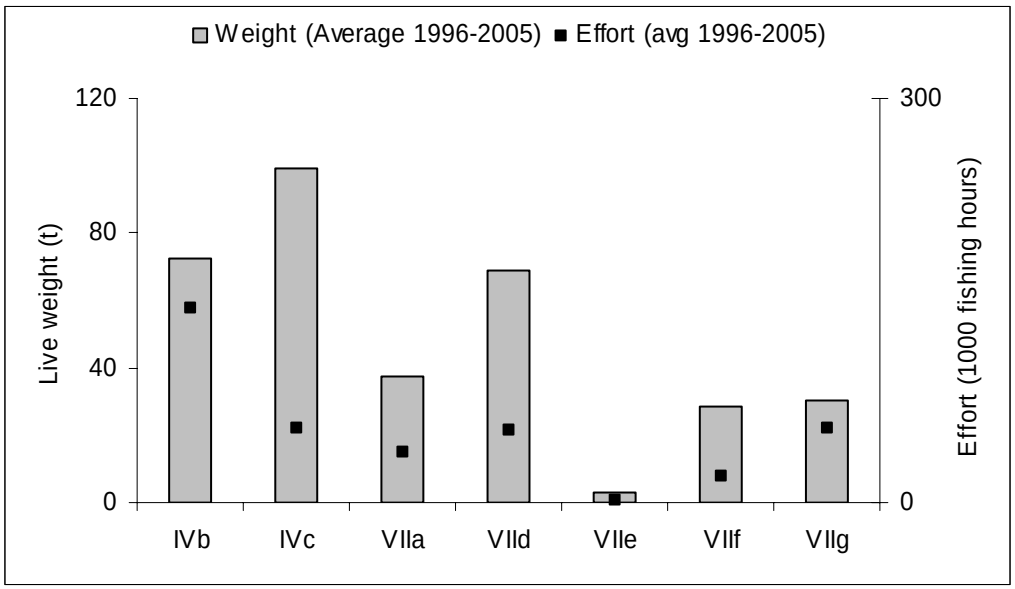


Figure 10.3.1. Average effort and average landings of turbot for the Belgian beam trawl fleet for the period 1996–2005.

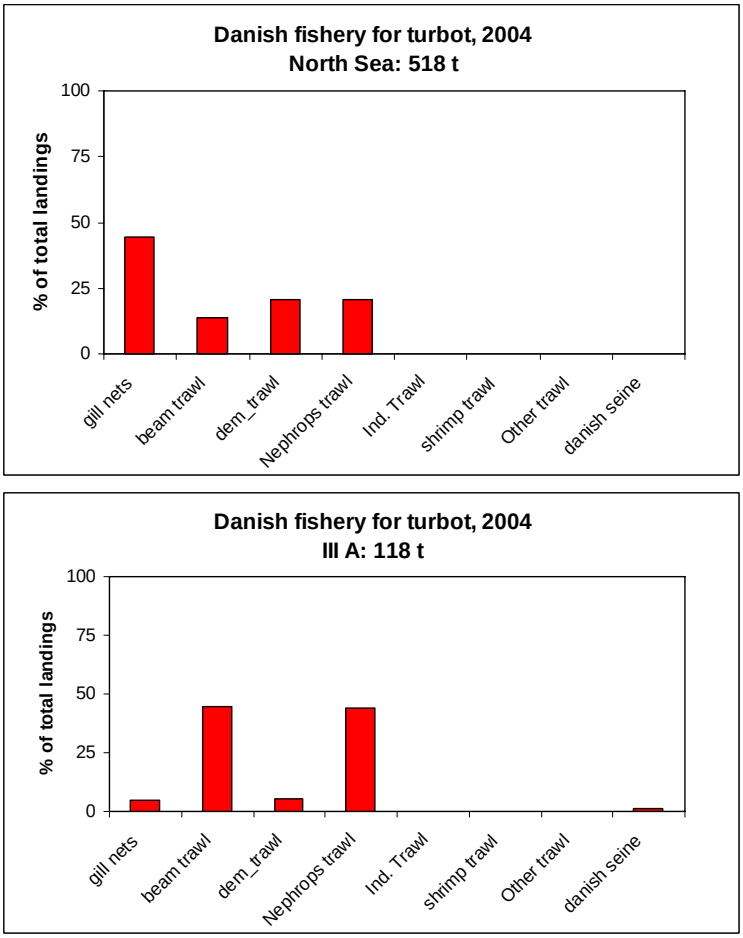
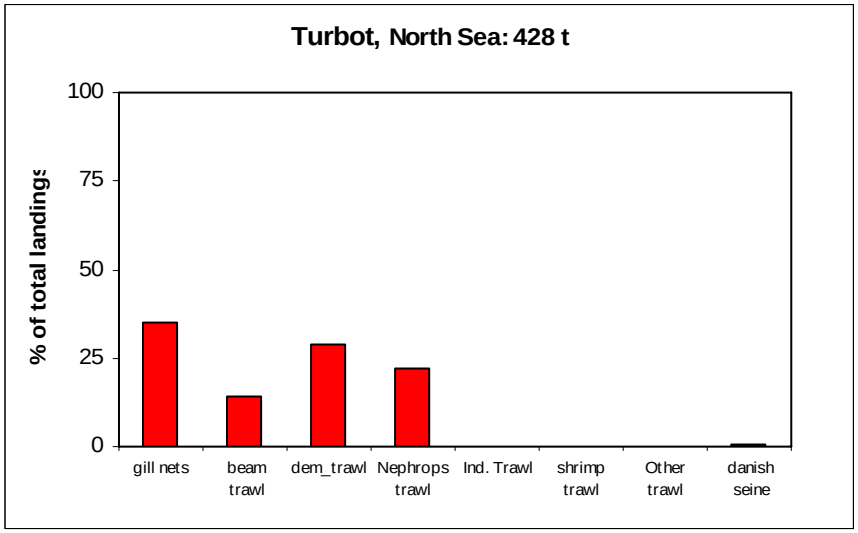


Figure 10.3.2a. Total Danish landings (2004) of turbot in the North Sea and IIIa by fishery.



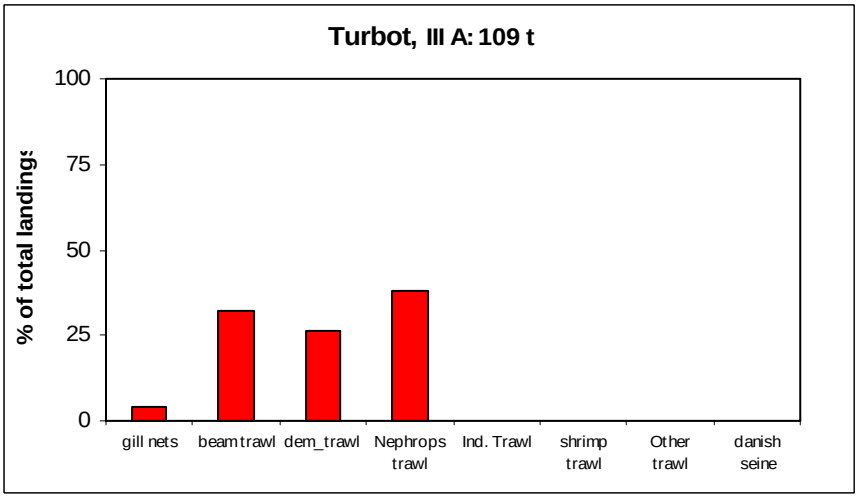


Figure 10.3.2b. Total Danish landings (2005) of turbot in the North Sea and IIIa by fishery.

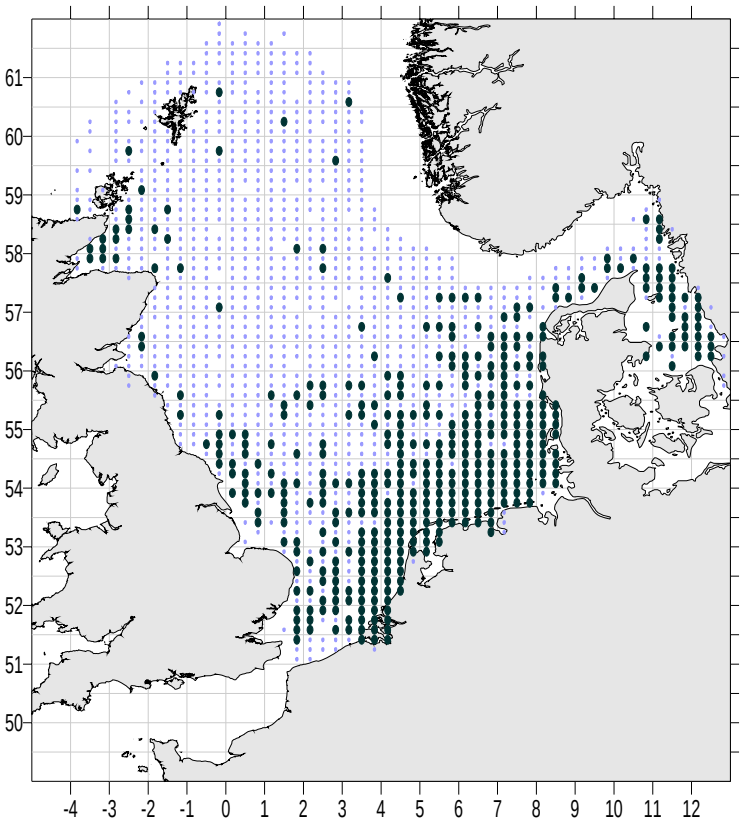


Figure 10.4.1. Turbot catches (present or absent) during the IBTS and BTS surveys.

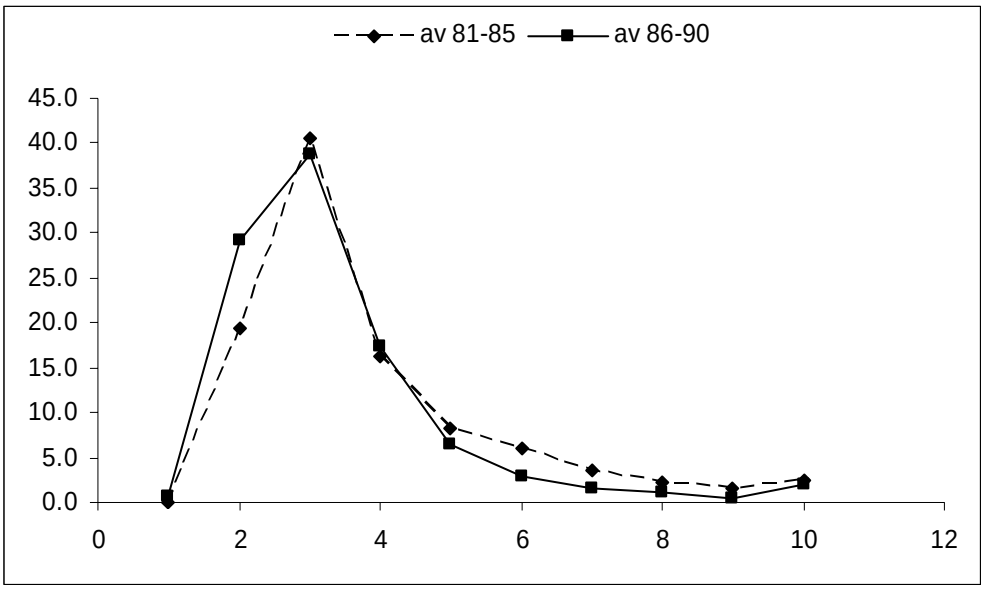


Figure 10.5.1. Relative age distribution of turbot in the commercial landings of the Dutch beam trawl fleet averaged over the periods 1981–85 and 1986–1990.

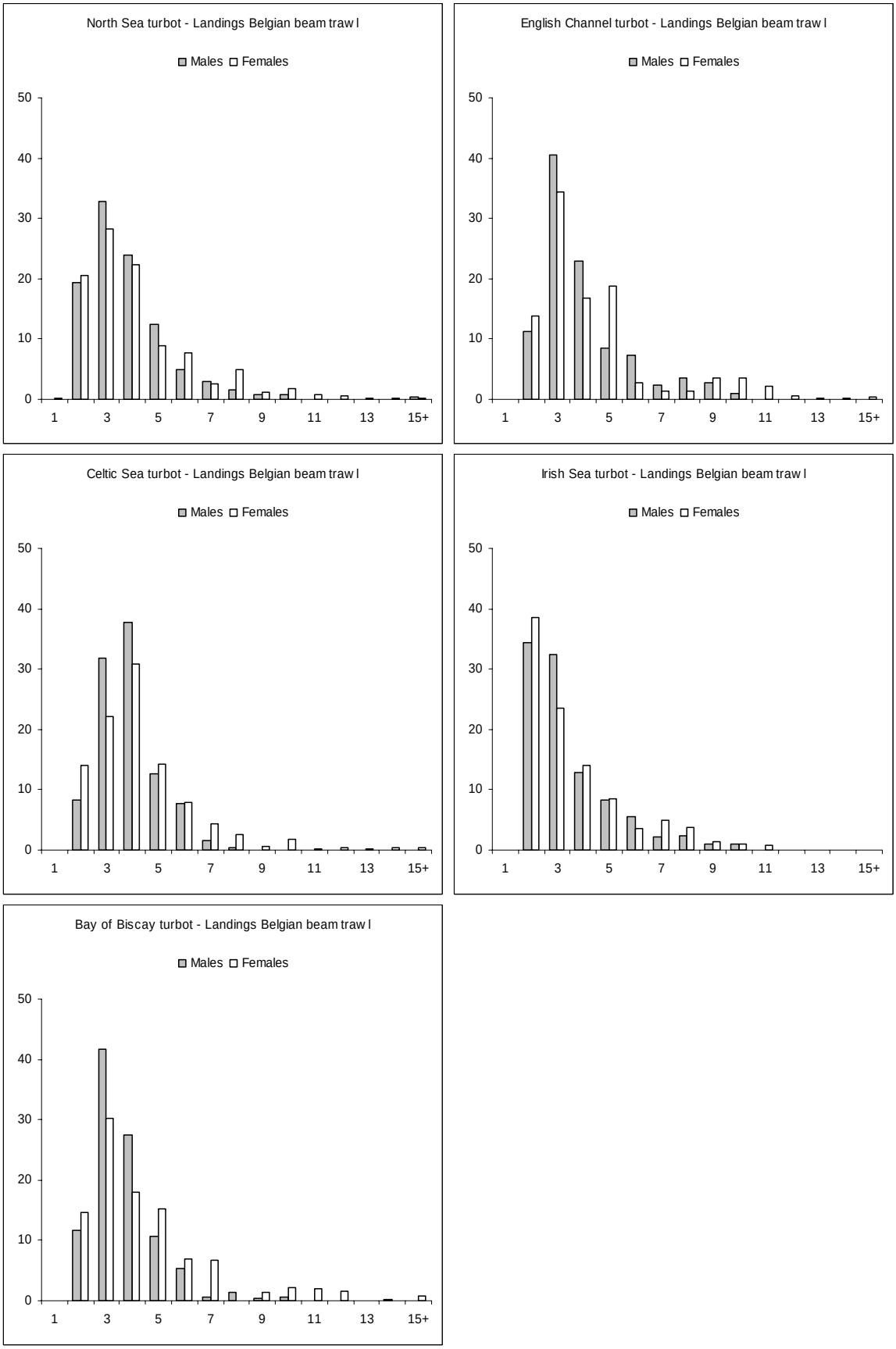


Figure 10.5.2. Relative age distribution of turbot in the commercial landings of the Belgian beam trawl fleet for the period 1996–1997.

11 Lemon sole

11.1 General biology

Lemon sole *Microstomus kitt* is a commercially important flatfish found in the shelf waters of the North Atlantic from the White Sea and Iceland southwards to the Bay of Biscay. They are common in the North Sea and Channel but are absent in the Baltic (Pawson, 1995). Lemon sole may be found over a variety of substrate types from 40–200 m depth (Wheeler, 1969).

11.2 Stock identity and possible management areas

There is little information available on lemon sole stock identity. However, using tagging information, Jennings *et al.* (1993) suggested that the seasonal movements of lemon sole in the western Channel were restricted and that lemon sole in this area could be considered as a separate stock. Clearly, further work on lemon sole stock identity is required.

11.3 Fisheries data

11.3.1 Landings

Total landings of lemon sole within the ICES area are given in Table 11.3.1. Landings increased from approximately 8000 t in the early 1970s to a peak of 14 504 t in 1984. This was followed by a decrease in landings before another peak of 15 506 t in 2001. Landings since 2001 have decreased to approximately 10 000 t. The majority of landings are made by Belgium, Denmark, UK (England & Wales and Northern Ireland), UK (Scotland), France and Iceland.

Total international landings of lemon sole by sea area are given in Table 11.3.2a & b. The majority of landings are from areas IVa, b & c and VII e–k.

11.3.1.1 UK (E&W)

Landings of lemon sole by UK England and Wales (E&W) vessels into and outside of the UK are given in Tables 11.3.3, 11.3.4 and 11.3.5. The majority of catches of lemon sole are made in Divisions IVb, VIId, VIIe and VIIf and landed into the UK (E&W) by beam and otter trawlers (Figure 11.3.1).

11.3.1.2 UK (Scotland)

Landings by the UK Scottish fleet of lemon sole into Scotland from the North Sea and west coast are given in Table 11.3.6a. Most of these catches are from Divisions IVa and IVb (northern and central North Sea) by light trawl, demersal pair trawl and seine (Table 11.3.6b). Lemon sole is mainly caught as a by-catch in the mixed demersal trawl fishery.

11.3.1.3 Denmark

The majority of the Danish landings of lemon sole come from the North Sea, with the remainder from IIIa (Skagerrak and Kattegat) and the north eastern part of the North Sea (Norwegian Deep). It is taken as bycatch, mainly in (mixed) demersal trawl fisheries. In the North Sea, more than 80% of lemon sole landings are taken in fisheries using 'demersal trawl' (mesh size > 100 mm), whereas the main gear in Division IIIa is the *Nephrops* trawl (100 mm > mesh size > 70 mm), (Figures 11.3.2 and 11.3.3, respectively).

11.3.2 CPUE

11.3.2.1 UK (E&W)

Cefas routinely calculates cpue for several species in the southwest. Figure 11.3.2 shows the average cpue of lemon sole caught by trawlers operating in ICES Divisions VIIe, f, g & h between 1972 and 2004 with otter trawls and 1978 and 2004 with beam trawls. Only data on vessels >12m are provided, as vessels smaller than this are not obliged to provide effort data. The cpue calculation standardises the cpue of individual vessels based upon their fishing power.

11.4 Survey data; recruit series

11.4.1 UK (E&W)

Cefas conducts several annual surveys in which lemon sole are routinely measured or biological information is retained. Four of the most important surveys are the Irish Sea (VIIa, f & g) beam-trawl survey, the Channel (VIId) beam-trawl survey, the Carhelmar (VIIe) commercial beam-trawl survey and the English groundfish (IVb & c) GOV trawl survey. A summary of the numbers of fish measured for the four Cefas survey series and the abundance (number per 30 minute tow) is given in Table 11.4.1 and Figure 11.4.1. Length distributions for these survey series for the last 5 years are given in Figure 11.4.2, but are available for the entire duration of each survey series. A summary of the number of fish for which biological data area is available is given in Table 11.4.2. There are a large number of otoliths available for this species. However, few have been aged, although ageing of lemon sole re-commenced at the beginning of 2004. In addition, data on length distributions, distributions and abundance are available in Cefas technical reports for the Celtic Sea (Warnes and Jones, 1995), the Irish Sea (Parker-Humphreys, 2004a) and the English Channel and southern North Sea (Parker-Humphreys, 2004b).

Cefas also undertakes Young Fish Surveys along various parts of the east and south coast of England. Abundance and length distribution information for many of the species under investigation by WGNEW, including lemon sole, can be found in a summary of data for the years 1981 – 1997 in Rogers *et al*. (1998).

11.4.2 UK (Scotland)

FRS carries out yearly surveys in the North Sea and west of Scotland in which lemon sole are caught and measured. No biological data is taken for this species and age data has not been recorded since 1995.

11.4.3 France

France has data on the number and abundance of lemon sole caught during its EVHOE surveys. A composite picture of lemon sole abundance is given in Figure 11.4.3. Lemon sole are most abundant in the north eastern Celtic Sea, off the north west coast of Cornwall and off the southern coast of Ireland.

11.4.4 Germany

Germany has length data for lemon sole caught between 1985 and 2005 from its IBTS (Table 11.4.3). In addition, biological data such as otoliths, sex and maturity are available for 708 individuals caught in the IBTS between 2003 and 2005. However, these individuals have not been aged.

In addition, it is possible that survey datasets from other countries may contain data on lemon sole, and this should be investigated further.

11.5 Biological sampling

Table 11.5.1 shows the number of length and age samples required under the Data Collection Regulations, and those collected through market sampling and the number of lengths of landed and discarded fish collected aboard commercial vessels, for 2004, compiled from available technical reports. It is unclear whether the otolith samples collected have been read.

11.5.1 UK (E&W)

The Cefas Biological Sampling Programme (BSP) has routinely collected length distribution and biological data and otoliths for lemon sole since 1990. A summary of the number of samples and number of fish for which data are available is given in Tables 11.5.2 and 11.5.3. The majority of the otoliths collected have not been aged.

11.5.2 UK (Scotland)

Only length data is collected for lemon sole as part of the FRS market sampling programme.

11.5.3 Denmark

Biological samples of lemon sole from Danish fisheries in the North Sea and in IIIa have been taken both from landed catches and through the national at-sea-sampling programme.

11.5.4 Netherlands

Since 2003 IMARES have been collecting length, age and sex data for lemon sole as part of its market sampling programme (Figure 11.5.1).

11.5.5 Belgium

Length data for lemon sole are collected from the Belgium beam trawl fleet (Table 11.5.4) during market sampling surveys. No other biological or age data is collected.

11.6 Population biology parameters and other research

11.6.1 Discard data

All EU countries are required to collect discard data. However, at present, it is unknown what data have been collected.

11.6.2 Additional information

The basic biology of lemon sole is relatively well known and a summary of lemon sole life history is given in Wheeler (1969). Jennings *et al.* (1993) investigated the distribution, migrations and stock integrity of lemon sole in the western English Channel, using data from official statistics and collected during research surveys. They reported that lemon sole are relatively abundant in the western English Channel and that abundance had not changed notably since the 1950s. However, no lemon sole <18 cm TL were caught during the study, suggesting that juveniles inhabit rocky areas, where they are not accessible to sampling.

Additional information on lemon sole abundance and length distributions can be found in reports from the UK Fisheries Science Partnership (Cotter *et al.,* 2004a, 2004b, Walmsley *et al*., 2004, Armstrong *et al.,* 2005). This programme, which was established in 2003, is composed of a series of programmes designed to answer specific questions that scientists or the fishing industry may have regarding commercial stocks. Information on lemon sole is available for the North Sea and Celtic Sea.

11.7 Analysis of stock trends

11.7.1 Commercial cpue data

The average cpue for lemon sole in the southwest area has been reasonably constant over the time series. The average cpue in the 1980s was almost 4 kg/h, but this declined in the early 1990s and since the early 2000s has been less than 2 kg/h.

Cpue indices for lemon sole caught by E&W beam and otter trawlers in ICES Divisions VIIe, f, g & h are given in Figure 11.3.2. Trends for beam trawlers show high cpue for lemon sole in the early to mid-1980s of approximately 4 kg/h, followed by a decline to approximately 1 kg/h or less by 1990. For Divisions VIIe, g & h, values rose to approximately 2 kg/h by 1995, before declining again. However, for Division VIIf, values have increased to approximately 2 kg/h since 1990. Otter trawlers show a less consistent cpue series for all areas. This may reflect the fact that otter trawlers may target a variety of species and, as a result, the effort used to take lemon sole may be variable. In contrast, beam trawlers primarily target sole and the effort used to take lemon sole may remain more constant.

11.7.2 Survey abundance data

Survey abundances (number of fish caught per 30 minute tow) for lemon sole caught in four Cefas survey series are given in Figure 11.4.1. Abundances of this species in the Channel Beam trawl and Carhelmar surveys tend to be similar, with values relatively constant at 3 fish per 30 min. since 1997. In the North Sea, however, lemon sole abundance has increased from ~6 fish/ 30 min. in 1991 to ~24 fish/30 min. in 2005. This rise in abundance has not been reflected in landings for Divisions IVa, b &c over this time.

11.8 Management

There are currently no management measures in place for lemon sole. At present, there is insufficient data to assess stock status.

11.9 References

Armstrong, M., Dann, J., Keable, J. and Ashworth, J. 2005 - Fisheries Science Partnership 2005/2006 final report. Programme 4: North Sea lemon sole, 32 pp.

Cotter, J., Warnes, S., Bannister, C., Boon, T., and Mills, C. 2004a. Fisheries Science Partnership 2003/2004 final report. Catches of Monk, Hake and other species in western waters by FV Billy Rowney, FV Twilight III, and by RV Corystes, autumn 2003, 50 pp.

Cotter, J., Armstrong, M. J., Dann, J., Garrod, C., and Goddard, M. 2004b. Fisheries Science Partnership 2004/2005 final report. Programme 7: North Sea plaice and lemon sole, 42 pp.

Jennings, S., Howlett, G. J., and Flatman, S. 1993. The distribution, migration and stock integrity of lemon sole *Microstomus kitt* in the western English Channel. Fisheries Research 18: 377–388

Parker-Humphreys, M, 2004a. Distribution and relative abundance of demersal fishes from beam trawl surveys in the Irish Sea (ICES Division VIIa) 1993-2001. Sci. Ser. Tech. Rep., CEFAS Lowestoft, 120: 68 pp.

Parker-Humphreys, M, 2004b. Distribution and relative abundance of demersal fishes from beam trawl surveys in the eastern English Channel (ICES Division VIId) and the southern North Sea (ICES Division IVc) 1993-2001. Sci. Ser. Tech. Rep., CEFAS Lowestoft, 124: 92 pp.

Pawson, M. G, 1995. Biogeographical identification of English Channel fish and shellfish stocks. Fish. Res. Tech. Rep., MAFF, Lowestoft, 99: 72 pp.

Rodgers, S. I., Millner, R. S. and Mead, T.A. 1998. The distribution and abundance of young fish on the east and south coast of England (1981 to 1997). Sci. Ser., Tech. Rep., CEFAS, Lowestoft, 108: 130 pp.

Walmsley, S., Warnes, S., Armstrong, M. Cotter, J. and Dann, J. 2004. Fisheries Science Partnership 2004/2005 final report. Programme 3: Western anglerfish, 58 pp.

Warnes, S., and Jones, B. W. 1995. Species distributions from English Celtic Sea groundfish surveys, 1984 to 1991. Fish. Res. Tech. Rep., MAFF, Lowestoft, 98: 42 pp.

Wheeler, A, 1969. The fishes of the British Isles and North-west Europe. MacMillan, London 613 pp.

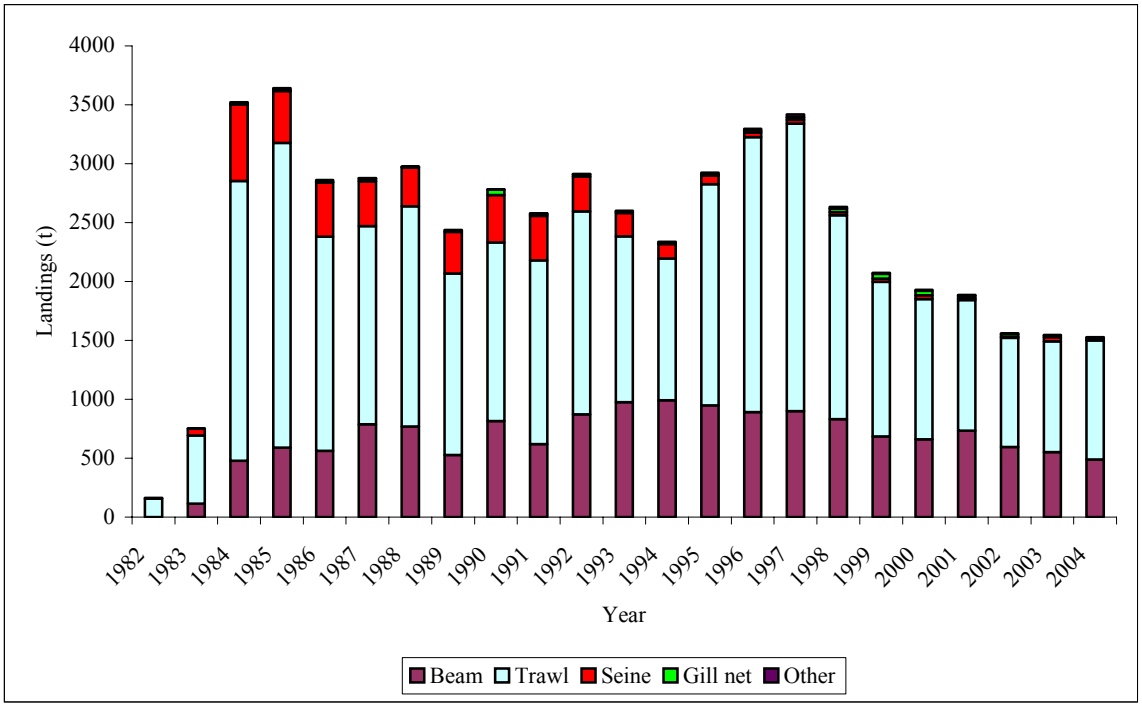
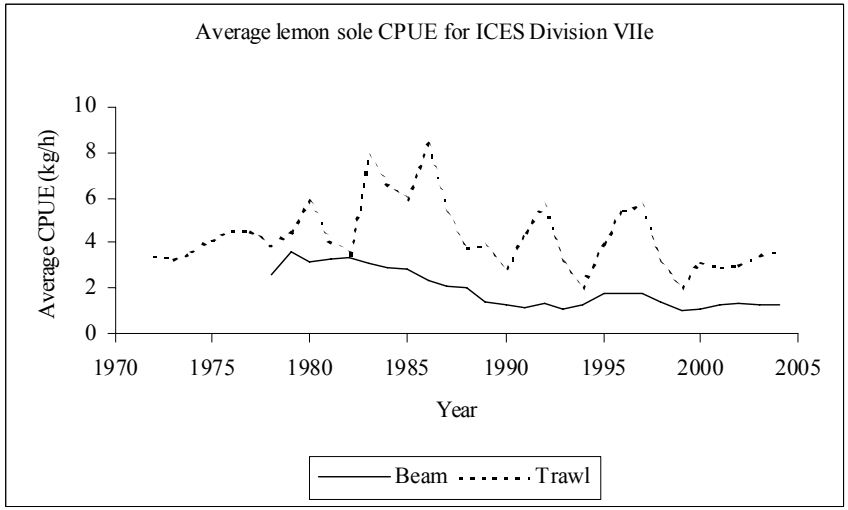
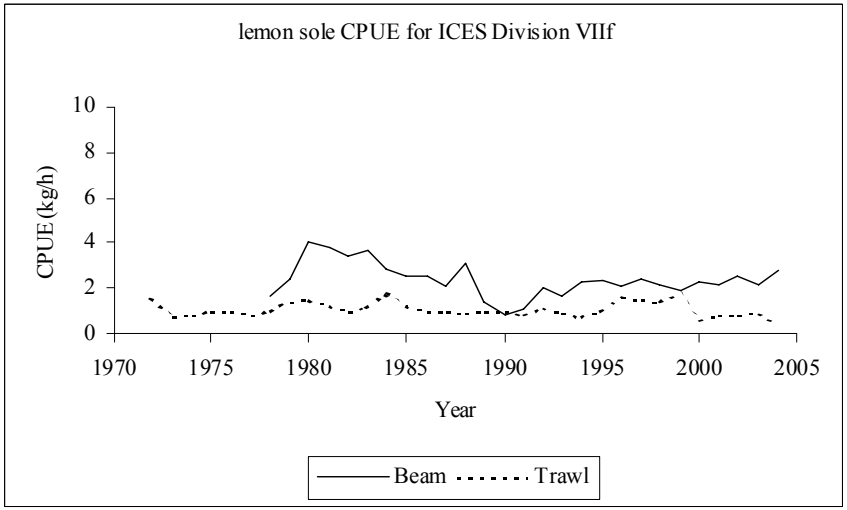
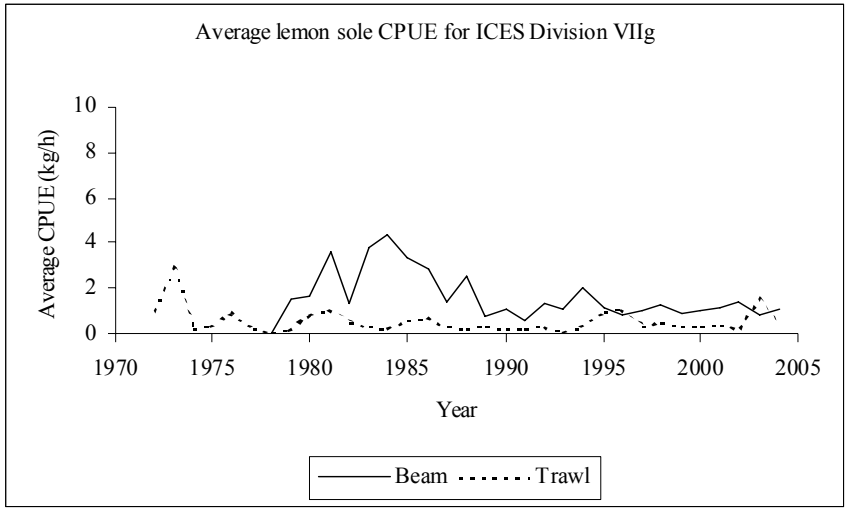


Figure 11.3.1. Annual landings (t) of lemon sole by E&W vessels by gear group.







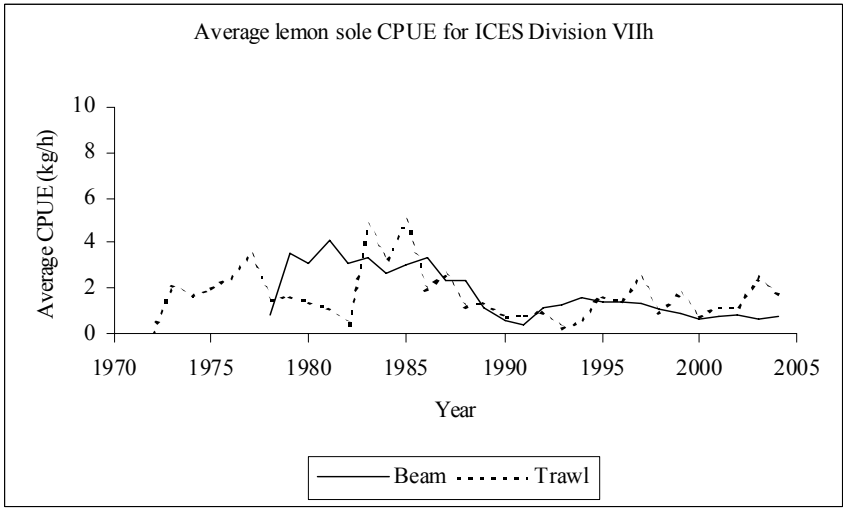


Figure 11.3.2. Average cpue (kg/h) of lemon sole caught by (>21 m length) beam and other trawlers in ICES Divisions VIIe, f, g & h between 1972 and 2004.

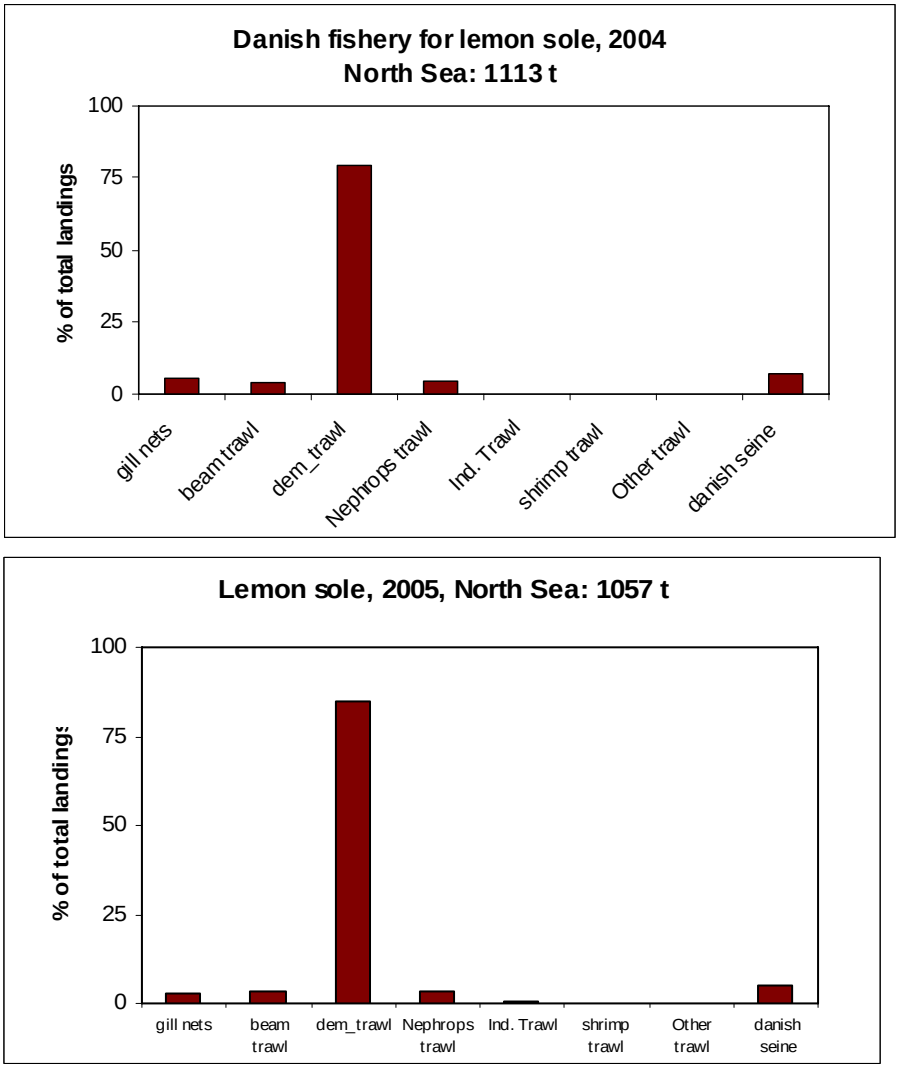


Figure 11.3.2. Landings of lemon sole from the North Sea by the Danish fleet, by gear type.

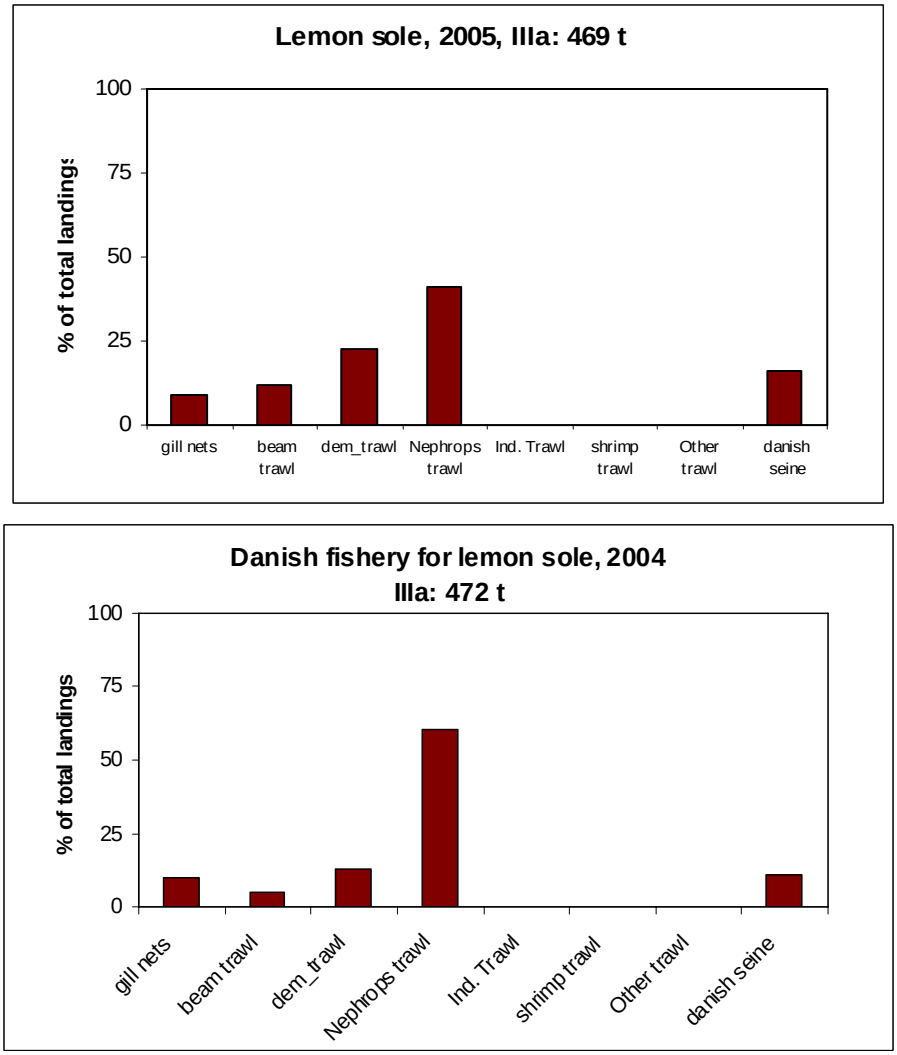


Figure 11.3.3. Landings of lemon sole from Division IIIa Sea by the Danish fleet, by gear type.

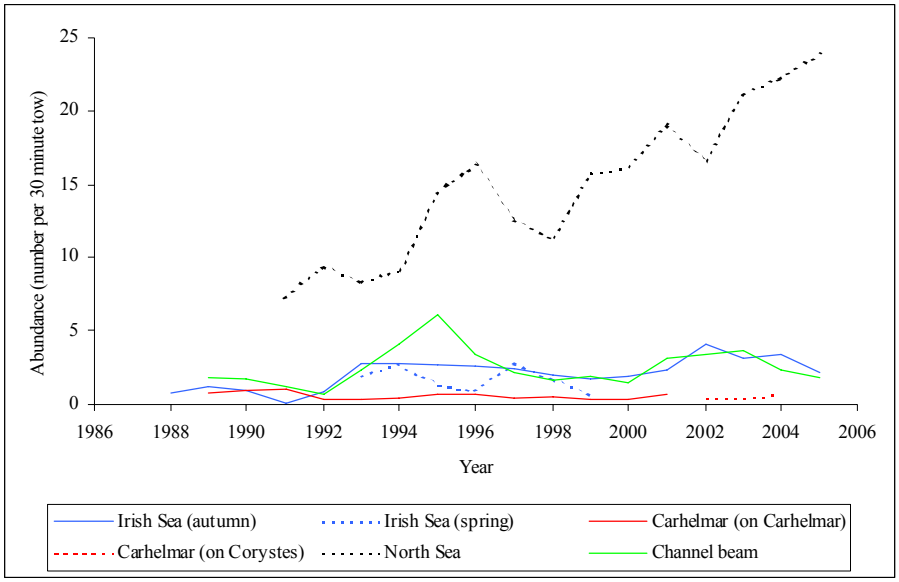


Figure 11.4.1. The abundance (number of fish per 30 minute tow) of lemon sole caught during four Cefas survey series. Details of the surveys are given in the text.

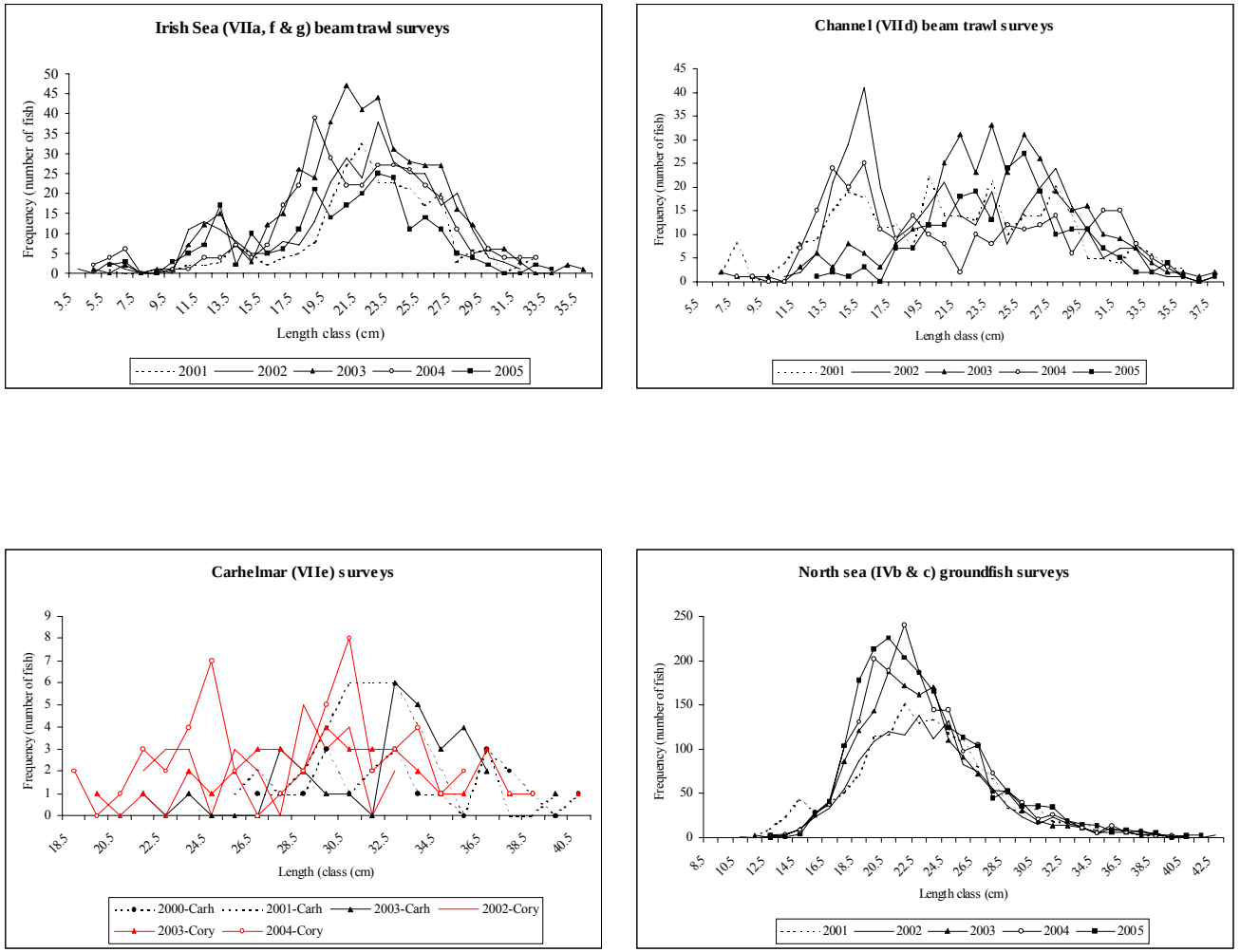


Figure 11.4.2: Length distributions of lemon sole caught in four Cefas survey series.

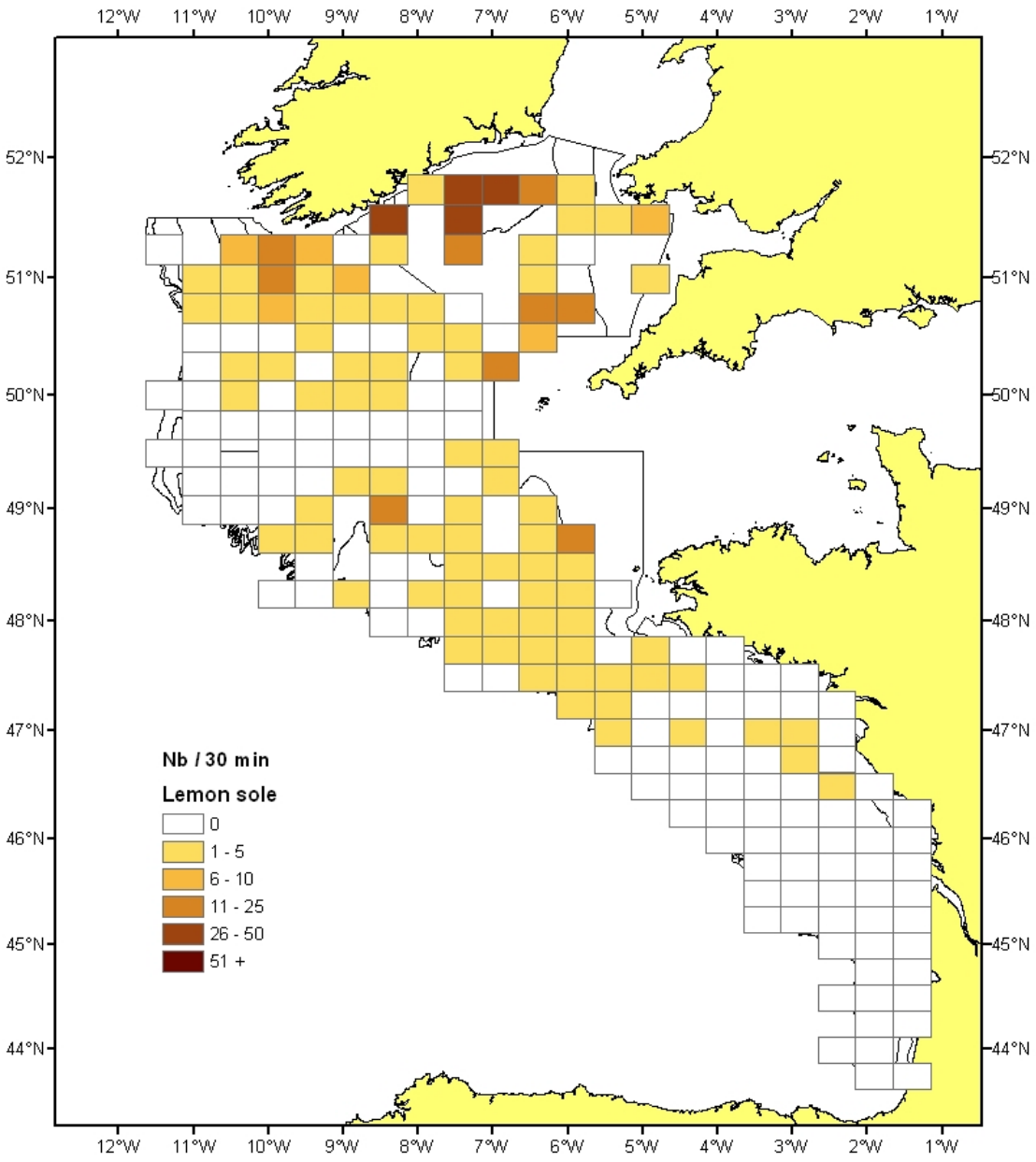


Figure 11.4.3. Average abundance (number of fish per 30 minute tow) of lemon sole caught in the French EVHOE surveys 1997–2004.

Table 11.3.1. Total international landings of lemon sole by country for 1973–2004. Note that data for 2004 are provisional only. Source: FishStat.

	Belgium	Denmark	Faeroe Is	France	Germany	Guernsey	Iceland	Ireland	Isle of Man	Jersey	Netherlands	Norway	Portugal	Spain	Sweden	UK(E&W+NI)	UK(E&W)	UK(NI)	UK(S)	Total
1973	971	692	1193	0	76	0	175	0	0	0	217	16	0	0	71	0	2715	0	1987	8113
1974	923	630	607	0	61	0	84	0	0	0	270	0	0	0	50	0	2293	0	2189	7107
1975	1171	784	972	0	85	2	67	0	0	0	300	0	0	0	63	0	2674	0	2103	8221
1976	819	800	815	0	73	1	63	4	0	0	330	0	0	0	50	0	2895	0	2035	7885
1977	883	850	787	0	81	0	11	291	0	0	303	0	0	0	51	0	2812	0	2580	8649
1978	989	1151	747	1323	56	0	24	160	0	0	245	0	0	0	59	0	2801	0	2554	10109
1979	916	1592	799	1905	42	1	47	169	0	0	400	0	0	0	114	0	2935	0	2441	11361
1980	741	1233	502	2098	49	0	63	203	0	0	303	0	0	0	89	0	3426	0	2661	11368
1981	843	1330	683	2584	39	0	77	230	0	0	415	0	0	0	76	0	2855	0	2255	11387
1982	1246	1328	761	2539	52	1	86	239	9	0	769	0	0	0	80	0	3434	3	2175	12722
1983	1523	1387	1015	2352	28	1	112	304	24	0	1021	0	0	0	114	0	3740	4	2879	14504
1984	1532	1117	1209	2176	22	1	73	379	6	0	na	0	0	0	67	0	3714	4	2743	13043
1985	1411	1317	852	1891	26	1	367	370	4	0	na	0	0	0	68	0	3847	8	2549	12711
1986	891	1185	636	1801	16	0	488	298	7	0	na	0	0	0	57	0	3025	10	2205	10619
1987	803	1354	360	2016	14	0	675	321	6	0	na	0	0	0	69	0	3009	4	2542	11173
1988	901	1230	451	2204	14	0	855	340	3	0	307	0	0	0	57	0	3075	22	2575	12034
1989	788	1447	303	2145	40	0	804	511	4	0	397	0	0	0	77	2831	0	0	2499	11846
1990	786	1807	383	1882	49	0	702	545	4	0	na	0	0	0	78	3149	0	0	2920	12305
1991	748	1779	219	1676	41	0	1095	461	8	0	na	12	0	0	89	2965	0	0	3290	12383
1992	777	2032	261	1455	30	0	915	505	7	0	na	30	0	0	125	3175	0	0	2650	11962
1993	711	2008	201	1514	41	0	697	531	2	0	na	31	0	0	146	2812	0	0	2631	11325
1994	710	1289	276	1828	29	0	692	390	3	0	na	33	0	0	127	2529	0	0	2588	10494
1995	1007	1208	265	1944	72	0	741	723	2	1	na	30	0	0	96	3077	0	0	1896	11062
1996	1095	1108	236	2396	68	0	984	581	4	0	na	46	0	0	117	3492	0	0	1953	12080
1997	976	1172	332	1782	78	0	1135	668	0	0	na	63	0	235	121	3603	0	0	2117	12282
1998	1256	1591	464	1522	152	0	1432	528	4	1	838	59	0	1197	106	2865	0	0	2365	14380
1999	1021	1812	433	1349	69	0	1860	531	3	1	681	59	0	1282	95	2202	0	0	2808	14206
2000	1057	2037	389	1308	74	0	1438	469	3	3	492	59	0	2207	71	2030	0	0	2337	13974
2001	1076	1821	728	1374	78	0	1371	440	1	1	456	53	0	4040	61	2049	0	0	1957	15506
2002	1089	1446	1221	1442	120	0	950	482	0	1	402	61	0	408	48	1683	0	0	1036	10389
2003	1025	1477	1131	1470	142	0	1245	520	0	0	399	75	3	286	39	1636	0	0	968	10416
2004	1339	1610	0	0	86	0	2210	0	0	0	0	61	0	0	34	1606	0	0	831	7777

UK(S) - UK Scotland

UK(E&W) - UK England and Wales

UK(NI) - UK Northern Ireland

UK(E&W+NI) - UK England, Wales and Northern Ireland

*** Provisional data**

na - data unavailable

Table 11.3.2a. Total international lemon sole landings by areas I - VI for 1973–2004. Note that data for 2004 are provisional only. Source: FishStat.

	Area 27Area 27 Sub-area 22Area 27 Sub-area 23)			I	IIa	IIb	IIIa	IIIb,c	IIId	IV	IVa	IVa+b	IVa, b+IIIa	IVb	IVc	Va	Vb	Vb 1	Vb 2	VIa	VIb
1973	0	0	0	0	0	0	214	0	0	0	829	478	71	3051	210	475	0	1673	36	211	1
1974	0	0	0	0	0	0	183	0	0	0	781	447	50	2816	183	332	0	1227	20	255	0
1975	0	0	0	0	0	0	317	0	0	11	797	521	0	3353	347	326	0	1421	23	269	0
1976	3	0	0	3	0	2	361	0	0	0	872	516	0	3171	271	202	0	1209	36	369	3
1977	0	0	0	0	0	0	627	0	0	0	1122	321	0	3920	298	38	191	693	118	484	2
1978	0	0	0	0	0	0	705	4	0	517	1015	0	0	4044	532	31	35	721	37	442	3
1979	0	0	0	0	1	0	833	12	0	876	1036	0	0	4087	429	54	10	798	2	379	0
1980	0	0	0	0	0	0	722	12	0	599	1059	2	0	4487	277	79	0	471	21	346	2
1981	0	0	0	0	0	0	793	15	0	605	837	1	0	3973	517	99	0	650	21	317	0
1982	0	0	0	0	0	0	735	11	0	670	821	3	0	4662	1012	98	0	717	36	240	1
1983	0	16	0	0	0	0	759	0	0	735	1198	4	0	5436	884	119	0	971	44	284	1
1984	0	25	0	0	1	0	595	0	0	567	1171	3	0	4553	636	80	0	1155	54	356	2
1985	0	0	0	0	0	0	793	33	0	555	971	4	0	4458	447	380	0	789	61	257	19
1986	0	31	1	0	1	0	639	0	0	157	938	1	0	3695	256	496	0	576	60	214	15
1987	0	34	1	0	0	0	669	0	0	19	1177	1	0	3932	387	680	0	348	12	329	23
1988	0	21	1	0	0	0	642	0	0	3	1221	1	0	4228	445	860	0	436	15	398	19
1989	0	9	0	0	0	0	693	0	0	2	1067	2	0	4565	331	810	0	287	14	469	12
1990	0	18	0	41	0	0	872	0	0	4	1251	4	0	4581	350	704	15	337	5	491	54
1991	0	36	3	0	0	0	734	0	1	2	1264	6	0	4951	395	1098	6	207	12	426	52
1992	0	83	7	0	0	0	952	0	0	0	1194	5	0	4622	305	919	5	258	3	384	19
1993	0	55	6	0	5	0	1156	2	1	0	1312	3	0	4146	378	701	13	191	18	462	7
1994	0	38	4	0	6	2	803	0	0	0	1183	0	0	3482	597	692	35	176	104	462	9
1995	0	41	6	0	3	0	714	1	2	0	886	0	0	3077	749	741	7	262	3	566	8
1996	0	41	9	0	4	0	635	0	15	0	864	0	0	2976	897	984	10	231	5	499	11
1997	0	40	7	5	7	0	768	0	0	0	790	0	0	3536	401	1135	8	328	4	432	11
1998	0	49	5	12	2	0	868	0	0	0	923	0	0	4909	634	1432	8	455	8	357	57
1999	1349	63	5	11	2	0	844	0	0	0	1032	0	0	4969	315	1864	6	432	0	276	125
2000	389	36	3	22	5	0	803	1	0	0	1158	0	0	4368	454	1438	15	0	0	202	131
2001	5	24	5	10	2	0	584	0	1	0	1054	0	0	3750	585	1371	19	726	2	188	98
2002	0	16	4	19	5	0	522	0	0	0	585	0	0	2737	505	950	36	1216	4	152	34
2003	0	17	1	13	24	0	541	0	0	0	621	0	0	2569	508	1245	26	1126	5	125	46
2004	0	23	4	13	16	0	525	0	0	0	487	0	0	2452	130	2210	20	0	0	45	8

Table 11.3.2b. Total international lemon sole landings by areas VII–XIV and total international landings for the ICES area for 1973–2004. Note that data for 2004 are provisional only. Source: FishStat.

	VIIA	VIIB	VIIB+C	VIIC	VIID	VIID+E	VIIE	VIIF	VIIG	VIIG-K	VIIH	VIIJ	VIIK	VIII	VIIIA	VIIIB	VIIIC	VIIID	IX	IXA	XIV	TOTAL
1973	54	0	0	0	0	451	0	198	0	160	0	0	0	0	0	0	0	0	0	0	1	8113
1974	66	0	1	0	0	351	0	265	0	130	0	0	0	0	0	0	0	0	0	0	0	7107
1975	57	0	1	0	33	0	356	284	0	105	0	0	0	0	0	0	0	0	0	0	0	8221
1976	51	0	0	0	42	0	499	159	0	114	0	0	0	1	0	0	0	0	0	0	1	7885
1977	79	0	16	0	36	1	447	99	0	156	0	0	0	1	0	0	0	0	0	0	0	8649
1978	116	18	6	3	139	2	737	244	321	113	304	6	0	1	13	0	0	0	0	0	0	10109
1979	143	10	7	1	260	0	1201	427	512	107	108	0	0	0	68	0	0	0	0	0	0	11361
1980	146	82	4	1	152	0	1165	515	714	197	143	88	0	1	83	0	0	0	0	0	0	11368
1981	196	0	32	0	290	0	979	465	0	1540	0	0	0	57	0	0	0	0	0	0	0	11387
1982	195	0	31	0	584	0	1180	417	0	1245	0	0	0	64	0	0	0	0	0	0	0	12722
1983	278	0	29	0	491	0	1583	426	0	1132	0	0	0	2	112	0	0	0	0	0	0	14504
1984	313	0	31	0	586	0	1342	328	0	1102	0	0	0	0	143	0	0	0	0	0	0	13043
1985	348	18	13	12	347	0	1480	310	632	313	338	44	5	2	81	0	0	1	0	0	0	12711
1986	333	15	15	65	251	0	1162	398	578	292	333	26	2	1	66	1	0	1	0	0	0	10619
1987	314	54	0	34	310	0	1153	423	578	55	428	117	1	1	92	0	0	1	0	0	0	11173
1988	274	41	0	36	258	0	1149	534	607	63	531	147	1	2	100	0	0	1	0	0	0	12034
1989	325	46	0	26	364	0	1015	406	664	68	427	162	0	4	75	0	0	3	0	0	0	11846
1990	213	54	0	11	423	0	1139	309	530	51	483	281	1	6	73	0	0	4	0	0	0	12305
1991	199	45	0	21	428	0	1184	334	355	26	309	220	0	1	64	1	0	3	0	0	0	12383
1992	206	41	0	12	364	0	1241	343	447	36	231	241	0	1	42	0	0	1	0	0	0	11962
1993	173	48	0	8	422	0	884	346	538	49	204	157	0	2	37	0	0	1	0	0	0	11325
1994	163	46	0	7	695	0	712	349	451	45	278	109	0	1	44	0	0	1	0	0	0	10494
1995	177	84	0	9	877	0	1272	378	439	100	304	302	2	7	44	0	0	1	0	0	0	11062
1996	174	61	0	4	1151	0	1756	414	432	109	425	281	7	9	74	1	0	1	0	0	0	12080
1997	178	41	0	7	563	0	1878	553	410	130	436	298	2	2	76	0	0	1	0	235	0	12282
1998	155	45	0	13	346	0	1135	588	446	118	310	277	5	6	69	1	15	1	0	1131	0	14380
1999	111	43	0	5	140	0	515	265	355	0	69	203	2	0	0	1	2	0	0	1202	0	14206
2000	85	106	0	59	388	0	691	454	630	0	226	257	4	5	38	6	2	1	0	1997	0	13974
2001	134	83	0	55	483	0	820	463	652	0	231	250	3	5	36	4	1	0	0	3862	0	15506
2002	148	72	0	28	474	0	871	541	670	0	269	453	5	21	37	6	0	1	0	8	0	10389
2003	166	57	0	58	471	0	891	428	715	0	253	328	5	0	125	0	0	1	3	48	0	10416
2004	50	1	0	4	225	0	758	476	181	0	67	81	1	0	0	0	0	0	0	0	0	7777

Table 11.3.3. Annual landings (t) of lemon sole by E&W vessels into E&W by ICES Division. Source: Cefas FAD database.

	IIA	IIIA	IVA	IVB	IVC	VA	VB	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIJ	VIIK	VIIIA	VIIIB	VIID	XIVB	TOTAL
1982	0	0	2	23	6	0	0	1	0	0	0	0	48	78	5	0	0	0	0	0	0	0	0	163
1983	0	0	4	408	14	0	0	1	0	5	0	0	78	217	15	4	6	0	0	0	0	0	0	752
1984	0	0	78	1991	78	0	0	4	0	16	1	0	109	1051	90	31	70	2	0	0	0	0	0	3518
1985	0	0	60	2005	64	0	0	1	2	18	0	0	66	1194	82	23	99	9	0	0	0	0	0	3622
1986	0	0	20	1592	29	0	0	3	3	18	0	0	41	923	94	15	108	5	0	0	0	0	0	2851
1987	0	0	23	1636	47	0	0	7	4	31	0	0	44	808	132	13	115	4	0	0	0	0	0	2863
1988	0	0	18	1692	70	0	0	25	3	36	0	0	29	796	118	10	140	1	0	0	0	0	0	2937
1989	0	0	17	1510	32	0	0	11	1	33	0	0	39	609	55	7	56	0	0	0	0	0	0	2371
1990	0	0	23	1550	35	0	0	4	1	17	0	0	79	753	54	10	184	0	0	0	0	0	0	2711
1991	0	0	23	1371	42	0	0	1	0	18	0	0	71	809	80	10	92	0	0	0	0	0	0	2517
1992	0	0	34	1400	34	0	0	2	0	35	0	0	113	946	94	29	73	3	0	0	0	0	0	2763
1993	0	0	32	1310	23	0	4	1	0	31	0	0	63	679	99	32	83	3	0	0	0	0	0	2361
1994	0	0	27	1175	33	0	2	1	0	22	0	0	91	522	102	26	153	1	0	0	0	0	0	2156
1995	0	0	35	1056	75	0	0	3	0	19	0	0	145	1052	128	16	137	4	0	0	0	0	0	2671
1996	0	0	36	957	70	0	3	1	0	11	0	0	203	1471	107	16	160	16	0	0	1	0	0	3054
1997	0	0	41	1094	45	0	1	2	0	19	0	0	105	1552	137	21	155	0	0	0	0	0	0	3172
1998	0	0	35	984	87	0	1	0	0	14	0	0	89	864	135	19	103	2	0	0	0	0	0	2336
1999	0	0	39	940	52	0	1	1	0	6	1	0	89	504	113	28	64	7	0	0	0	0	0	1846
2000	0	0	41	779	26	0	0	0	0	5	0	0	120	523	119	25	58	8	0	0	0	0	0	1706
2001	0	0	23	623	20	0	1	0	0	7	1	0	185	604	115	26	50	5	0	0	0	0	0	1663
2002	0	0	14	342	9	0	2	1	0	6	0	0	115	649	112	15	57	4	0	0	0	0	0	1327
2003	0	0	1	333	8	0	0	0	0	11	0	0	109	649	107	20	51	6	0	0	0	0	0	1295
2004	0	0	0	289	7	0	0	3	0	6	0	0	104	737	97	20	58	5	0	0	0	0	0	1327
2005	0	0	1	235	5	0	0	1	0	6	3	0	70	712	96	18	75	0	0	0	9	0	0	1230

Table 11.3.4. Annual landings (t) of lemon sole by E&W vessels outside E&W by ICES Division. Source: Cefas FAD database.

	IIA	IIIA	IVA	IVB	IVC	VA	VB	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIJ	VIIK	VIIIA	VIIIB	VIIID	XIVB	TOTAL
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
1984	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4
1985	0	0	2	7	1	0	0	0	0	0	0	0	0	0	0	4	0	3	0	0	0	0	0	18
1986	0	0	1	2	0	0	0	0	1	0	1	0	0	0	0	3	0	2	0	0	0	0	0	10
1987	0	0	2	6	0	0	0	1	3	0	0	0	0	0	0	1	0	2	0	0	0	0	0	15
1988	0	0	1	22	3	0	0	6	0	0	0	0	0	0	0	6	0	1	0	0	0	0	0	39
1989	0	0	3	60	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68
1990	0	0	2	61	8	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	72
1991	0	0	0	53	4	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0	0	0	0	61
1992	0	0	6	139	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	150
1993	0	0	9	224	1	0	0	2	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	239
1994	0	0	7	159	2	0	0	5	1	0	1	0	0	0	0	0	0	5	0	0	0	0	0	181
1995	0	0	3	192	8	0	0	12	0	1	2	0	2	1	0	5	0	28	1	0	0	0	0	254
1996	0	0	2	153	5	0	0	1	0	0	6	0	2	1	0	5	0	64	2	0	0	0	0	242
1997	0	0	3	180	2	0	0	0	0	0	0	2	2	0	0	2	0	54	0	0	0	0	0	246
1998	0	0	1	190	1	0	0	2	9	1	9	7	0	0	0	1	0	76	1	0	0	0	0	297
1999	0	0	1	151	0	0	0	1	0	1	14	5	0	0	0	2	1	48	1	0	0	0	0	226
2000	0	0	0	164	0	0	0	0	0	0	9	5	1	0	0	2	0	43	0	0	0	0	0	225
2001	0	0	1	143	2	0	0	0	0	0	13	3	1	0	0	3	0	57	0	0	0	0	0	223
2002	0	0	1	196	1	0	2	0	0	0	3	0	0	1	0	0	0	30	0	0	0	0	0	234
2003	0	0	6	170	3	0	0	3	4	1	3	5	0	0	0	0	2	55	0	0	0	0	0	251
2004	0	0	2	118	1	0	0	0	0	0	0	4	0	0	0	5	2	65	1	0	0	0	0	199
2005	0	0	1	170	3	0	0	0	0	0	8	1	0	0	0	2	4	0	0	0	17	0	0	207

Table 11.3.5. Total annual landings (t) of lemon sole by E&W vessels by ICES Division. Source: Cefas FAD database.

	IIA	IIIA	IVA	IVB	IVC	VA	VB	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIJ	VIIK	VIIIA	VIIIB	VIIID	XIVB	TOTAL
1982	0	0	2	23	6	0	0	1	0	0	0	0	48	78	5	0	0	0	0	0	0	0	0	163
1983	0	0	4	408	14	0	0	1	0	5	0	0	78	217	15	4	6	2	0	0	0	0	0	754
1984	0	0	78	1991	78	0	0	4	0	16	1	0	109	1051	90	31	70	5	0	0	0	0	0	3522
1985	0	0	62	2011	65	0	0	2	2	18	0	0	66	1194	82	27	99	12	0	0	0	0	0	3640
1986	0	0	21	1594	29	0	0	3	3	18	1	0	41	923	94	18	108	7	0	0	0	0	0	2861
1987	0	0	25	1642	47	0	0	7	7	31	0	0	44	808	132	15	115	6	0	0	0	0	0	2879
1988	0	0	19	1714	73	0	0	32	3	36	0	0	29	796	118	15	140	2	0	0	0	0	0	2976
1989	0	0	20	1570	33	0	0	15	1	33	0	0	39	610	55	7	56	0	0	0	0	0	0	2439
1990	0	0	25	1611	43	0	0	4	1	17	0	0	79	753	54	10	184	0	0	0	0	0	0	2783
1991	0	0	23	1424	46	0	0	1	0	18	0	0	71	809	80	12	93	1	0	0	0	0	0	2578
1992	0	0	40	1539	35	0	0	3	0	35	0	0	114	946	95	29	73	4	0	0	0	0	0	2913
1993	0	0	41	1534	24	0	4	2	0	31	0	0	64	679	99	32	83	5	0	0	0	0	0	2599
1994	0	0	34	1334	35	0	2	6	1	22	1	0	91	523	102	26	153	6	0	0	0	0	0	2337
1995	0	0	38	1248	82	0	0	15	0	20	2	0	147	1052	129	21	137	32	1	0	0	0	0	2925
1996	0	0	38	1110	76	0	3	2	0	12	6	0	205	1471	107	22	160	80	2	0	1	0	0	3296
1997	0	0	43	1274	46	0	1	2	0	19	0	2	107	1552	137	23	155	55	0	0	0	0	0	3419
1998	0	0	37	1174	88	0	1	2	9	15	9	7	90	864	135	20	104	77	1	0	0	0	0	2633
1999	0	0	40	1091	53	0	1	1	0	7	16	5	89	504	113	31	65	55	1	0	0	0	0	2072
2000	0	0	41	944	26	0	0	0	0	5	9	5	121	523	119	26	58	51	0	0	0	0	0	1931
2001	0	0	25	766	22	0	1	0	0	8	14	3	186	605	115	29	50	62	0	0	0	0	0	1885
2002	0	0	15	538	10	0	4	1	0	7	3	1	116	650	112	15	57	34	0	0	0	0	0	1561
2003	0	0	7	503	11	0	0	3	4	12	3	5	109	649	107	21	53	61	0	0	0	0	0	1546
2004	0	0	2	407	8	0	0	3	0	6	0	4	105	738	97	25	60	70	1	0	0	0	0	1526
2005	0	0	2	405	7	0	0	2	0	6	11	1	70	712	96	20	79	0	0	0	26	0	0	1437

Table 11.3.6a. Annual landings (tonnes) of lemon sole by Scottish vessels into Scotland by ICES Division. Source: FRS FMD database.

YEAR	IIA	IIB	IIIA	IVA	IVB	IVC	VB1	VB2	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIJ	VIIK	XII	XIVA	TOTAL
1980	0	0	0	870	1288	0	2	+	199	+	5	+	0	0	0	0	0	0	0	0	0	2365
1981	0	0	0	676	1132	0	0	+	192	+	3	0	0	0	0	0	0	0	0	0	0	2004
1982	0	0	0	671	1119	0	0	+	137	0	3	0	0	0	0	0	0	0	0	0	0	1931
1983	0	0	0	964	1431	0	0	0	154	+	2	0	0	0	0	0	0	0	0	0	0	2551
1984	0	0	0	939	1296	0	0	0	189	2	12	+	0	0	0	0	0	0	0	0	0	2438
1985	0	0	0	784	1330	+	+	0	128	15	5	0	+	0	0	0	0	0	0	0	0	2262
1986	0	0	0	842	1134	0	+	0	132	9	2	0	+	0	0	0	+	0	0	0	0	2120
1987	0	0	0	1049	1167	0	+	0	211	14	9	+	+	0	0	0	0	0	0	0	0	2451
1988	+	0	0	1108	1108	0	+	+	222	15	7	+	0	0	0	0	0	0	0	0	0	2460
1989	0	0	0	947	1171	0	+	0	260	11	3	+	0	0	0	0	0	0	0	0	0	2392
1990	+	0	0	1096	1310	3	15	+	293	50	5	1	+	0	0	0	+	1	+	0	0	2776
1991	0	0	0	1122	1658	0	5	0	277	50	6	2	+	0	0	0	+	1	+	0	0	3121
1992	0	0	0	996	1220	0	5	1	225	17	3	1	0	+	0	0	+	0	+	+	0	2467
1993	+	0	0	1112	958	+	4	0	287	6	5	1	0	2	0	0	+	0	0	0	0	2373
1994	0	0	0	1006	1003	0	34	0	322	7	4	1	0	0	0	0	0	0	0	0	0	2375
1995	+	0	0	737	667	0	7	+	284	8	5	1	+	0	0	0	0	0	0	0	0	1709
1996	+	+	0	758	694	+	6	+	282	8	1	+	+	+	+	0	+	0	0	0	0	1751
1997	1	0	0	676	940	+	7	+	173	10	2	+	+	2	+	+	0	0	0	0	0	1810
1998	+	0	0	792	1074	+	7	0	148	14	1	+	0	+	0	0	0	0	0	0	0	2037
1999	+	0	0	897	1387	+	5	+	134	51	2	+	+	+	0	0	+	0	0	0	0	2477
2000	+	0	0	985	952	0	13	1	99	50	1	+	0	0	+	0	0	0	0	+	0	2101
2001	+	0	+	803	758	0	16	1	115	29	1	0	0	0	0	0	+	0	0	0	0	1722
2002	+	0	0	416	326	+	27	2	75	11	2	0	0	0	0	+	+	0	0	0	0	859
2003	+	0	0	374	309	+	22	1	59	14	7	0	0	0	0	0	0	0	0	0	+	786
2004	0	0	0	323	252	+	17	+	38	7	6	+	+	0	0	0	+	0	0	0	0	644
2005	0	0	0	553	259	+	15	+	11	1	+	0	0	0	0	0	0	0	0	0	0	841
Total	2	+	+	21495	25943	4	207	7	4646	399	103	8	1	5	+	+	1	1	1	+	+	52824

+ less than 500 Kg landed

Table 11.3.6b. Annual landings (tonnes) of lemon sole by Scottish vessels into Scotland by gear type. Source: FRS FMD database.

YEAR	BTR	CRF	GNT	GRL	ITR	LTR	MED	MTD	MTN	MTR	NTR	OTH	OTN	PSH	PSN	PSO	PTD	PTO	QTR	SDR	SEN	SML	STO	STP	STR	TRD	TOTAL
1980	0	0	0	0	0	1269	0	0	0	214	89	0	0	0	0	0	69	0	3	+	719	0	0	+	3	0	2365
1981	0	0	0	0	+	830	0	0	0	184	68	0	+	0	0	0	250	0	2	+	669	+	0	0	1	0	2004
1982	0	0	0	0	0	806	0	0	0	100	49	0	2	0	0	0	232	0	+	+	740	0	0	0	1	0	1931
1983	0	0	0	0	+	1091	0	0	0	167	78	0	11	0	0	0	287	0	1	+	914	0	0	0	2	0	2551
1984	43	0	+	0	+	931	0	0	0	90	97	0	0	0	0	0	383	0	2	+	891	0	0	0	+	0	2438
1985	46	0	+	0	0	774	0	0	0	126	91	0	+	0	0	0	502	0	1	+	719	0	0	0	2	0	2262
1986	35	0	+	0	0	705	0	0	0	121	89	0	0	0	0	0	356	0	+	+	812	0	0	0	1	0	2120
1987	100	0	+	0	+	829	0	0	0	63	136	0	+	0	0	0	373	0	+	1	943	0	0	0	5	0	2451
1988	40	0	+	0	0	997	0	0	0	40	132	0	0	0	0	0	420	0	0	1	830	0	0	0	1	0	2460
1989	27	0	+	0	0	894	1	0	0	27	115	0	0	1	0	0	443	0	+	0	882	+	0	0	1	0	2392
1990	70	0	+	0	0	913	+	0	0	29	100	0	+	0	0	0	605	0	+	0	1058	0	0	0	+	0	2776
1991	180	0	+	0	0	776	2	56	47	21	53	0	0	0	0	0	671	0	+	0	1315	+	0	0	0	0	3121
1992	199	0	+	+	0	647	1	49	27	9	54	0	+	0	0	0	497	0	+	0	983	+	0	0	+	0	2467
1993	40	0	+	0	0	758	+	36	27	12	58	0	0	0	0	0	616	0	1	0	825	+	0	0	+	0	2373
1994	51	0	+	+	0	703	2	68	27	50	92	0	0	0	566	0	472	0	+	0	343	+	0	0	+	0	2375
1995	45	0	+	0	0	534	+	14	8	24	50	13	0	0	285	0	392	+	+	0	340	+	1	0	0	0	1709
1996	50	0	+	0	0	612	3	23	3	17	74	11	0	0	246	0	378	+	+	0	331	+	2	0	1	0	1751
1997	39	0	+	0	0	495	3	67	14	48	63	5	0	0	206	0	575	+	0	0	294	0	2	0	+	+	1810
1998	26	0	+	0	0	598	+	61	17	47	60	11	0	0	252	1	677	+	0	0	282	0	+	0	2	0	2037
1999	14	1	+	0	0	617	5	100	22	100	85	17	0	0	323	0	809	+	+	0	383	+	+	0	+	0	2477
2000	5	0	0	0	0	621	+	132	36	140	94	13	0	0	204	0	539	1	+	0	316	+	+	0	+	0	2101
2001	5	0	+	0	0	524	+	122	37	89	75	19	0	0	150	0	432	1	+	0	269	+	1	0	+	0	1722
2002	2	+	+	0	0	263	+	50	34	69	72	27	0	0	38	0	201	1	0	0	102	0	+	0	0	0	859
2003	2	+	0	0	0	260	+	63	21	62	125	7	0	0	9	0	136	5	0	0	97	+	+	0	0	0	786
2004	2	+	0	0	0	186	+	27	18	57	152	6	0	0	7	0	87	1	1	0	99	0	1	0	0	0	644
2005	2	0	0	0	0	214	+	21	47	44	192	5	0	0	0	0	189	1	0	0	126	0	+	0	+	0	841
Total	1024	1	2	+	+	17847	19	890	387	1948	2343	133	13	1	2284	1	10593	11	13	3	15283	1	8	+	19	+	52824

+ less than 500 Kg landed

BTR Beam Trawl
MTD Multiple Trawl Demersal
PSN Pair Seine
SML Small LinesCRF Creel Fishing
MTN Multiple Trawl Nephrops
PSO Purse Seine Others
STO Single Boat Pelagic Trawl Others
GNT Gill Nets Demersal
MTR Trawl Single Demersal
PTD Pair Trawl Demersal
STP Single Boat Pelagic Trawl
GRL Great Lines
NTR Nephrop Trawl
PTO Pair Trawl Others
STR Shrimp Trawl
ITR Industrial Trawl
OTH Other Gears
QTR Queen Scallop Trawl
TRD Tractor Dredging
LTR Light Trawl
OTN Other Nets

SDR Scallop Dredging
MED Mechanical Dredging
PSH Purse Seine Herring
SEN Seine Net

Table 11.4.1. Summary of the number of lemon sole measured and the average abundance (number of fish per 30 minute tow) caught during annual Cefas surveys. Note: the Irish Sea beam-trawl survey is usually carried out in autumn, but during 1993–1999, an additional survey was carried out during spring. The Carhelmar survey is named for the commercial vessel on which the survey is carried out. In 2002–2004, this survey was carried out on the RV Corystes, with both vessels fishing the survey grid in 2003.

	Irish Sea (VIIa, f &g) beam trawl				Carhelmar (VIIe) beam trawl				North Sea (IVb & c)		Channel beam trawl (VIId)	
	Autumn		Spring		Carhelmar		Corystes					
Year	Number	Abundance	Number	Abundance	Number	Abundance	Number	Abundance	Number	Abundance	Number	Abundance
1988	62	0.78										
1989	90	1.17			44	0.79					116	1.79
1990	110	1.01			54	0.96					120	1.76
1991	11	0.10			57	1.11			643	7.23	93	1.20
1992	92	0.84			20	0.36			705	9.40	55	0.68
1993	398	2.80	229	1.94	20	0.37			641	8.33	189	2.39
1994	338	2.79	341	2.82	25	0.44			721	9.12	336	4.10
1995	324	2.70	98	1.26	35	0.65			1225	14.41	636	6.06
1996	315	2.56	66	0.97	35	0.60			1390	16.35	382	3.38
1997	268	2.41	317	2.76	26	0.46			1022	12.61	198	2.13
1998	206	2.04	154	1.74	32	0.55			958	11.27	156	1.58
1999	174	1.72	44	0.67	18	0.32			1226	15.71	173	1.92
2000	189	1.95			21	0.36			1226	16.13	164	1.47
2001	238	2.33			38	0.66			1501	18.99	331	3.09
2002	439	4.02					31	0.44	1306	16.53	350	3.37
2003	331	3.06			30	0.52	37	0.47	1586	21.14	383	3.68
2004	364	3.41					51	0.69	1798	22.19	288	2.34
2005	227	2.10							1939	23.94	171	1.84

Table 11.4.2. Summary of the number of lemon sole for which biological data (otoliths, weight, length, sex and maturity) are available during annual Cefas surveys. Note: the Irish Sea beam trawl survey is usually carried out in autumn, but during 1993-1999, an additional survey was carried out during spring.

	CARHELMAR (VIIE)	IRISH SEA, AUTUMN (VIIA, F &G)	IRISH SEA, SPRING (VIIA, F &G)	CHANNEL BEAM (VIID)	NORTH SEA (IVB & C)
1993	19	204	216		
1994	55	233	275	16	
1995	36	191	61	98	
1996	35	200	64	138	
1997	28	144	221		
1998	32	119	103	92	
1999	18	129			
2000	21	133		32	
2001	38	152		168	
2002	31	182		182	
2003	36	187			224
2004				81	240
2005		141		104	272

Table 11.4.3. Summary of the data available for lemon sole from German surveys.

SURVEY DATA	IBTS COVERAGE	LENGTH MEASUREMENTS (NUMBER)	AGE	DISCARD AND BYCATCH DATA	LANDINGS BY GERMAN VESSELS*
Time series 1959-2005	20 %	Time series 1985-2005	708 specimens 2003-2005 additionally sex, maturity	DCP	

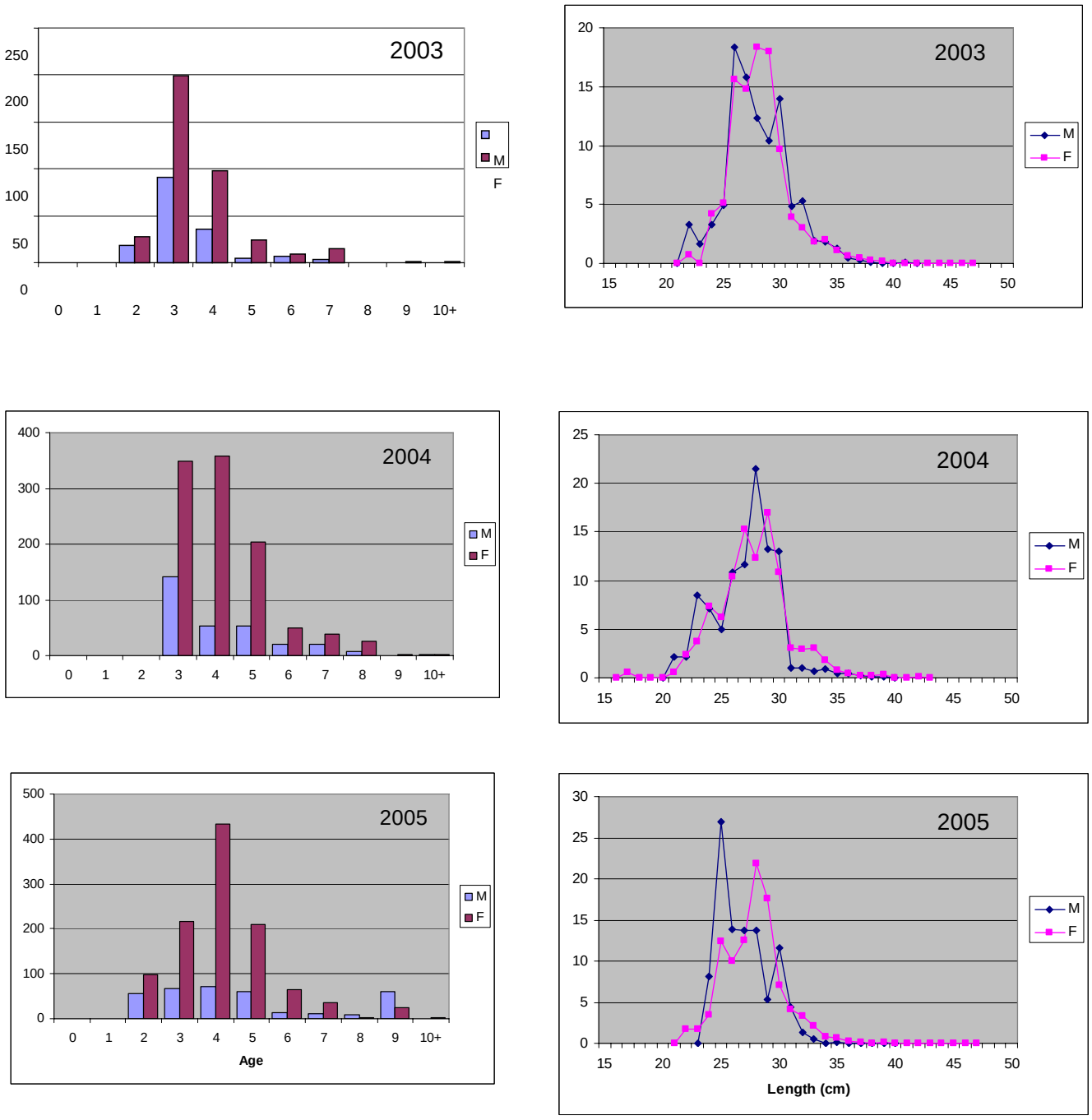


Figure 11.5.1. Summary of raised Dutch market sampling data of lemon sole 2003–2005. Numbers (x1000) landed by age by sex (left hand graphs). Percentage landed by length by sex (right hand graphs).

Table 11.5.1. Summary of the number of lemon sole length and age samples required and achieved by all countries submitting technical reports for 2004.

	Market samples				On board sampling	
Stock areas	Lengths required	Lengths collected	Ages required	Ages collected	Landings measured	Discards measured
IV, VIId	343	12396	429	1399	12122	4257
V, VI, VII (excl. VIId), VIII, IX, X, XII, XIV	-	-	-	-	281	662

Table 11.5.2. Summary of the number of lemon sole measured and number of length samples collected through the Cefas biological sampling programme for 1990-2004, by ICES Division.

	IVa		IVb		IVc		VIIa		VIId		VIIe		VIIf		VIIg		VIIh		Total	
	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Samples
1990									461	1	19337	57	410	2	628	1	1043	3	21879	64
1991									1580	1	13682	42	361	1			964	4	16587	48
1992											13040	32	2032	3			1234	4	16306	39
1994							482	1			2205	21	1682	4			992	8	5361	34
1995									70	4	10299	84	90	1	105	1	1322	12	11886	102
1996											12144	85	95	1			1201	10	13440	96
1997											9992	81	218	2			1378	12	11588	95
2000	3499	21	21859	158	61	1	47	1			9407	86	118	1			987	9	35978	277
2001	1743	10	14890	102							9154	80	285	2	205	2	1409	13	27686	209
2002	1032	6	6697	42	175	1					7743	79	275	3			1132	13	17054	144
2003			6162	52	52	1					6086	58	361	3			1697	15	14358	129
2004			3904	34							8797	79	490	4	84	1	516	6	13791	124

Table 11.5.3. Summary of the number of lemon sole and number of biological samples (including otoliths/scales, weight, sex and maturity) collected through the Cefas biological sampling programme for 1990–2004, by ICES Division.

	IVa		IVb		IVc		VIIa		VIId		VIIe		VIIf		VIIg		VIIh		VIIj		Total	
Year	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Sample	Fish	Samples	Fish	Samples	Fish	Samples	Fish	Sample	Fish	Sample	Fish	Sample	Fish	Samples
1992											90	6									90	6
1993											1482	91	22	4			53	3			1557	98
1994											1252	60	63	5	2	1	297	18			1614	84
1995					3	1	9	1			1390	64	24	2	30	2	193	13			1649	83
1996											1086	51	10	1			238	12			1334	64
1997											1170	43	8	2			119	7			1297	52
1998			5700	53							10587	129	675	11			746	17	5	1	17713	211
1999			3837	131							10610	134	124	2			834	11			15405	278
2000	144	11	1657	169							957	46					110	6			2868	232
2001	39	4	1575	154	6	1					1509	77	32	2			331	16			3492	254
2002	88	8	1134	128	19	2					1174	67	6	2			290	12			2711	219
2003	15	1	470	34			12	1			1245	83	53	7			82	8			1877	134
2004			350	20					11	1	1153	72	61	5	7	1	84	12			1666	111

Table 11.5.4. Length distribution of North Sea lemon sole landed by the Belgian Beam trawl fleet.

LENGTH (CM)	2002	2003	2004	2005	2006*
23	118479	15465	7765	0	6572
24	196837	86251	39839	13971	30761
25	172449	139816	132078	90809	55685
26	216172	125310	194740	146692	84751
27	286078	149473	244512	266439	134561
28	188983	153008	230543	207560	169554
29	192929	151481	207672	227513	151599
30	137152	150053	159948	187096	149745
31	111544	95987	157147	154651	143311
32	96511	113839	135863	82322	162118
33	82274	86703	142404	68112	121703
34	55587	59873	85845	73038	89015
35	40938	27524	69162	31498	42559
36	25397	12715	40923	26525	36213
37	18741	7974	26482	16578	16513
38	10865	8410	11637	8289	9792
39	6971	8597	2023	8289	3487
40	6174	7934	1674	0	2981
41	387	2898	1153	1658	595
42	1582	5217	285	1658	0
43	1041	2898	0	0	276
44	0	1739	0	0	276
45	836	0	0	0	0
46	316	0	0	0	0
47	316	0	0	0	0
48	0	0	0	0	0
49	0	0	0	0	0
50	0	0	0	0	0
Total number	1968559	1413166	1891696	1612697	1412064
Total weight (kg)	541519	451935	580389	539265	502857

*** data for 2006 are preliminary**

12 Dab

12.1 General biology

Dab 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 secondmost abundant species in the North Sea (Daan *et al.,* 1990). According to the IBTS results and other research surveys 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 southern North Sea (Rijnsdorp *et al.,* 1992). Specimens released along the Belgian coast and the West-Frisian island Terschelling remained in the area (de Clerck, 1984; Rijnsdorp *et al.,* 1992, summarising earlier work from U. Damm, F. Lamb and A Rijnsdorp, referenced therein).

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 'euyhaline' and 'eurytherme' (Bohl 1959; Henderson and Holmes, 1991).

Dab has proven to be a valuable indicator in ecotoxicological studies (only one reference, e.g. Vethaak *et al.,* 1992).

12.2 Stock identity and possible assessment areas

The existence of several spawning grounds and the wide distribution of dab may indicate the presence of more than one stock (Table 12.2.1). However, egg surveys are available to only a limited extent to verify potential spawning grounds.

Meristic data (Lozán, 1988) corroborate the hypothesis of several stocks for dab, distinguishing significantly between populations from western British waters and the North Sea and the Baltic. Further, tagging experiments and significant meristic differences within Baltic populations led Temming *et al.* (1989b) to propose an individual stock around Bornholm, separated from IIIc22. However, no further scientific evidence is available.

Under the EU Data Collection Regulation, 5 stocks/management units have been defined (those underlined are subject to sampling under the DCR):

- II, V, VI, VII (excl. d), VIII, IX, X, XII, XIV
- IIIa north
- IIIa south, IIIb-d
- IV, VIId
- VIId.

12.3 Fisheries data

12.3.1 Landings

According to ICES catch statistics, the annual catch of dab in ICES Divisions III, IV, and VII has been well above 10 000 t since 1973. Apparent decreases in total catch are due to unreported catches by the Netherlands, Norway and Spain (Table 12.3.1, Figure 12.1).

12.3.1.1 UK (E&W)

Landings of dab by England and Wales (E&W) vessels into E&W, foreign ports and total E&W landings are given in Tables 12.3.2, 12.3.3 and 12.3.4. Landings peaked in the mid-1990s but have since declined and, in 2004, the E&W fleet landed only 142 t of this species. Landings by gear group can be provided for this species if required.

12.3.1.2 Germany

Time series by area, season and fleet are available.

12.3.2 Description of fishing fleet

12.3.2.1 Germany

Dab is caught in the fisheries directed at plaice and sole. Landings are dominated by catches from demersal trawlers of 12 m to 24 m length (> 60% of landings in 2004 by L2M2-type vessels (acc. to EU regulation 1639/2001-code)). Landings and fleets differ regionally. In IIIc22, which accounted for 48% of all dab landings in 2004, L1-type vessels contributed about 20%. In IVb, only L2-type vessels were engaged, providing 45% of all dab landings. Accordingly, 93% of all German dab landings were caught in IIIc22 and IVb.

12.3.2.2 The Netherlands

Dab is part of the by-catch in the beam trawl fishery for plaice and sole. Discard data have been collected during recent years and an overview on discards can be made. Only the bigger specimens of dab are landed, and most of the catch will usually be discarded. The portion retained depends on the availability of the main target species, and on market prices.

12.3.3 Catch and effort data by sea area and country

No information available to the WG.

12.4 Survey data, discards, recruit series

12.4.1 International surveys

The ICES IBTS has recently extended its focus area to western and southern European shelf areas (ICES, 2005) and thus now together with BITS provides data on most of the distribution range of dab.

As national surveys have been devoted to IBTS (see next sections), there is likely to be some overlap between IBTS and national surveys.

12.4.2 National surveys

Summary of present information is provided in Table 12.4.1, distinguishing between offshore, coastal and inshore surveys where possible.

12.4.2.1 UK (E&W)

Cefas conducts several annual surveys in which dab are routinely measured or biological information is retained. Four of the most important surveys are the Irish Sea (VIIa, f & g) beam-trawl survey, the Channel (VIId) beam-trawl survey, the Carhelmar (VIIe) commercial beam-trawl survey and the English groundfish (IVb & c) GOV trawl survey.

Cefas also undertakes Young Fish Surveys along various parts of the east and south coast of England. Abundance and length distribution information for many of the species under investigation by WGNEW, including dab, can be found in a summary of data for the years 1981–1997 in Rogers *et al* (1998).

12.4.2.2 Germany

Survey data exist since 1959. Different surveys have been undertaken, covering offshore, coastal and Wadden Sea habitats (Figure 12.2). Different types of gear have been applied, so that catchability effects can be extracted from the data. Fine scale spatial distribution analysis is available for some areas in the North Sea, indicating the level of spatial aggegregation for this species.

12.4.2.3 Denmark

Dab is taken, often in large quantities, in the fisheries for plaice, both in the North Sea, IIIa and in the Belt Sea. The majority of Danish landings of this species are recorded from the North Sea. In the North Sea most of the landings are from trawl fisheries, while in IIIa Danish seine accounts for most of the landings, see Figure 12.3. Huge quantities of dab catches are discarded.

12.4.3 Discards and discard mortality

Dab and plaice are probably the most discarded species in the ICES area. For the period 1960 to 1981, discards in IIIc22 were estimated for Danish and German fisheries (Temming, 1983). Further discard and bycatch data will be provided by the DCR programme.

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

Berghahn *et al.* (1992) provide discard mortality data for a number of bycatch species taken by shrimp vessels in the North Sea. Survival of flatfish is noted to depend strongly on the species and the size of specimens, as well as the catch processing conditions. A series of experiments on dab survival resulted in discard mortalities ranging from 0% to 67%, with an average mortality of 32.6% for fish collected after "sieving" and 11.9% for dab collected from the catch before "sieving" (Table 12.4.2). Additional data on the mortality of fish taken in shrimp fisheries in the Wadden Sea is available (Table 12.4.3).

12.4.4 Recruit series

Recruitment series are only available from analytical assessments (Temming, 1983).

12.5 Biological sampling

12.5.1 UK (E&W)

All fish caught are routinely measured during CEFAS surveys, and for most surveys, biological information is collected for dab. A summary of the numbers of fish measured and the numbers of biological samples (otoliths, length, weight, sex and maturity) in four Cefas survey series is presented in Tables 12.5.1 and 12.5.2, respectively.

In addition, data on length distributions, distributions and abundance is available in Cefas technical reports for the Celtic Sea (Warnes and Jones, 1995), the Irish Sea (Parker-Humphreys, 2004a) and the English Channel and southern North Sea (Parker-Humphreys, 2004b).

Length information from market sampling for this species is available for 2000–2003 only. Biological samples for otoliths, weight, sex and maturity are only available for 2000–2002. A summary of the number of samples available is given in Tables 12.5.3 and 12.5.4. The otoliths collected have not been aged.

12.5.2 Germany

An extensive time series on length measurements is available, separated by area and gear type (Figure 12.4). Market samples for dab are not available.

12.5.3 DCR programme

From the DCR programme, length sampling and ageing information is available (Table 12.5.5).

12.6 Population biology parameters and a summary of other research

Several extended population studies provide regional age-length keys by sex, fecundity data and small scale distribution analyses for dab in the southern North Sea, the English Channel and the Bay of Biscay (Deniel, 1990; Rijnsdorp *et al.,* 1992; Jennings *et al.,* 1999). Maturity is reached at about 2 - 3 years. Maturity data are available in terms of combined age-at-maturity and length-at-maturity information (Deniel, 1990; Jennings *et al.,* 1999) (Deniel and Tassel, 1986).

Mortality rates for 0-group dab during winter time have been calculated for 11 time series (Iles and Beverton, 1991). Temperature is considered as a mortality factor for eggs (van der Land, 1991).

12.7 Analyses of stock trends and potential status indicators

According to IBTS Q1 data for the North Sea, the abundance of dab has increased remarkably in the long-term (ICES, 2005). The increase was partly related to opportunistic adaptations to trawl fisheries (Kaiser and Ramsey, 1997). For the Baltic Sea, an analysis of long-term data since the 1920s revealed a severe decline in dab stocks, potentially related to bottom oxygen deficiencies in the 1970s observed in the Baltic proper and to cod predation (Temming *et al.,* 1989a).

Analysis of length-frequency distributions (LFDs) for the period 1998–2005 for which a consistent catch record is available reveals considerable differences between ICES areas IVb and VIId,e. In IVb with high dab catches (Table 12.3.3), LFDs are truncated to lengths < 30 cm (Fig. 12.5). This is consistent with catch LFDs for area IVb (Figure 12.6). Specimens < 20 cm are usually discarded. With a given length-at-maturity of 21.6 cm (Deniel and Tassel, 1986), the catch comprises immature as well as mature specimens.

On average, in IVb 1 to 2 length groups can be discerned likely to represent different age groups present in the stock. In turn, in VIId,e where in particular in VIIe catches are low and declining, a diverse structure of the LFDs is evident (Figure 12.6). On average, 3 to 4 length groups are present. Specimens older than 3 years (app. length > 28 cm) are present in the stock.

The rationale, that fisheries, as documented by the catch record and structure of the LFDs are linked, is further corroborated by the relatively flat LFDs for 1998 and 1999 in IVb, corresponding to years with highest reported catches since 1973 (Table 12.3.2).

12.8 References

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Table 12.2.1. Dab spawning grounds, nurseries and affiliated populations.

SPAWNING GROUND (REF)	NURSERY GROUND (REF)	ADULT POPULATION (REF)	REMARKS (REF)
	Kattegat (8)		Referring to ICES IIIa
	Bridgwater Bay (1)	Bristol Channel (1)	Referring to ICES VII f
Off Flamborough Head (2), Dogger Bank (4,5)		Humber-The Wash - Doggerbank (?)	Adult population delineated by means of survey results in (3). Ref. to ICES IV b
Central German Bight (5)	E Coastal zone & Wadden Sea	German Bight-Doggerbank-Southern Bight	Referring to ICES IV b According to findings from Campos et al. (1994) spawning grounds in the German Bight and the Southern Bight are not separated
Southern Bight (5) Eastern Channel (5)	SE Coastal zone of Southern Bight (6) Eastern Channel (7)		Referring to ICES IV c
	Western Scottish waters (9)		Referring to ICES VI a
		Western Channel (10)	

1- Henderson and Holmes (1991),

2 - Harding and Nicholls (1987),

3 - Rijnsdorp et al. (1992),

4 - van der Land (1991),

5 - Bohl (1959),

6 - Bolle et al. (1994),

7 - Amara et al. (2001),

8 - Pihl (1989),

9 - Steele and Edwards (1970), Edwards and Steele (1968),

10 - Ortega-Salas (1979), Ph.D. thesis 1981.

Table 12.3.1. Total reported landings of dab by country in the ICES area (- : missing data, . = fishing ceased).

YEAR	BELGIUM	DENMARK	FRANCE	GERMANY	IRELAND	NETHERLANDS	NORWAY	SPAIN	SWEDEN	UK	TOTAL
1973	720	4554	3110	174	65	3641	1179	-	136	1726	15305
1974	352	4465	1365	197	77	4105	-	-	123	1538	12222
1975	664	4320	2283	190	122	4040	-	-	120	1364	13103
1976	551	3712	1284	193	170	3489	-	-	-	1227	10626
1977	705	3828	2009	189	135	4104	-	-	85	1349	12404
1978	566	3563	1754	262	147	3514	82	-	80	1463	11431
1979	528	4185	2470	271	129	4741	-	-	92	1390	13810
1980	585	3871	2296	173	123	5029	-	-	112	1166	13356
1981	625	4252	2639	273	205	4737	-	-	105	1149	13985
1982	559	4750	2313	332	240	5138	-	-	83	1399	14815
1983	676	2803	2437	269	325	5366	-	-	142	1411	13429
1984	727	2763	2467	232	331	-	-	-	92	1316	7928
1985	620	3498	2421	234	410	-	-	-	73	1462	8718
1986	595	2687	2787	241	409	-	-	-	71	1483	8275
1987	769	3826	3136	352	298	-	-	-	78	1858	10317
1988	938	3544	3053	399	156	3419	-	-	98	1713	13320
1989	578	3625	1897	359	70	2521	-	-	51	1543	10644
1990	518	2705	1446	406	72	-	-	-	54	1038	6239
1991	600	2806	1407	672	41	-	-	-	59	1570	7155
1992	588	2193	1458	626	76	-	-	-	46	1332	6319
1993	648	2754	1551	1103	47	-	-	-	38	1253	7394
1994	557	3249	1236	1944	26	-	-	-	38	1611	8661
1995	546	2796	882	-	40	-	-	-	59	2172	6496
1996	674	2873	1102	1880	23	-	-	-	18	2163	8733
1997	761	2396	1433	1384	41	-	-	-	23	2536	8574
1998	936	1969	1570	798	42	7983	-	-	19	2284	15601
1999	952	1766	.	1103	21	8661	-	5	12	2125	14645
2000	846	1436	1056	1114	20	6544	50	11	6	1683	12766
2001	832	1661	939	1075	25	5890	54	11	7	1502	11996
2002	743	2106	1182	762	16	4955	54	12	6	1333	11169
2003	666	2256	1027	1146	20	5138	91	.	4	1324	11672
2004	578	1774	.	1527	.	.	55	.	3	1281	5218

Table 12.3.2. Dab landings (in t) by area according to ICES catch statistics. Apparent reductions in catches 1990–1997 in IV b, c due to unreported catches.

(- : missing data, . = fishing ceased). VII d, e separated to reveal different trends by area

YEAR	IIIA	IVA	IVB	IVC	VIID	VIIE	VIID,E	VIIA,B,C,F-K
1973	1,449	1,812	3,241	2,705	-	-	2,157	2051
1974	2,003	591	3,743	2,812	658	223	1,118	1225
1975	2,049	345	3,197	3,488	1,386	710	2,096	491
1976	1,583	370	2,641	2,906	772	437	1,209	996
1977	2,318	443	2,715	3,544	1,280	419	1,703	1072
1978	2,688	396	1,932	3,304	1,270	272	1,554	534
1979	2,716	322	2,567	3,988	1,031	1,148	2,180	382
1980	2,333	301	2,153	4,527	1,573	337	1,916	415
1981	2,679	333	2,526	3,627	2,107	407	2,514	510
1982	2,902	506	3,175	3,528	1,657	405	2,062	459
1983	2,906	507	3,660	3,270	2,003	310	2,313	619
1984	2,769	395	727	922	2,074	313	2,387	576
1985	1,545	388	898	681	2,117	281	2,398	685
1986	1,608	448	1,804	598	2,512	337	2,849	770
1987	2,258	621	2,552	730	2,850	347	3,197	589
1988	2,254	527	4,737	1,797	2,802	440	3,242	395
1989	2,346	526	3,889	1,397	1,747	233	1,980	262
1990	1,574	281	1,947	462	1,302	149	1,451	258
1991	1,609	291	2,545	606	1,272	145	1,417	251
1992	1,454	276	1,799	572	1,408	118	1,526	268
1993	1,723	194	2,470	645	1,454	92	1,546	191
1994	1,963	149	3,246	466	1,243	115	1,358	166
1995	1,530	98	3,361	406	813	101	914	195
1996	1,409	121	4,071	642	1,051	112	1,163	191
1997	1,015	82	4,660	517	1,450	182	1,632	258
1998	963	47	7,639	5,073	1,535	144	1,679	228
1999	675	25	8,671	4,580	131	67	198	193
2000	660	39	5,788	4,768	1,045	90	1,135	200
2001	766	42	5,027	4,730	915	83	998	192
2002	979	29	4,517	4,132	1,123	80	1,203	142
2003	869	32	5,259	3,717	1,153	85	1,238	143
2004	782	14	4,944	3,650	1,078	92	1,170	177
2005	841	15	6,041	3,346	1,056	93	1,149	159

Table 12.3.3. Landings (t) of dab by E&W vessels into E&W by ICES Division.

	IVA	IVB	IVC	VIIA	VIID	VIIE	VIIF	VIIG	VIIH	VIIJ	TOTAL
1982	0	2	5	2	40	27	2	0	0	0	78
1983	3	33	27	11	58	92	18	0	0	0	242
1984	2	106	112	20	80	251	41	0	4	0	615
1985	1	95	104	35	90	224	62	0	4	0	614
1986	1	106	79	41	79	270	40	0	12	0	628
1987	2	142	60	57	108	251	54	0	12	0	685
1988	3	141	59	51	77	312	43	0	18	0	705
1989	1	89	32	38	41	158	15	0	2	0	376
1990	2	76	28	39	45	104	7	0	1	0	301
1991	2	128	41	62	94	101	16	0	10	0	455
1992	1	93	46	46	106	93	14	0	8	0	407
1993	1	98	42	45	82	76	17	0	5	0	366
1994	3	79	35	46	56	93	9	0	3	0	323
1995	3	117	26	41	35	81	6	0	1	0	311
1996	2	64	36	54	45	102	7	0	2	0	311
1997	3	38	30	57	51	113	11	0	2	0	305
1998	4	42	32	35	47	86	8	0	1	0	255
1999	4	48	29	32	45	66	7	0	0	0	231
2000	3	26	17	21	35	68	20	0	2	0	191
2001	1	42	16	14	41	66	9	0	1	0	190
2002	0	28	8	7	32	61	4	0	0	0	140
2003	0	15	9	10	35	64	6	0	0	0	139
2004	0	9	5	9	27	79	6	0	0	0	134

Table 12.3.4. Landings (t) of dab by E&W vessels into foreign ports by ICES Division.

	IVA	IVB	IVC	VIIA	VIID	VIIE	VIIF	VIIG	VIIH	VIIJ	TOTAL
1982	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	1	1	0	0	3
1984	1	0	0	0	0	0	1	6	4	0	13
1985	1	1	1	1	0	1	1	9	4	4	24
1986	0	4	2	1	0	3	2	0	12	5	28
1987	0	10	0	1	0	0	2	0	12	1	26
1988	0	10	0	0	0	0	0	0	18	5	34
1989	2	23	5	0	0	1	0	0	2	3	35
1990	0	49	45	0	0	1	0	1	1	0	97
1991	1	68	52	2	7	1	0	0	18	1	149
1992	1	108	15	1	2	0	0	0	8	1	135
1993	1	259	3	2	0	0	1	0	5	0	273
1994	0	526	2	1	0	0	1	0	3	2	534
1995	1	991	5	1	2	1	0	0	1	8	1010
1996	1	903	5	1	1	1	3	0	2	2	920
1997	0	986	5	1	2	0	0	2	2	9	1008
1998	0	791	4	1	1	0	0	1	5	42	845
1999	0	667	0	0	0	0	0	1	1	26	695
2000	2	681	2	0	0	0	0	1	2	0	687
2001	2	582	3	0	0	1	0	0	1	2	592
2002	1	450	4	1	0	0	1	2	0	19	477
2003	3	0	0	0	1	0	0	3	0	8	17
2004	1	0	0	0	0	0	0	4	1	1	7

Table 12.3.5. Total landings (t) of dab by E&W vessels by ICES Division.

	IVa	IVb	IVc	VIIa	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	Total
1982	0	2	5	2	40	27	2	0	0	0	78
1983	3	33	27	11	58	92	18	1	0	0	244
1984	3	106	112	20	80	252	42	9	4	0	628
1985	2	96	105	36	90	225	63	13	4	4	638
1986	1	110	81	42	79	273	42	12	12	5	656
1987	2	152	60	58	108	251	55	12	12	1	711
1988	3	152	59	51	77	312	44	18	18	5	739
1989	3	112	36	39	41	158	15	2	2	3	411
1990	2	125	72	39	45	105	7	2	1	0	398
1991	3	195	93	64	101	102	17	10	18	1	604
1992	2	201	60	47	108	93	15	8	8	1	543
1993	3	357	45	47	82	76	18	5	5	0	639
1994	3	604	37	47	56	93	9	3	3	2	857
1995	4	1108	31	42	37	82	7	1	1	8	1321
1996	3	967	41	55	47	102	10	2	2	2	1231
1997	3	1024	35	57	53	113	11	3	2	9	1312
1998	4	834	35	36	48	86	8	2	5	42	1100
1999	4	715	29	32	45	66	7	2	1	26	927
2000	4	707	18	22	35	68	20	2	2	0	878
2001	3	624	19	14	41	67	9	1	1	2	782
2002	1	478	12	8	32	61	4	2	0	19	618
2003	3	15	9	10	36	64	6	4	0	8	156
2004	1	9	5	9	27	79	6	4	1	1	142

Table 12.4.1. Survey information by ICES division.

Offshore surveys with regional focus, coastal surveys delimited depth range and coastal affiliation, inshore surveys cover estuaries and shallow water systems such as the Wadden Sea. ICES IBTS not included (refers to IV a - c)

ICES AREA	NUMBER OF SURVEYS AND AFFILIATION TO HABITATS (OFFSHORE/COASTAL/INSHORE)	PERIOD	SPECIFIED AREA	SPECIFICS	SOURCE
III					
IV a	1 (1 / 0 / 0)	1975 - present			ISH
IV b	4 (2 / 1 / (1))	1966(1974)-present	(Wadden Sea)		Cefas / ISH
IV c	2 (1 / {1} / 0)	{1982-2001}			Cefas / {ISH}
VI a					
VII a	1				Cefas
VII b					
VII d	1				Cefas
VII e	1				Cefas
VII f	2 (1 / 1* / 0)	1981-1991* (present)	Bristol Channel*	*Sampled from power plant cooling water filter	(* Henderson and Holmes 1991), Cefas
VII g	1				Cefas
VII h					
VIII a					
VIII b					

Table 12.4.2. Dab mortality from shrimp fishery bycatch. A = after sieving out; B = results of controls with samples collected from the catch before sieving; TL = total length; Catch = total catch in one codend; N_b = number in the beginning; N_e = number at the end of the experiment. Source: Berghahn *et al.* (1992). Sieving refers to an onboard sorting system for shrimp.

Date		TL Range (cm)	Catch (kg)	Water Temperature (celcius)	Duration of Experiments (d)	N_B	N_E	Mortality (%)
5/23/88	A	10.5–21	100	12–13.4	5.5	63	46	27
	B	12–22				26	23	12
8/2/88	B	14.5–24	50	17.2–17.4	5.5	40	31	23
8/8/88	A	12–20.5	70	18.0–18.8	5.5	6	2	67
8/15/88	A	9.5–20	70	17.6	5.0	13	8	38
5/15/89	A	12.5–20	110	12.0–14.0	6.0	19	17	11
5/21/89	B	10.5–23.5				20	20	0
	A	12–27	55	15.0–15.2	6.0	81	54	33
5/28/89	B	12–26				45	40	11
	A	10.5–25	150	15.7–14.4	5.5	31	23	26
7/49/89	B	11.5–25.5				11	10	9
7/25/89	B	20–20.5	75	15.0–16.0	5.0	2	2	0
5/10/90	A	20.5–26	125	17.2–17.5	5.5	5	4	20
	A	7–19.5	40	16.0	5.0	33	17	48
5/16/90	B	11–16				2	2	0
7/20/91	A	7.5–25	15	14.0–13.6	4.0	40	23	43
	B	12.5–25	50	16.7–17.5	5.0	12	12	0
Average				A		291	196	32.6
				B		159	140	11.9

Table 12.4.3. Mortality of selected fish species in the bycatch of the shrimp fishery in the Wadden Sea after five days of maintenance (Berghahn, 1990).

Species	Number of Trials	Total Catch One Codend kg	Water Temp. C	Number of Specimens	Total Length cm	Mortality %
Dab	4	55–125	14.4–17.5	133	10–27	10–35
Sculpin	7	70–150	14.4–18.8	52	10–20	0
Hooknose	6	70–150	12.0–18.8	134	7–16	0.0–13
Eelpout	4	70–100	12.0–17.6	45	13–20	0.0–17

Table 12.5.1. The number of dab measured each year for four Cefas survey series

	Irish Sea	Irish Sea	Carhelmar	Channel	North Sea
	Autumn	Spring			
1988					
1989	4167		869	1490	
1990	8457		489	1257	
1991			423	1584	86619
1992	7278		250	4482	19458
1993			285	1503	16954
1994	11282		943	2356	18247
1995	10420		611	1484	19863
1996	8562	3208	591	1783	23781
1997	10844		560	1367	35103
1998			468	798	20104
1999		4802	584	1102	31835
2000	12456		297	1083	12581
2001			1255	2221	51005
2002	9765			1557	38647
2003	16527			2260	47922
2004	5770			2201	40332
2005				752	48149
Total	105529	8010	7625	29281	510602

Table 12.5.2. The number of dab for which biological data (otoliths, weight, sex and maturity) have been collected from four Cefas survey series.

	IRISH SEA	IRISH SEA	CARHELMAR	CHANNEL	NORTH SEA
YEAR	AUTUMN	SPRING			
1989				2	
1990				20	
1991				68	
1992				276	
1993	4				
1994				269	
1995	501		128	230	
1996	486		108	353	
1997		435			
1998				262	
1999				143	
2000				165	
2001	424			355	
2002	341		162	421	
2003	530		201		458
2004					370
2005	485			368	398
Total	2771	435	599	2932	1226

Table 12.5.3: Number of dab measured during the Cefas market sampling programme

	NO OF FISH	NO OF SAMPLES
2000	5210	94
2001	6150	88
2002	2825	34
2003	781	12
Total	14966	228

Table 12.5.4. Number of dab for which biological information has been collected by the Cefas market sampling programme.

	NO OF FISH	NO OF SAMPLES
2000	1074	67
2001	780	73
2002	404	38
2003		
Total	2258	178

Table 12.5.5. Market sampling of new MOU species under the DCR (based on the 2004 technical reports from Belgium, Denmark, Finland, France, Germany, Ireland, the Netherlands, Spain, Sweden and the UK).

SPECIES	AREA	LENGTH REQUIRED	LENGTH ACHIEVED	AGE REQUIRED	AGE ACHIEVED
Limanda limanda	IV, VIId	1772	3056	0	300

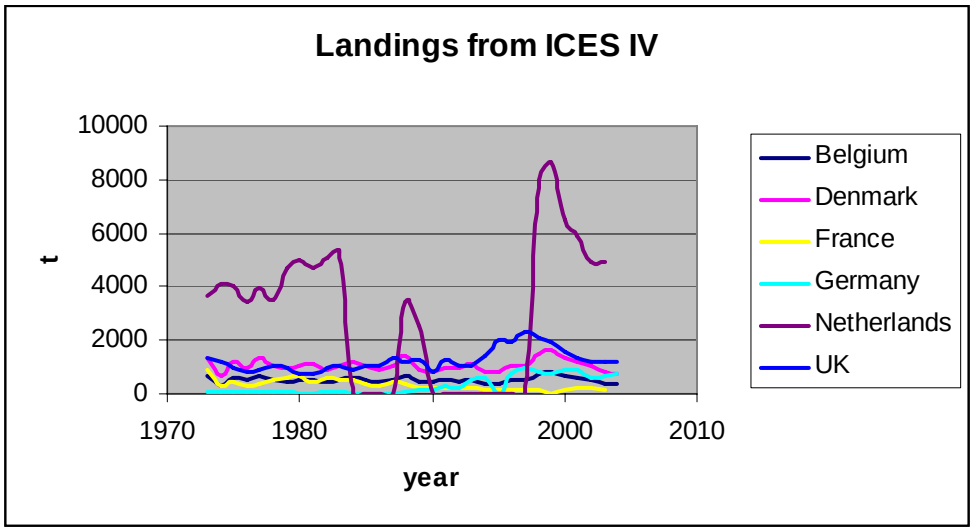

Figure 12.1. Dab landings from ICES statistics in Sub-area IV by year and country.

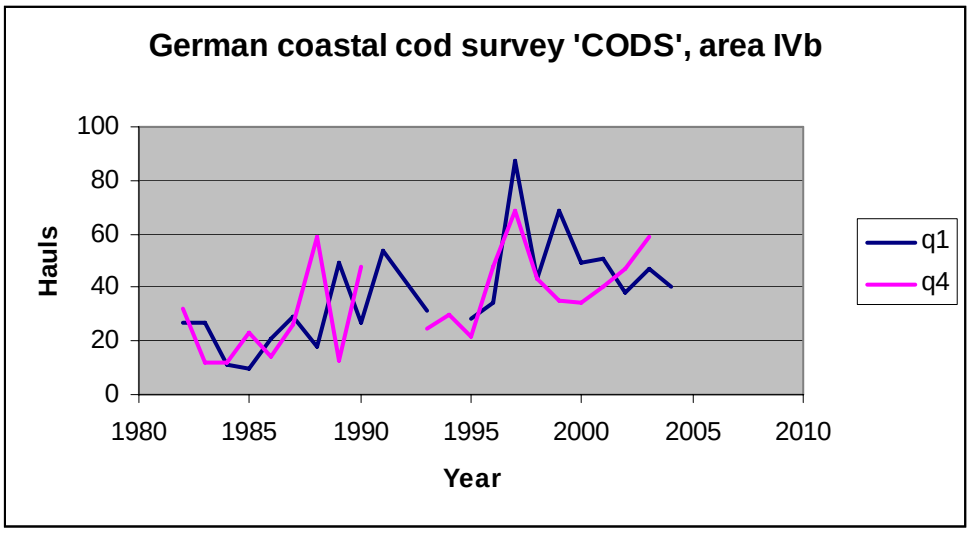

Figure 12.2. Hauls by quarter for German Coastal Cod Survey.

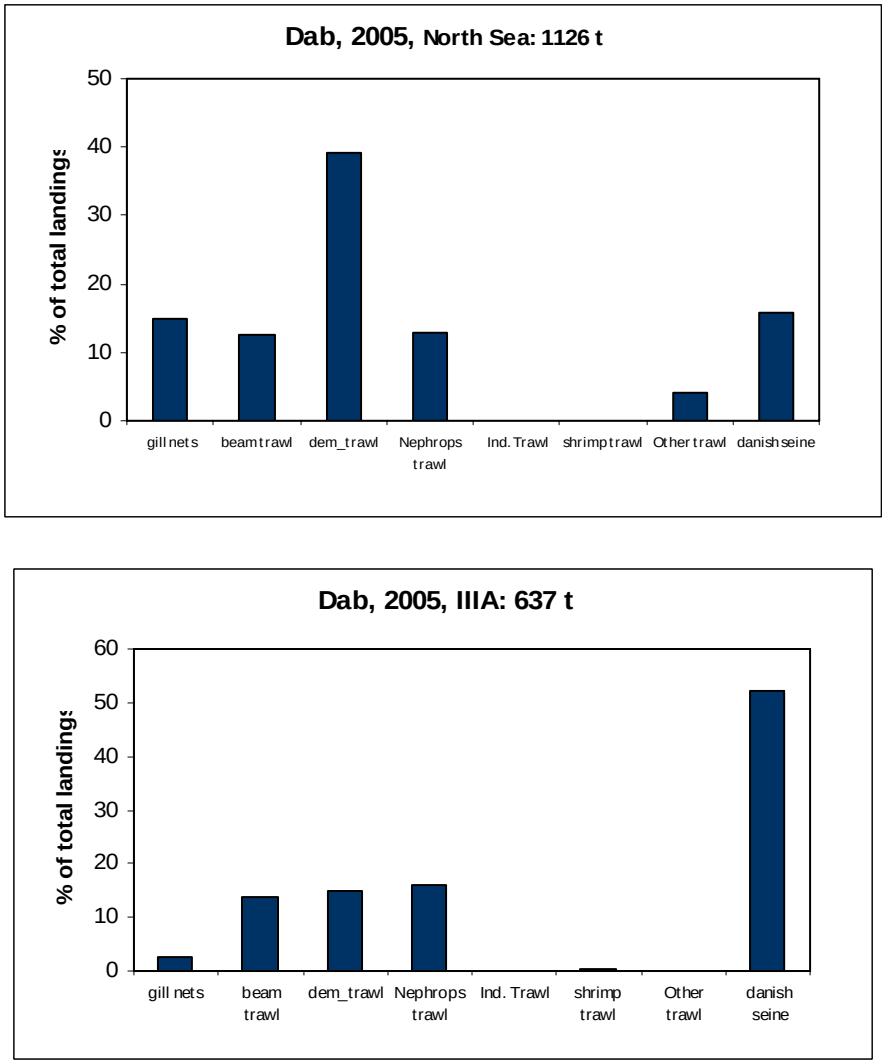

Figure 12.3. Danish landings of dab in 2005 per gear type according to log-book data.

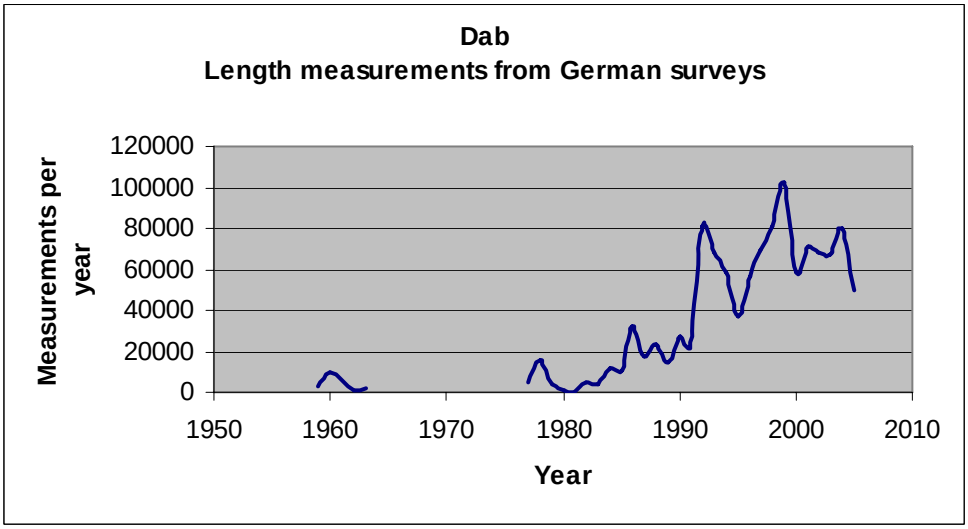

Figure 12.4. German time series of length measurements for dab.

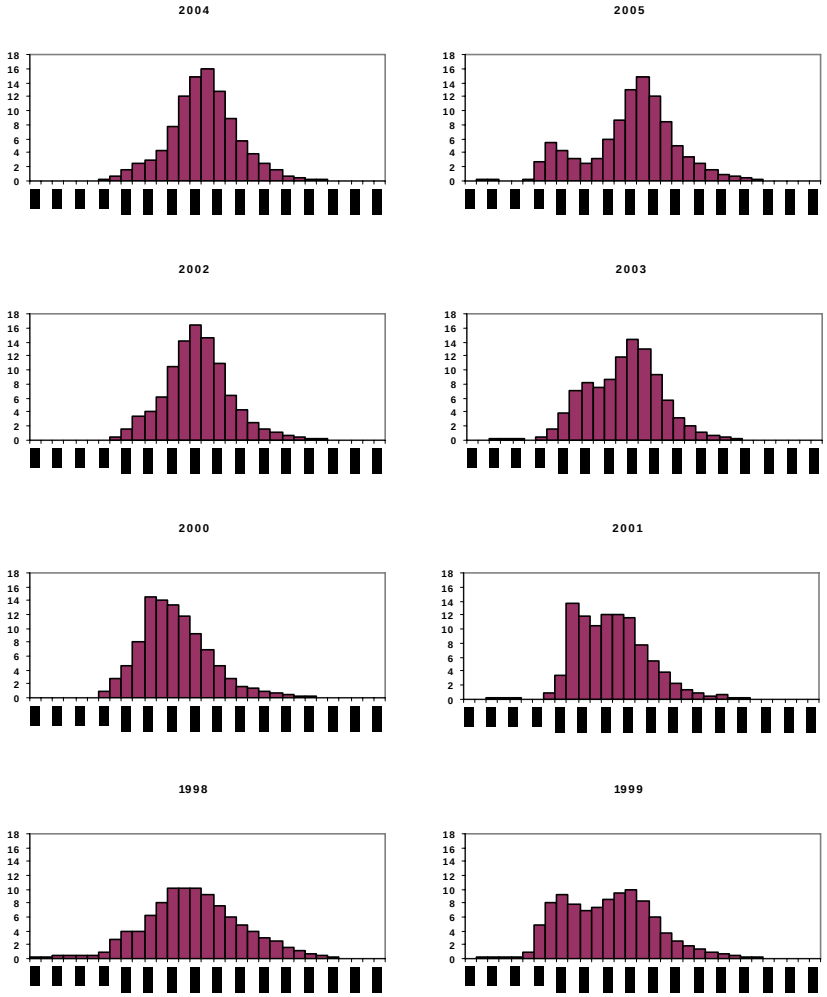

Figure 12.5. Length-frequency distribution (LFD) of dab from the German Q3-survey, ICES area IVb. Frequency in %.

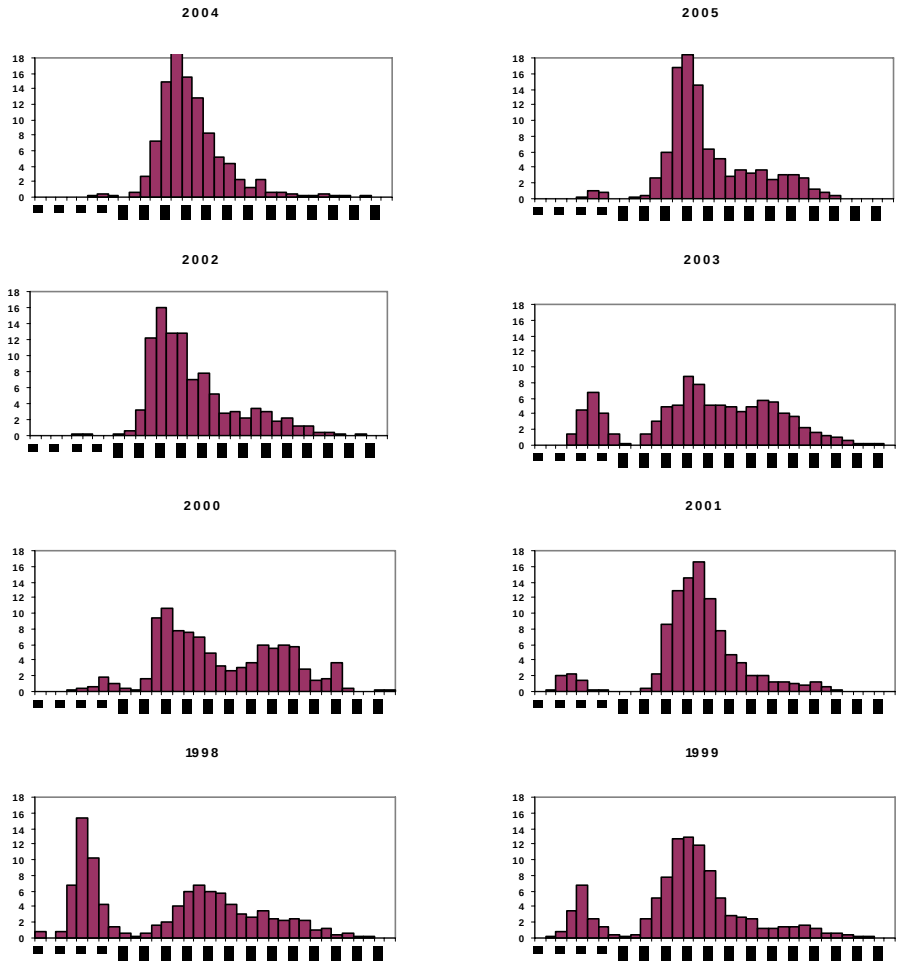

Figure 12.6. LFD from the French Q4 survey, ICES area VII d,e. Frequency in %.

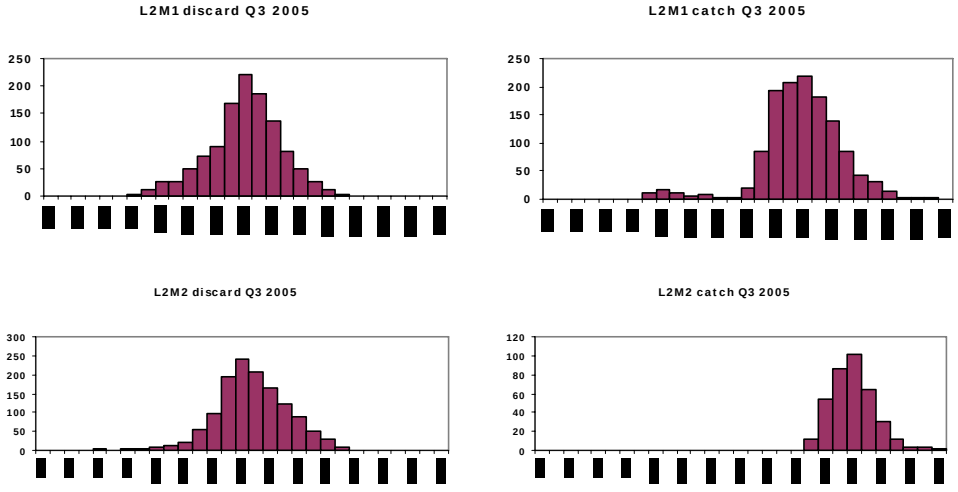

Figure 12.7. LFD of catches and discards in 2005, Q3 by metiér. From German DCR program.

13 Flounder

In the 2005 WGNEW report that the focus in the chapter on flounder was on the Baltic. This year, the terms of reference specifically excluded the Baltic for this species. This leaves areas IV and IIIa as the only areas where relevant landings of flounder are being taken.

13.1 General biology

Flounder (*Platichthys flesus*) is a euryhaline flatfish: the life cycle of each individual usually includes marine, brackish, and freshwater habitats. It has a coastal distribution in the Northeast Atlantic, ranging from the White Sea and the Baltic in the north, to the Mediterranean and Black Sea in the south (Nielsen, 1986). Flounder can live in low salinity water but they reproduce in water of higher salinity. In the North Sea, Skagerrak and Kattegat flounder spawn between February and April. In the Baltic, spawning is later, further to the east and to the north.

Flounder settle at a size of 8–10 mm. The bottom-living stages appear by the end of April in brackish water near river mouths. The juveniles either stay in the brackish environment or migrate further up the rivers.

Flounder is a good example of the increasing growth in length and especially in weight with increasing salinity. Growth also increases with temperature and, in a laboratory experiment, 0-group flounder from the North Sea had optimum growth at a temperature of 20°C. Males are smaller than females and more numerous in the younger age classes.

During autumn, both mature and immature flounder withdraw from the inshore and estuarine feeding areas. The immature flounder migrate into coastal areas, where they spend the winter. The adults move further offshore to the 25–40 m deep spawning grounds, the most important of which are situated along the coasts of Belgium, the Netherlands, Germany, and Denmark. An area of potential importance for spawning is the eastern part of the English Channel, while small areas off the English and Scottish coasts are probably of minor significance (Rijnsdorp and Vethaak, 1989). The eggs are found pelagically off the continental coasts mostly in February (Van der Land, 1991), and the pelagic larvae enter the western Wadden Sea during April–May (Van der Veer and Groenewold, 1987). Apart from estuarine and shallow nurseries such as the Wadden Sea, small flounder (< 25 cm) can also commonly be found in fresh water as long as there are no major barriers obstructing movement to and from the sea (Vethaak, 1992).

13.2 Stock identity and possible assessment areas

There is no information about possible stock assessment areas in the North Sea. Flounder is mainly found in the southeastern North Sea, in the Skagerrak and in the Kattegat (Figure 13.1).

13.3 Fisheries data

Since the early 1900's, annual North Sea catches have fluctuated between 1000 and 4000 t (Figure 13.2). Flounder is of relatively little commercial importance in the North Sea and the Kattegat, but its importance in the Baltic is considerable.

Landings of flounder by country for the years 1973–2004 are provided in Table 13.3.1. It is obvious that landing data are not complete; see for example the data for the Netherlands and for Poland. Landings by ICES Division, for the same period, are given in Table 13.3.2, but the quality of the data is poor due to incomplete data.

Details of landings by England and Wales (E&W) are provided in Tables 13.3.3, 13.3.4 and 13.3.5. UK landings for this species are small, with only 128 t landed by the E&W fleet in 2004.

Landings by gear group can be provided for this species if required.

13.4 Survey data, recruit series

Several surveys in the North Sea, Skagerrak and Kattegat can provide information on abundance and distribution of flounder, for example the International Bottom Trawl Survey IBTS (quarter 1 and 3) and the Beam Trawl Survey BTS (quarter 3). The Demersal Fish Survey DFS (quarter 3) targets 0- and 1-group of sole and plaice and also catches juvenile flounder.

In addition, data on length distributions, distributions and abundance is available in Cefas technical reports for the Celtic Sea (Warnes and Jones, 1995), the Irish Sea (Parker-Humphreys, 2004a) and the English Channel and southern North Sea (Parker-Humphreys, 2004b).

Cefas also undertakes Young Fish Surveys along various parts of the east and south coast of England. Abundance and length distribution information for many of the species under investigation by WGNEW, including flounder, can be found in a summary of data for the years 1981 – 1997 in Rogers *et al*. (1998).

Distribution in winter and in summer in the North Sea, Skagerrak and Kattegat is given in Knijn *et. al.* (1993). During the winter surveys, flounder was caught in the Southern and German Bights and, in particularly high numbers, in the Kattegat. Flounder had migrated out of reach of the survey gears into shallow waters by summer.

13.5 Biological sampling

Length information from UK market sampling for this species is available for 2000–2001 only. Biological sampling for otoliths, weight, sex and maturity is only available for 2000. A summary of the number of samples available is given in Tables 13.5.1. The otoliths collected have not been aged.

Population biological parameters and other research.

Flounder feeds on a wide variety of small invertebrates (mainly polychaete worms, shellfish, and crustaceans), but locally the diet may include small fish species like smelt and gobies (Rijnsdorp and Vethaak, 1989). The most intensive feeding occurs in the summer, while food is sparse in the winter. Investigations from the Kiel Bay and Gdansk Bay suggest that they do not feed during spawning.

One- to six-year-old specimens caught in Dutch waters during the third quarter of the year are on average 11, 20, 25, 29, 31, and 34 cm long (Van Leeuwen and Vethaak, 1988). The females mature at an age of three to four years.

13.6 Analyses of stock trends

The abundance of flounder in the quarter 1 IBTS is shown in Figure 13.3 for the period 1977–2004. This graph suggests an increase in abundance from 1977 to a maximum in the late 1980s, followed by a gradual decrease.

13.7 Management

In areas IIa (EC waters) and IV (EC waters) there is a combined TAC for flounder and dab. In 2006 this TAC was 17 100 t. There is no minimum landings size.

13.8 References

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Table 13.3.1. SS Landings (t) of flounder by country.

	BEL	DEN	EST	F.I	FIN	FRA	GER	IRL	LAT	LIT	NET	NOR	POL	POR	RUS	SPA	SWE	UK	USS	TOTAL
1974	126	7097	0	0	55	0	2818	0	0	0	2661	0	0	358	0	0	639	327	0	14081
1975	76	5484	0	0	100	0	2663	0	0	0	2191	0	5139	286	0	1279	662	264	0	18144
1976	97	4044	0	0	194	0	3240	0		0	2081	0	4394	177	0	1270	678	262	12835	29272
1977	111	3719	0	0	203	0	3916	51	0	0	1768	0	4879	0	0	0	474	330	16761	32212
1978	124	5156	0	5	390	47	3471	0	0	0	1536	0	0	8	0	54	410	438	17523	29162
1979	131	4256	0	3	399	124	3265	0	0	0	1260	0	0	0	0	0	415	496	2670	13019
1980	191	3253	0	3	52	117	3379	0	0	0	806	0	0	0	0	0	430	422	2305	10958
1981	164	5168	0	0	78	94	3456	0	0	0	1068	0	0	0	0	0	374	345	2323	13070
1982	111	4449	0	0	50	70	3932	0	0	0	1597	0	0	0	0	166	218	400	2596	13589
1983	88	5597	0	14	39	157	4511	0	0	0	2061	0	0	0	0	437	305	387	2371	15967
1984	274	5114	0	0	43	118	3588	0	0	0	0	0	0	0	0	0	400	359	1859	11755
1985	165	4434	0	0	37	120	3852	0	0	0	0	0	0	0	0	0	213	312	1528	10661
1986	158	5190	0	0	52	389	3205	0	0	0	0	0	0	0	0	0	314	355	1438	11101
1987	134	3788	0	0	58	136	2408	15	0	0	0	0	0	0	0	0	258	427	2194	9418
1988	164	3950	0	0	69	144	3326	29	0	0	682	0	0	0	0	0	315	372	1605	10656
1989	201	3810	0	0	70	139	3975	14	0	0	916	0	0	0	0	0	298	294	1723	11440
1990	155	4035	0	0	59	213	2039	28	0	0	0	0	0	0	0	0	239	231	1427	8426
1991	272	3612	248	0	76	215	3173	17	445	0	0	0	0	0	0	0	203	328	326	8915
1992	170	2800	164	0	64	149	2056	17	624	9	0	0	0	0	75	0	269	310	0	6707
1993	213	3798	165	0	85	125	1630	17	475	120	0	0	0	0	159	0	211	276	0	7274
1994	224	3585	162	0	79	166	6018	19	329	262	0	0	0	0	173	0	275	383	0	11675
1995	348	4233	102	0	89	206	4489	24	362	194	0	0	0	0	268	0	460	388	0	11163
1996	277	5468	297	0	93	236	1637	13	294	330	0	0	0	0	774	74	1261	357	0	11111
1997	146	5378	334	0	80	212	2451	13	367	624	0	0	0	0	1131	319	1079	379	0	12513
1998	307	4725	355	0	74	152	2159	13	364	736	4942	0	0	0	1188	873	526	293	0	16707
1999	364	3527	416	0	76	198	2347	13	509	571	3159	0	0	0	965	323	274	149	0	12891
2000	322	4605	420	0	448	219	2766	13	418	618	2658	5	0	0	1392	88	341	201	0	14514
2001	316	6064	482	0	499	241	2349	18	613	0	2620	4	0	0	1351	139	468	149	0	15313
2002	230	5143	515	0	448	285	2385	19	599	0	3531	4	0	6	1327	13	357	173	0	15035
2003	263	3561	442	0	196	272	1737	44	673	0	3172	9	0	30	1402	32	270	257	0	12360
2004	409	4525	406	0	189	0	1913	0	769	0	0	18	8740	16	1277	0	212	154	0	18628

Table 13.3.2. Landings (t) of flounder by ICES division.

YEAR	ICES DIVISION											GRAND
	I	II	IIIA	IIIB-D	IV	IX	V	VI	VII	VIII	XIV	TOTAL
1973	32	0	346	6569	2065	0	0	21	177	0	0	9210
1974	18	0	1658	7906	3879	358	0	35	227	0	0	14081
1975	579	986	1467	11988	2939	0	5	31	149	0	0	18144
1976	8393	2735	1099	13685	3079	0	1	40	176	0	64	29272
1977	8524	3473	1119	16317	2505	1	0	55	218	0	0	32212
1978	9025	6060	1648	9892	2211	0	5	44	232	45	0	29162
1979	0	0	1319	9230	2077	0	3	41	343	6	0	13019
1980	0	0	561	8329	1698	0	3	19	326	22	0	10958
1981	0	0	1905	8625	2248	0	0	11	267	14	0	13070
1982	0	166	1311	9104	2689	0	0	17	299	3	0	13589
1983	0	437	2512	9550	3069	0	14	11	350	24	0	15967
1984	0	0	2746	7637	1030	0	0	18	306	18	0	11755
1985	0	0	1305	8252	793	0	0	19	280	12	0	10661
1986	0	0	1751	7901	814	0	0	10	330	295	0	11101
1987	0	0	1169	7037	754	0	0	10	417	31	0	9418
1988	0	0	1313	7338	1598	0	0	13	391	3	0	10656
1989	0	0	1129	8020	1951	0	0	18	296	26	0	11440
1990	0	0	708	6477	881	0	0	9	327	24	0	8426
1991	0	0	624	6180	1659	0	0	3	432	17	0	8915
1992	0	0	507	4541	1276	0	0	6	365	12	0	6707
1993	0	0	743	3732	2545	0	0	5	239	10	0	7274
1994	0	0	943	8377	2063	0	0	13	257	22	0	11675
1995	0	0	498	8228	2125	0	0	4	285	23	0	11163
1996	0	0	542	8130	2005	73	0	7	311	43	0	11111
1997	0	0	437	9994	1290	313	0	14	423	42	0	12513
1998	0	0	725	9235	5560	832	0	9	282	64	0	16707
1999	0	0	588	8161	3672	318	0	0	148	4	0	12891
2000	0	0	656	10235	3165	79	0	4	320	55	0	14514
2001	0	0	705	11038	3022	128	0	2	378	40	0	15313
2002	13	0	524	10153	3890	16	0	0	401	38	0	15035
2003	0	0	473	7711	3639	32	0	1	471	33	0	12360
2004	0	0	478	17452	528	15	0	0	154	1	0	18628

Table 13.3.3. Landings (t) of flounder by E&W vessels into E&W by ICES Division.

	IVA	IVB	IVC	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIIA	VIIIB	VIIJ	VIIK	TOTAL
1982	0	0	3	0	0	130	0	0	14	3	0	0	0	0	0	0	0	150
1983	0	0	63	0	0	133	0	0	18	6	3	0	0	0	0	0	0	224
1984	0	1	120	0	0	157	0	0	19	35	6	0	0	0	0	0	0	338
1985	0	2	107	0	0	100	0	0	24	55	5	0	0	0	0	0	0	292
1986	0	6	104	0	0	123	0	0	27	75	2	0	0	0	0	0	0	337
1987	0	2	68	0	0	168	0	0	74	71	2	0	0	0	0	0	0	386
1988	0	1	65	0	0	121	0	0	44	92	2	3	0	0	0	0	0	328
1989	0	1	58	0	0	60	0	0	36	71	2	0	0	0	0	0	0	227
1990	0	1	24	0	0	71	0	0	32	46	2	0	0	0	0	0	0	176
1991	0	0	32	0	0	97	0	0	54	66	8	0	0	0	0	0	0	257
1992	0	0	45	2	0	96	0	0	62	58	2	0	0	0	0	0	0	266
1993	0	0	39	0	0	35	0	0	67	27	4	0	0	0	0	0	0	172
1994	0	2	55	0	0	19	0	0	81	28	6	0	0	0	0	0	0	191
1995	0	3	75	0	0	65	0	0	38	27	6	0	0	0	0	0	0	214
1996	0	3	44	0	0	65	0	0	38	47	2	0	0	0	0	0	0	201
1997	0	0	68	0	0	63	0	0	60	61	13	1	0	0	0	0	0	266
1998	0	0	24	0	0	51	0	0	45	35	1	0	0	0	0	0	0	157
1999	0	0	24	0	0	36	0	0	29	27	1	0	0	0	0	0	0	118
2000	0	0	40	0	0	54	0	0	39	49	5	0	0	0	0	0	0	187
2001	0	0	26	0	0	45	0	0	25	43	2	0	0	0	0	0	0	143
2002	0	0	18	0	0	31	0	0	31	50	2	0	0	0	0	0	0	132
2003	0	0	12	0	0	42	0	0	20	58	13	0	0	0	0	1	0	147
2004	0	0	5	0	0	16	0	0	21	40	0	0	0	0	0	1	0	84

Table 13.3.4. Landings (t) of flounder by E&W vessels into foreign ports by ICES Division.

	IVA	IVB	IVC	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIIA	VIIIB	VIIJ	VIIK	TOTAL
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
1991	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
1992	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
1993	0	69	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	72
1994	0	166	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	167
1995	0	131	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142
1996	0	118	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	119
1997	0	38	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46
1998	0	70	1	0	0	0	1	1	0	0	0	0	0	0	0	17	2	93
1999	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
2000	0	9	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	11
2001	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
2002	0	7	6	0	0	0	1	0	0	0	0	0	0	0	0	1	0	16
2003	0	36	19	0	0	0	0	0	0	0	0	0	0	0	0	2	0	57
2004	0	26	14	0	0	0	0	0	0	0	0	0	0	0	0	3	0	43

Table 13.3.5. Total landings (t) of flounder by E&W vessels by ICES Division.

	IVA	IVB	IVC	VIA	VIB	VIIA	VIIB	VIIC	VIID	VIIE	VIIF	VIIG	VIIH	VIIIA	VIIIB	VIIJ	VIIK	TOTAL
1982	0	0	3	0	0	130	0	0	14	3	0	0	0	0	0	0	0	150
1983	0	0	63	0	0	133	0	0	18	6	3	0	0	0	0	0	0	224
1984	0	1	120	0	0	157	0	0	19	35	6	0	0	0	0	0	0	338
1985	0	2	107	0	0	100	0	0	24	55	5	0	0	0	0	0	0	292
1986	0	6	104	0	0	123	0	0	27	75	2	0	0	1	0	0	0	338
1987	0	2	68	0	0	168	0	0	74	71	2	0	0	0	0	0	0	386
1988	0	1	65	0	0	121	0	0	44	92	2	3	0	0	0	0	0	328
1989	0	1	58	0	0	60	0	0	36	71	2	0	0	0	0	0	0	227
1990	0	1	35	0	0	71	0	0	32	46	2	0	0	0	0	0	0	187
1991	0	1	49	0	0	97	0	0	54	66	8	0	0	0	0	0	0	274
1992	0	1	52	2	0	96	0	0	63	58	2	0	0	0	0	0	0	275
1993	0	69	42	0	0	35	0	0	68	27	4	0	0	0	0	0	0	244
1994	0	168	56	0	0	19	0	0	81	28	6	0	0	0	0	0	0	358
1995	0	134	86	0	0	65	0	0	38	27	6	0	0	0	0	0	0	356
1996	0	121	45	0	0	65	0	0	38	47	2	0	0	0	0	0	0	319
1997	0	38	76	0	0	63	0	0	60	61	13	1	0	0	0	0	0	312
1998	0	71	26	0	0	51	1	1	45	35	1	0	0	0	0	17	2	250
1999	0	24	24	0	0	36	0	0	29	27	1	0	0	0	0	1	0	143
2000	0	9	41	0	1	54	0	0	39	49	5	0	0	0	0	1	0	198
2001	0	5	26	0	0	45	0	0	26	43	2	0	0	0	0	0	0	148
2002	0	7	24	0	0	31	1	0	31	50	2	0	0	0	0	2	0	148
2003	0	36	31	0	0	42	0	0	21	58	13	0	0	0	0	3	0	204
2004	0	26	19	0	0	16	0	0	21	40	0	0	0	0	0	3	0	128

Table 13.4.1. The number of flounder measured each year for four Cefas survey series (UK).

	IRISH SEA	IRISH SEA	CARHELMAR	CHANNEL	NORTH SEA
	AUTUMN	SPRING			
1988					
1989	17			34	
1990	45			77	
1991				122	2
1992	59			296	6
1993	33		1	99	
1994	28			38	
1995			4	224	1
1996	18	109	7	411	2
1997	36			176	6
1998			1	62	
1999		194	3	180	5
2000	43		3	265	
2001			7	158	
2002	33			575	
2003	33		2	267	3
2004				177	5
2005				193	8
Total	345	303	28	3354	38

Table 13.5.1. Number of flounder measured and the number for which biological information (otoliths, weight, sex and maturity) has been collected during the Cefas biological sampling programme (UK).

	LENGTH SAMPLES		BIOLOGICAL SAMPLES	
	LENGTHS	SAMPLES	NO OF FISH	NO OF SAMPLES
2000	1021	25	73	5
2001	1515	30		
Total	2536	55	73	5

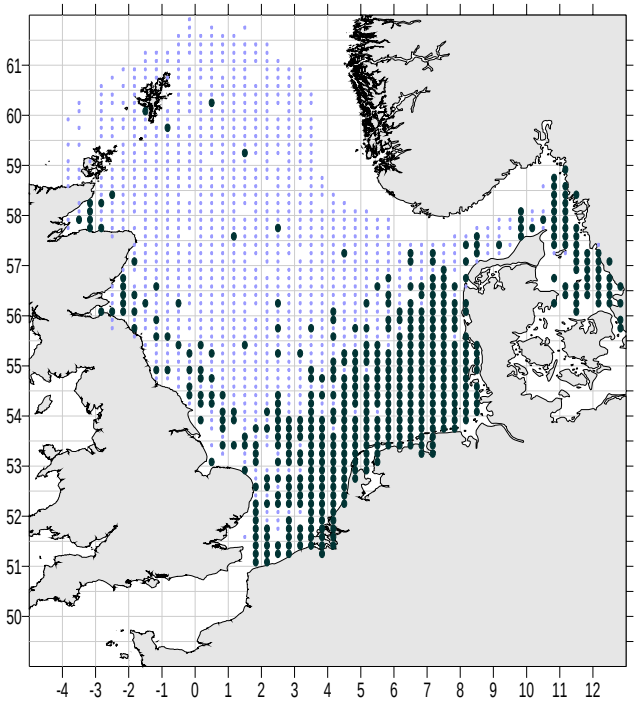


Figure 13.1. Presence/absence data for flounder in IV and IIIa based on international data from IBTS and BTS surveys and some Dutch flatfish surveys (DFS, SNS).

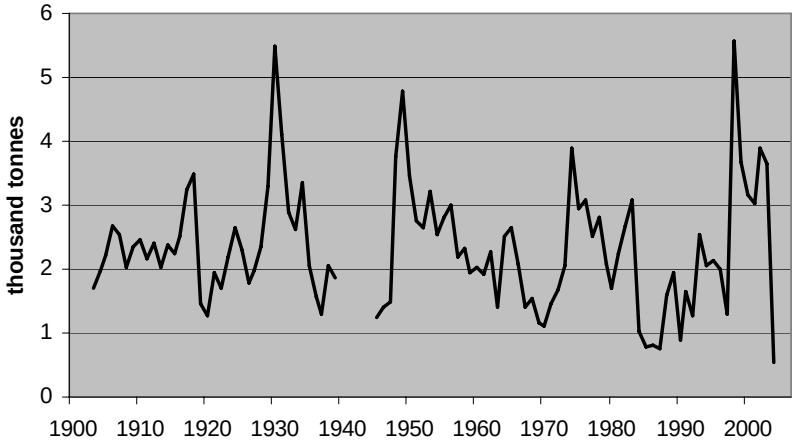


Figure 13.2. Landings (in thousand t) of flounder from the North Sea (IV).

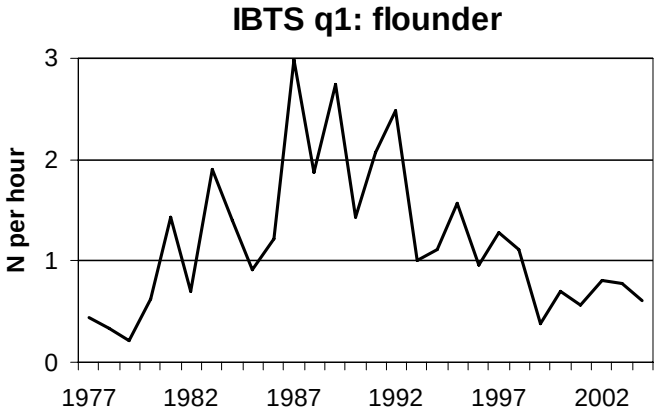


Figure 13.2. Abundance (N per hour for all length classes combined) of flounder in the quarter 1 IBTS in the North Sea (roundfish areas 1–7).

14 Witch flounder

14.1 General biology

Witch flounder *Glyptocephalus cynoglossus* is found mainly on soft bottoms in moderately deep waters, i.e. around 100–400 m. It is found in coastal waters on both sides of the North Atlantic. According to Molander (1935), spawning takes place in more shallow waters, from 70–100 m. Peak season of spawning is June – July in the North sea area (IIIa and IV). The eggs and larvae are pelagic. The growth pattern seems to differ between sexes. Sampling of the Swedish catches in 2005 indicated a majority of females and, in IIIa, the largest individuals in the catches are normally females. Data on maturity are also available for 2005.

Most of the more recent information published on general biology refers to investigations in the NW Atlantic.

14.2 Fisheries

14.2.1 Denmark

The Danish landings of this species come from Skagerrak and the north eastern part of the North Sea (Norwegian Deep). In the North Sea, the witch flounder is generally taken as by-catch in the (mixed) demersal fisheries targeting round fish and *Nephrops*. In the Skagerrak, it is by-catch in *Nephrops* fisheries (Figure 14.2.1). This species is also typical as a bycatch in the fisheries for deep water shrimp (*Pandalus*), both in the Skagerrak and the Norwegian Deep.

14.2.2 Sweden

The Swedish catches of witch flounder are taken in IIIa, mainly in fisheries targeting *Nephrops* and *Pandalus*. According to recent analyses of the species composition of some catches in these fisheries for the period 1997–2004, in some trips more than 30% by weight in the landings consisted of witch flounder. Therefore, in such cases, a fishery targeting this species can be defined (Inst. of Mar. Res. (Lysekil), 2005).

Historically, the Swedish fishery for witch flounder peaked in the 1920s and 1930s with annual landings exceeding 1000 t.

14.2.3 Spain

No data available.

14.2.4 U.K. Scotland

No data available.

14.3 Stock identity and possible assessment areas

Little information on stock identities for witch flounder is available for ICES waters. As it is a rather stationary species, a first approach regarding assessment units would be to base these on the ICES Divisions/Sub-divisions associated with the fisheries. According to Molander (1935), it is possible to distinguish 2 stocks in IIIa and IV. Thus three units: IIIa, IVa and VIa.

14.4 Historical landings

In the first half of 20th century, Sweden had very high landings of this species from IIIa in the 1920s, up to more than 1500 t annually, see Section 14.2.2. Figure 14.4.1. shows the development in total landings from ICES waters during the past 25 years. In the early years the trend indicates increasing exploitation. The conspicuous drop in recorded landings in the

first half of the 1990s can partly be explained by the absence of Spanish landings figures for the years 1990–1993. Apart from this, total landings seem to have fluctuated between 10 000 and 14 000 t since 1987, and have remained at the same level (around 12 000 t) since 1997 (Figure 14.4.1). Table 14.4.1 shows the landings by country for the most recent 10 year period. Notice that 2004 landings figures are missing for some countries. Denmark, Iceland, Spain and U.K. contribute more than 80% of the total landings. Figure 14.4.2 shows total landings distributed by major fishing nations.

14.5 Catch and effort data by sea area and country

Logbook records for catches of witch flounder are available for the Danish fisheries, notably fisheries for deep-water shrimp in IIIa and the North Sea since the mid-1980s. As a typical by-catch species, which has not been subject to any TAC limitations, the risk that logbook based cpue figures are biased is probably less for this species, than for targeted species.

Logbook data on cpue in IIIa are also available from the Swedish fisheries. Analysis of the 1997–2004 data gives information on the geographical distribution of the fisheries, as well as supplying information on effort and cpue by fishery for this period. It seems that during this period the effort of the fishery/fishing trips targeting witch flounder has increased.

14.6 Biological sampling

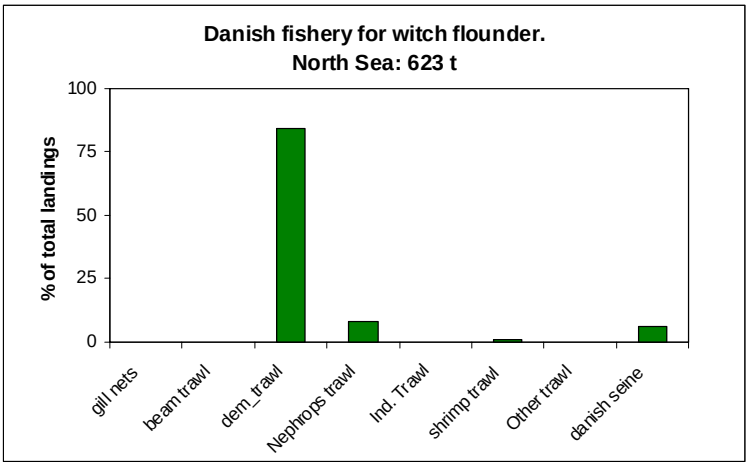
There have been no requests for biological advice on the exploited stocks of witch flounder and therefore no regular assessments have been carried out. However, this species has been subject of 'ad hoc' investigations covering only shorter time periods. Therefore, long continuous time series of biological measurements have not been available. Witch flounder has not been included as a mandatory species in the EU DCR, but this species is included in the national sampling programmes of Denmark and Sweden in IIIa.

No information was available on the sampling status of this species in the U.K. fisheries in the North Sea and northern shelf areas, nor of national sampling programmes for this species in Icelandic waters.

14.7 References

Fiskeriverket (Inst. of Mar. Res.). 2005. Rödtunga – en sammenställning av biologin och fisket nu og da. ('Witch flounder- a summary of the biology and fishery, present and past'). Lysekil., Int. Report (in Swedish).

Molander, A., 1935. Further data concerning the witch (*Pleuronectes cynoglossus* L.). Svenska Hydrografiska-Biologiska Kommissionens Skrifter. Ny serie Biologi. Band I. NR 6. 1935. Tryckeriaktiebolaget Tiden, Stockholm.



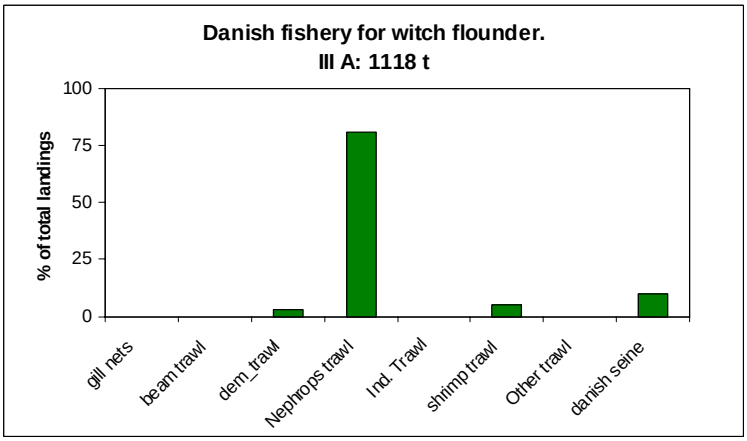


Figure 14.2.1 A & B. Total Danish (by-catch) landings of witch flounder by fishery.

Table 14.4.1. Total landings (t) of witch flounder in the ICES area, 1995-2004, by country.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004*
Denmark	897	999	1563	1906	2115	2338	2048	1907	1807	1812
Faeroe Islands	5	2	2	3	3		1	1	3	
France	734	719	816	602	484	587	586	632	642	
Germany	9	7	9	13	9	13	8	5	2	4
Iceland	1755	1486	1272	947	1408	1098	1132	1147	1948	2122
Ireland	602	616	605	657	713	551	915	831	971	
Isle of Man	2		1							
Netherlands	7		1	4	9	7	1			
Norway	100	80	86	139	134	97	88	82	87	87
Portugal	33	30	32	22	27	26	20	21	16	9
Spain	2339	1751	4183	4805	4148	2961	2870	3277	3740	
Sweden	357	299	355	448	501	579	575	584	549	552
UK - Eng+Wales+N.Irl.	1103	1427	1604	2160	1624	1682	1819	1587	1303	1215
UK – Scotland	2084	2049	2146	1729	2037	2420	2716	2310	2511	2274
ICES area, total	10027	9465	12675	13435	13212	12359	12779	12384	13579	8075

* preliminary

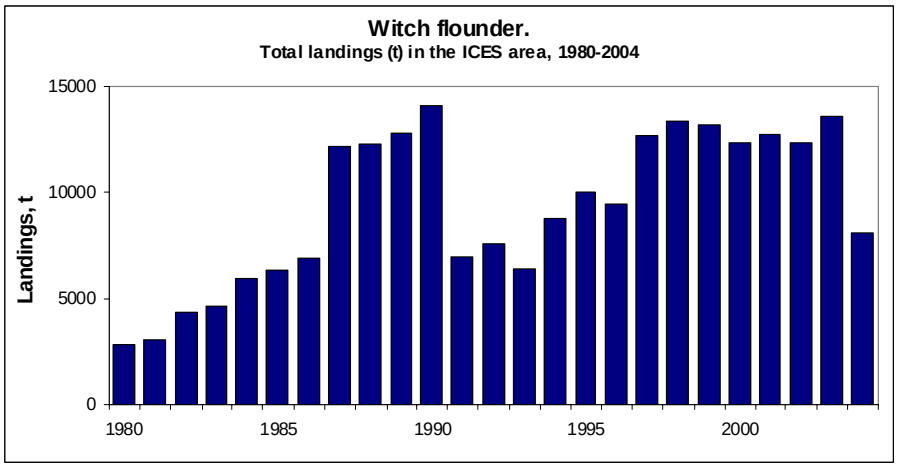


Figure 14.4.1. Total landings of witch flounder from 1980 to 2004.

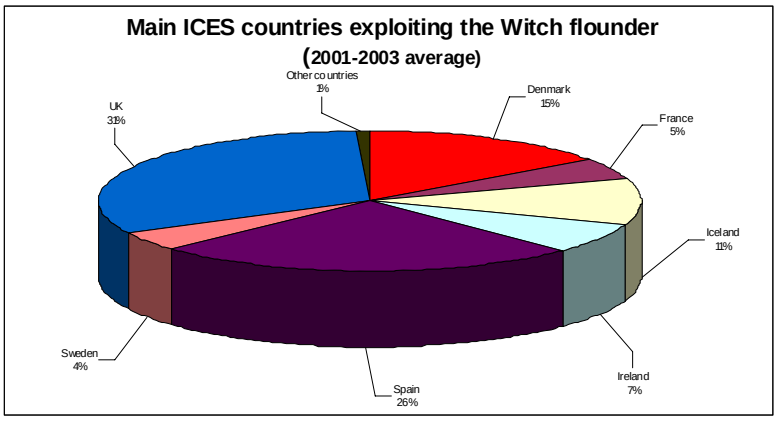


Figure 14.4.2. Total landings distributed by country.

15 Data requirements and recommendations for further research

15.1 Summary of information by species

The text table below summarizes the level of data availability per species. A distinction has been made between "data readily available", "some data available but more needed", and "raw data available but not processed". Where relevant a detailed inventory of the data status can be found in each species section.

SPECIES/AREA	IIIA	IV	VI	VIID,E	VIIA,F-H	VIIIA,B,D	VIIIC
sea bass	-	A	-	A	A	A	A-
red mullet	-	A, Anp	-	A-, Anp	Anp	A-	A-
grey gurnard	Anp	Anp	-	Anp	-	-	-
red gurnard	-	-	-	Anp	Anp	-	-
tub gurnard	-	Anp	-	Anp	-	-	-
turbot	Anp	A, Anp	-	A-	A-	-	-
brill	Anp	A, Anp	-	A-	A-	-	-
lemon sole	Anp	Anp	-	Anp	Anp	-	-
dab	Anp	Anp	-	Anp	Anp	-	-
flounder	-	Anp	-	-	-	-	-
witch flounder	Anp	Anp	-	-	Anp	-	-

- Not relevant
A Available
A- Some available but more needed
Anp Raw data available but not processed (candidate for Small Scale Project)

15.2 Small Scale Project

In the 2005 report of WGNEW several gaps in our knowledge of the biology and fisheries of the new MoU species were identified. It was suggested that a proposal for a Pilot Project should be submitted within the next year for funding by the EC, but this has not yet been done. An outline of the project was, however, included in the report of the Regional Coordination Meeting for the North East Atlantic, which was held in October 2006 in Lisbon. WGNEW was informed that the project was selected for further consideration in a later meeting of RCM chairs.

WGNEW discussed the need for an EC funded project again and it was felt that external funding was essential for WGNEW to make significant progress in its tasks. The main work to be done for a Small Scale Project would be to make data available from routine surveys, market sampling and discard sampling programmes, plus data on catches and effort and any further data from biological sampling or studies on stock ID.

After a discussion on the necessary duration of the project it was agreed to submit two proposals, an international proposal for making available data that were collected in the past and one by IFREMER for further work on the stock ID of striped red mullet. For the first project a period of 6 months was thought to be sufficient, whereas a stock ID project should last for at least 18 months. Below, further details on the international project will be provided.

The objective of the project will be to improve our knowledge on biological parameters, and the composition of catches and landings of species relevant to the WGNEW.

The main tasks to be undertaken by the participants are to compile historic data on length (and if possible age) distributions and biological parameters for commercial and survey catches for the most recent 25 years, for the species sea bass, striped red mullet, red gurnard, tub gurnard, grey gurnard, turbot, brill, lemon sole, dab, flounder, John Dory and witch flounder.

The duration of the study should not be more than 6 months from the signature of the contract.

The budget available for such a project is currently not known, but will probably not exceed 500 000 € covering all expenses, including personnel, transport, overheads and consumables plus two meetings in Brussels (to discuss the preliminary report and the presentation/ discussion of the draft final report).

Henk Heessen (IMARES) will act as coordinator of the general project.

An overview of data that could be made available through this project, for each species/area combination, is given below:

Sea bass

Survey data: IBTS
Landings data (t, by gear): UK (Sc), B
Landings data (lfd, by gear):
Effort data (by gear): UK (Sc)
Discard sampling: UK (Sc), UK (E&W), B
Biological sampling:

Striped red mullet in IV

Survey data: IBTS (Datras)
Landings data (t, by gear): NL, UK (sc), UK (E&W), B (minor catch)
Landings data (lfd, by gear):
Effort data (by gear): UK (Sc)
Discard sampling: NL, UK (Sc), UK (E&W), B (minor catch)
Biological sampling:

Red gurnard

Survey data: IBTS (Datras)
Landings data (t, by gear): UK (Sc), B
Landings data (lfd, by gear):
Effort data (by gear): UK (Sc), B
Discard sampling: UK (Sc), UK (E&W), B
Biological sampling:

Tub gurnard in IV

Survey data: IBTS (Datras), BTS (Datras), BTS (B)
Landings data (t, by gear): NL, B
Landings data (lfd, by gear):
Effort data (by gear): B
Discard sampling: NL, UK (E&W), B
Biological sampling:

Grey gurnard in IIIa

Survey data: IBTS (Datras), Coastal Survey Sweden (since 2000)
Landings data (t, by gear): DK, S
Landings data (lfd, by gear): DK
Effort data (by gear): not relevant
Discard sampling: DK, S
Biological sampling:

Grey gurnard in IV

Survey data: IBTS (Datras), BTS (B)
Landings data (t, by gear): UK (E&W), UK (Sc), NL, B
Landings data (lfd, by gear): DK
Effort data (by gear): not relevant
Discard sampling: DK, NL, UK (E&W), UK (Sc), UK (E&W), B
Biological sampling: some (historic) sampling during IBTS (Datras)

Grey gurnard in VIId,e

Survey data: CGFS
Landings data (t, by gear): F, UK (E&W), B
Landings data (lfd, by gear):
Effort data (by gear): not relevant
Discard sampling: F, UK (E&W), B
Biological sampling:

Turbot in IV

Survey data: BTS (NL), DFS (NL), IBTS (Datras)
Landings data (t, by gear): NL, UK (Sc), B
Landings data (lfd, by gear): NL, UK (Sc), B
Effort data (by gear): NL, UK (Sc), B
Discard sampling: NL, UK (Sc), UK (E&W), B
Biological sampling: NL, B

Brill in IV

Survey data: BTS (NL), DFS (NL), IBTS (Datras)
Landings data (t, by gear): NL, UK (Sc), B
Landings data (lfd, by gear): NL, UK (Sc), B
Effort data (by gear): NL, UK (Sc), B
Discard sampling: NL, UK (Sc), UK (E&W), B
Biological sampling: NL, B

Lemon sole in IV

Survey data: IBTS (Datras), BTS (B)
Landings data (t, by gear): NL, UK (Sc), B
Landings data (lfd, by gear): NL, UK (Sc), B
Effort data (by gear): NL, UK (Sc), B
Discard sampling: NL, UK (Sc), UK (E&W), B
Biological sampling: NL, UK (Sc)

Dab in IIIa

Survey data: IBTS (Datras)
Landings data (t, by gear): through ICES
Landings data (lfd, by gear): Dk, D
Effort data (by gear): Dk, D
Discard sampling: Dk
Biological sampling: Dk

Dab in IV

Survey data: IBTS (Datras), BTS (B, NL), DFS (B, NL)

Landings data (t, by gear): through ICES
Landings data (lfd, by gear): Dk, D, UK (Sc), NL
Effort data (by gear): NL, D, Dk, B, UK (Sc)
Discard sampling: NL, D, B, UK (Sc), UK (E&W)
Biological sampling: NL, some (historic) sampling during IBTS (Datras)

Dab in VIId,e

Survey data: Fr, UK
Landings data (t, by gear): through ICES
Landings data (lfd, by gear): Fr, UK (E&W)
Effort data (by gear): B
Discard sampling: B
Biological sampling:

Dab in VIIa,f-h

Survey data: FR, UK (E&W)
Landings data (t, by gear): through ICES
Landings data (lfd, by gear): FR, UK (E&W)
Effort data (by gear): FR, UK (E&W), B
Discard sampling: FR, UK (E&W), B
Biological sampling: FR, UK (E&W)

Flounder in IV

Survey data: IBTS q1 (Datras), Demersal Fish Survey (Wadden Sea), DFS (NL)
Landings data (t, by gear): D, NL, UK (Sc), B
Landings data (lfd, by gear): NL
Effort data (by gear): not relevant
Discard sampling: D, NL, UK (Sc), UK (E&W), B
Biological sampling: NL

Witch flounder in IIIa

Survey data: IBTS (Datras)
Landings data (t, by gear): DK, S
Landings data (lfd, by gear): S (small 2005 project)
Effort data (by gear): not relevant
Discard sampling: DK, S
Biological sampling: DK (some exploratory sampling), S (small 2005 project)

Witch flounder in IV

Survey data: IBTS (Datras)
Landings data (t, by gear): DK (exploratory sampling), UK (Sc), S
Landings data (lfd, by gear): DK
Effort data (by gear): not relevant
Discard sampling: DK (?), UK (Sc), UK (E&W), S (some)
Biological sampling: none

John Dory

Survey data: IBTS (Datras), EVHOE q4
Landings data (t, by gear): FR, UK (Sc), UK (E&W)
Landings data (lfd, by gear):
Effort data (by gear): not relevant
Discard sampling: UK (Sc), UK (E&W)
Biological sampling: none

15.3 Addition of a new species to the Terms of reference of the WGNEW

During the meeting, the group discussed the possible extension of the species for which management measures should be considered. In view of its growing importance to the fishery in the Celtic Sea, the coastal areas of Brittany and the Western Channel, the WG recommends that John Dory (*Zeus faber*) should be included in the ToRs of WGNEW.

16 Suggested Terms of reference for 2008

WGNEW has now met twice. Before the group can finalise its tasks, an EC funded project is considered essential, since too many data that exist in the different institutes are not yet made available to the WG. A Small Scale Project could fill these gaps. An EC call for proposals is expected to be published in the spring of 2007, with a deadline of July 2007. The WGNEW Small Scale Project will therefore start in the autumn of 2007 at the earliest, and as mentioned elsewhere, the project is expected to last for about six months. The participants in the project (probably consisting of all participants in WGNEW) are expected to meet once during the project. The final meeting of WGNEW should be held after the Small Scale Project has finished. At this stage it is impossible to predict when exactly the final meeting of WGNEW should be held, but the suggested venue is Boulogne sur Mer (France).

Suggested TOR's

The Working Group on Assessment of New MoU Species [WGNEW] (Co-Chairs: Henk Heessen, Netherlands and Jean-Claude Mahé, France) will meet in Boulogne for three days in 2008 to:

a) consider possibilities for fish stock assessments/input to management processes/indicators of the following species: sea bass, flounder (except for the Baltic) common dab (except for the Baltic), lemon sole, brill (except for the Baltic), turbot (except for the Baltic), witch flounder, red gurnard, tub gurnard, grey gurnard, striped red mullet and John dory, through.

1) review of knowledge on stock structure,
2) existing fisheries monitoring programmes and surveys including the EU Data Collection Programme,
3) existing databases made available for fish stocks assessment.

WGNEW will report by xx of YYYY to ACFM and LRC.

Annex 1: List of participants

NAME	ADDRESS	PHONE	FAX	EMAIL
Robert Bellail	IFREMER 8, rue François Toullec F-56100 Lorient France	+33 2 97873819	+33 2 97873836	Robert.Bellail@ifremer.fr
Franck Coppin	IFREMER 150, Quai Gambetta F-62200 Boulogne-sur-Mer France	+33 321995610	+33321995601	Franck.Coppin@ifremer.fr
Wim Demaré	ILVO-Fisheries Ankerstraat 1 B-8400 Oostende Belgium	+32 59 569830	+32 59330629	wim.demare@ilvo.vlaanderen.be
Heino Fock	Inst. for Sea Fisheriesi Palmaille 9 D 22767 Hamburg Germany	+49 40 389 05 266	+49 40 389 05 263	heino.fock@ish.bfafisch.de
Jon Ruiz Gondra	Txatxarramendi ugartea Sukarrieta Bizkaia Spain	+34 946029400	+34 946870006	jruiz@suk.azti.es
Henk Heessen	IMARES P.O. Box 68 NL-1970 AB IJmuiden the Netherlands	+31 255 564 692	+31 255 564 644	henk.heessen@wur.nl
Stephen Keltz	Fisheries Research Services. PO Box 101, 375 Victoria Road, AB11 9DB Aberdeen United Kingdom	+44 (0)1224 876544	+44 (0)1224 295511	s.j.keltz@marlab.ac.uk
Jean Claude Mahé	IFREMER 8, rue François Toullec F-56100 Lorient France	+33 (0)2 97 87 38 18	+33 (0)2 97 87 38 36	Jean.Claude.Mahe@ifremer.fr

Kelig Mahé	IFREMER 150, Quai Gambetta F-62200 Boulogne-sur-Mer France	+33 321995602	+33321995601	Kelig.Mahe@ifremer.fr
Yvon Morizur	IFREMER Centre de Brest BP 70 F-29280 Plouzané France	+33 (0) 298224481	+33(0)298224653	Yvon.Morizur@ifremer.fr
Anders Svenson	Havsfiskelaboratoriet Turistgatan 5 Box 4 453 30 Lysekil	+46 (0) 52318757	+46 (0) 52313977	anders.svenson@fiskeriverket.se
Sarah Walmsley	Cefas Lowestoft Laboratory Lowestoft Suffolk NR33 0HT United Kingdom	+44(0)1502527790	+44(0)1502513865	sarah.walmsley@cefas.co.uk

Annex 2: Working Document. Notes on the Basque fishery on sea bass (*Dicentrarchus labrax*) in the northeastern Atlantic waters in 2005

by

Jon Ruiz[1], Marina Santurtun, Ane Iriondo, Guzmán Díez, Isabel Gonzalez, Iñaki Artetxe & Iñaki Quincoces

Fundación AZTI, Instituto Tecnológico, Pesquero y Alimentario. Txatxarramendi ugartea z/g. 48395 Sukarrieta. Bizkaia. Basque Country (Spain).

[1] *jruiz@suk.azti.es*

INTRODUCTION

During 2005, AZTI continued monitoring the sea bass (*Dicentrarchus labrax L.*) fishery of the Basque Country (Spain) in relation to the monthly landings and fishing effort by sea area and gear. In this way, compilation and updating of the basic information on sea bass landings and landings per unit effort made by the Spanish fleets, when landed at the Basque Country ports, is updated every year since 1994 (Lucio *et al*., 2002, 2003, 2004).

As in previous years, sea bass catches can be considered as by-catches of other directed or mixed demersal fisheries operated by the Basque fleet, targeting Hake, Anglerfish, Megrim and others. These demersal fisheries operate in different sea areas -ICES Sub-areas VI, VII and VIII- and different gears: "baka" otter bottom trawlers, pair bottom trawlers with very high vertical opening (VHVO) nets, bottom and surface longliners , set (gill and trammel) netters and others. Scattered catches are also obtained in some years by purse-seiners targeting pelagic species.

In this paper, an update of sea bass landings on the Basque Country ports since 1994 to 2005 are presented. Also for the "baka" bottom trawl fleet operating in Div. VIIIa,b,d, -the most important fleet in relation to sea bass fishery- and for that same period, fishing effort and landings per unit effort (LPUE) values have been revised and updated.

Information on sea bass catches by the recreation fishery by means of rod and line on waters close to the Basque coast (eastern Div. VIIIc and southern Div. VIIIb) continues to be practically nil, but, as for the provious period and as a first approximation, catches might be considered very low.

RESULTS

1. Catches (landings) of Sea bass by sea area and gear

Total annual catches

In 2005 the sea bass Basque annual landings amounted to 52.8 tonnes. This supposes a decrease of 21 t comparing with 2004. 2005 landings are slightly bellow the 1996-2005 average (Table 1). As no bass discards are supposed to occur, landings might be considered as catches figures.

Annual catches by sea area

As in previous years, practically all catches were obtained in the Bay of Biscay: close to 82,5%: in Div. VIIIa,b,d and about 17,3% in Div. VIIIc (eastern Cantabrian Sea, *i.e.* south-eastern Bay of Biscay). Only very few catches (< 0.5 % total catches) came from Sub-area VII (Celtic Sea) and no catches were taken from Sub-area VI (western part of Scotland and around Rockall Bank) in 2005 (Figure 1).

Annual catches by gear

Summaries of the total catches of bass by sea area and gear from 1994 till 2005 are presented in Table 2. In this table the fishing gears are summarized into four groups: bottom trawl, longline, set net and purse seine.

In 2005, the general pattern of the annual catches by gear remains similar in comparison to previous years. Main catches were achieved by bottom trawl (around 78%) and the rest by longline (around 5%), by set nets (8%) and purse seine (10%). A decreasing relative importance of the longline in relation to the rest of the gears is observed along the last year (Figure 2). Between the different metiers of bottom trawl, "baka" otter trawl obtained almost the entire bass catches (90%), followed by VHVO Pair bottom trawl (32%). Since 2000 "Bou" otter trawl and twin nets trawl did not operate any more; these two metiers, working in Div. VIIIa,b,d, reported only an average around 2% of total trawl catches in the past (Figure 3).

2. Seasonality of Sea bass catches by sea area

Sub-areas VI and VII

In 2005 no bass catches were reported from Sub-area VI, as in the most of the whole period considered –excepting in 1997 (735 kg) and 2000 (64 kg), in both cases in December, by "baka" trawl.

From Sub-area VII, 120 Kg were landed in 2005, these catches were taken by longliners and trawlers at the same extend.

Divisions VIIIa,b,d

In 2005, as in the past, more than 80% of the annual landings in the Basque ports came from this sea area, and, as in previous years, the largest catches of bass were achieved during the first and the four quarter (Figure 4). Thus, the very marked seasonality on the sea bass catches in this sea area is maintained along all the period 1994-2005 (Figure 5). Most years, bass catches begin to take place in last and first quarter of the year (October to March). Very few catches occur between April to August.

Division VIIIc

This small sea area, in the more eastern part of Div. VIIIc, produces more than 15% of the total Basque reported landings (1996-2005). In 2005 a small increase has been observed in relation to 2004 (8,3 t and 9,1 t respectively), (Table 1). In those waters artisanal longline catch usually about 70% of the total landings, gillnet 15% and purse seine 10%. But in the last years purseine and gillnet catches are becoming more important. Although a kind of seasonality can be observed in the catches, related also to autumn and winter, that is not so precise as in the rest of the Bay of Biscay (Div. VIIIa,b,d). (Sea bass AZTI's monitoring for in 1994 and 1995 did not include landings values of the main fleets operating in Div. VIIIc, above longline and set nets; thus total landings reported for those years in this area must be considered underestimated).

In addition, a traditional, but small, sport fishery (by rods or by lines) takes place close to the coast and in the rivers mouths. No information on the catches amount or characteristics is available. In a first approximation, they could be considered not important (circa less than 3 t

per year). Main catches are obtained in autumn (September to November) (L. Arregi, pers. com.), although major effort in applied in summer months (holidays season).

3. Sea bass catches (landings) per unit effort

The "baka" otter bottom trawl fleet working in Div. VIIIa,b,d and landing in the Basque port of Ondarroa has only been selected to provide information on sea bass catches (landings) per unit effort (LPUEs) and on the abundance trends in the period 1994-2005. This fleet obtains the most important bass Basque catches and its fishing effort can be quantified with accuracy along all the period. However it has to be noted that bass is not a target for this metier -focused at present on mixed fisheries-, but only an economically interesting by-catch restricted to a period of the year.

The effective fishing effort of this fleet was calculated in number of fishing days, as result of multiplying the number of trips of the fleet in the sea area selected (Div. VIIIa,b,d) by the mean number of fishing days by trip in the area, season (quarter) and year:

$$\text{Effort} = \text{fishing days} = \text{trips} * (\text{mean days/trip})$$

The "baka" bottom trawl's fishing effort (fishing days) has progressively decreased since 1994 to 2000 in more than 60% (Table 3), mainly because of the severe diminishing of the number of boats of this Basque fleet. Then fishing effort has maintained at the same level until 2005.

The sea bass annual LPUEs, that remained relatively stable during 1994-1998 (around 5 kg/day), increased three times since 1999 until 2002 (about 15 kg/day) and decreased in 2003 (9 kg/day). But in 2004 and 2005, an increase can be appreciated again (17 Kg/day) (Figure 6). The sea bass LPUEs evolution by quarters presents a very different pattern within the years, but very similar between the years: the quarterly LPUEs are practically null in the 2nd and 3rd quarters, and high in the 1st and 4th quarters.

Although the observed increase of the annual sea bass LPUEs in the last years could be considered as an indicator of the increasing abundance of sea bass in this sea area, it must be taken with caution. In fact it coincides with the drastic diminishing of Northern hake LPUEs in the same area for the same fleet. In the past, in the 80's and until the middle of the 90's, hake was one of the main targets for the "baka" trawl (about 20% of total landings), but in the last years hake landings represent only around 5%. It would seem that, with the crisis of the Northern hake fishery in the last years of 90's and later with the enforcement on the minimum legal size in the hake landings, this fleet changed their objectives and accented its character of "very" mixed fishery, allocating more directed effort on other species not submitted to the TACs and Quotas system. This could be the case of the sea bass fishery.

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Table 1. Sea bass landings (kg) in the Basque Country ports by ICES Sub-area, in the period 1994-2005. (Average value for 1996-2004 is also presented. Landings for the years 1994-1995 must be taken with caution, especially for Div. VIIIc as they can be underestimated).

Year	VI	VII	VIII	TOTAL	VIIIa,b,d	VIIIc
1994	0	26	60477	60503	60473	4
1995	0	0	28770	28770	28770	0
1996	0	0	72440	72440	50945	21495
1997	0	42	50437	50479	41663	8774
1998	735	29	57898	58662	50205	7693
1999	0	1054	60007	61061	56819	3188
2000	64	100	62850	63014	57964	4886
2001	0	36	49469	49505	41553	7916
2002	0	2	64128	64130	49843	14285
2003	0	28	46008	46036	38424	7584
2004	0	296	73786	74081	65394	8392
2005	0	120	52700	52820	43571	9129
Av. [1996-2005]	80	171	58972	59223	49638	9334

Table 2. Total sea bass landings (in kg) in the Basque Country ports during the period 1994-2005 by sea area and gear. Fishing gears are summarised in trawl, longline, set net and purse seine.

Gear	Area	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average
All Trawl	VI	0	0	0	0	735	0	64	0	0	0	0	0	67
	VII	26	0	0	42	29	16	98	15	2	13	0	61	25
	VIIIabd	42386	17602	23198	20525	23498	41120	39900	38442	46219	34344	52437	40878	35046
	VIIIc	4	0	10	318	40	50	32	17	0	7	8	0	44
	Total	42416	17602	23208	20885	24302	41186	40094	38474	46221	34363	52445	40939	35178
All Longline	VI	0	0	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	1038	2	21	0	15	296	59	119
	VIIIabd	18087	11169	27606	16867	18839	9768	6284	394	1002	2885	12884	1413	10600
	VIIIc			8035	6127	4995	2078	3720	6493	10916	5598	3825	1085	5287
	Total	18087	11169	35641	22994	23834	12884	10006	6907	11918	8498	17005	2556	15125
All Set nets	VI	0	0	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0	0	0	0	0	0	0
	VIIIabd	0	0	0	4215	7855	5573	11452	2543	2559	603	0	327	2927
	VIIIc			1077	1919	659	608	713	969	1999	1588	1570	3677	1478
	Total	0	0	1077	6134	8514	6181	12165	3512	4557	2191	1570	4004	4159
All Purseine	VI	0	0	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0	0	0	0	0	0	0
	VIIIabd	0	0	141	26	13	358	328	174	59	593	72	953	226
	VIIIc			12197	410	1999	452	396	437	1289	391	2988	4367	2493
	Total	0	0	12338	436	2012	810	724	611	1348	984	3061	5320	2304
Others	Total	0	0	176	30	0	0	25	0	86	0	0	0	26
Grand Total		60503	28770	72440	50479	58662	61061	63014	49505	64130	46036	74081	52819	56792

Table 3. Sea bass 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 1994-2005.

VIIIa,b,d	**LANDINGS** (kg)	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
	Quarter 1	12832	6781	12452	11588	10500	10204	21290	21172	30582	14636	5550	24066
	Quarter 2	13	62	100	25	4	198	0	0	32	790	42	15
	Quarter 3	459	293	177	182	100	33	5	39	0	9	7589	465
	Quarter 4	15214	6691	5100	4917	3952	22065	11441	8145	7265	5717	22552	12373
BAKA-ON	TOTAL	**28518**	**13827**	**17829**	**16712**	**14556**	**32500**	**32736**	**29356**	**37879**	**21152**	**35733**	**36919**
VIIIa,b,d	**EFFORT** (days)	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
	Quarter 1	1596	1229	1459	1345	1097	855	969	856	847	906	766	739
	Quarter 2	1283	1006	883	1223	655	384	295	323	510	695	565	442
	Quarter 3	1230	825	699	770	384	316	219	151	202	176	167	210
	Quarter 4	1509	1414	1337	949	865	782	745	788	548	519	661	872
BAKA-ON	TOTAL	**5619**	**4474**	**4378**	**4286**	**3002**	**2337**	**2227**	**2118**	**2107**	**2296**	**2159**	**2263**
VIIIa,b,d	**LPUE** (kg/day)	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
	Quarter 1	8,0	5,5	8,5	8,6	9,6	11,9	22,0	24,7	36,1	16,2	7,2	32,6
	Quarter 2	0,0	0,1	0,1	0,0	0,0	0,5	0,0	0,0	0,1	1,1	0,1	0,0
	Quarter 3	0,4	0,4	0,3	0,2	0,3	0,1	0,0	0,3	0,0	0,1	45,4	2,2
	Quarter 4	10,1	4,7	3,8	5,2	4,6	28,2	15,4	10,3	13,3	11,0	34,1	14,2
BAKA-ON	TOTAL	**5,1**	**3,1**	**4,1**	**3,9**	**4,8**	**13,9**	**14,7**	**13,9**	**18,0**	**9,2**	**16,6**	**16,3**

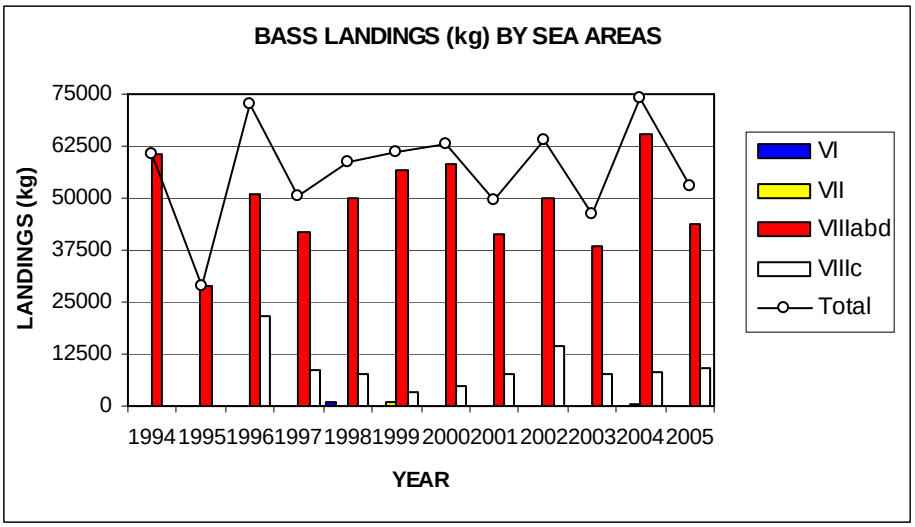


Figure 1. Sea bass landings (kg) in the Basque Country ports by sea area, in the period 1994-2005

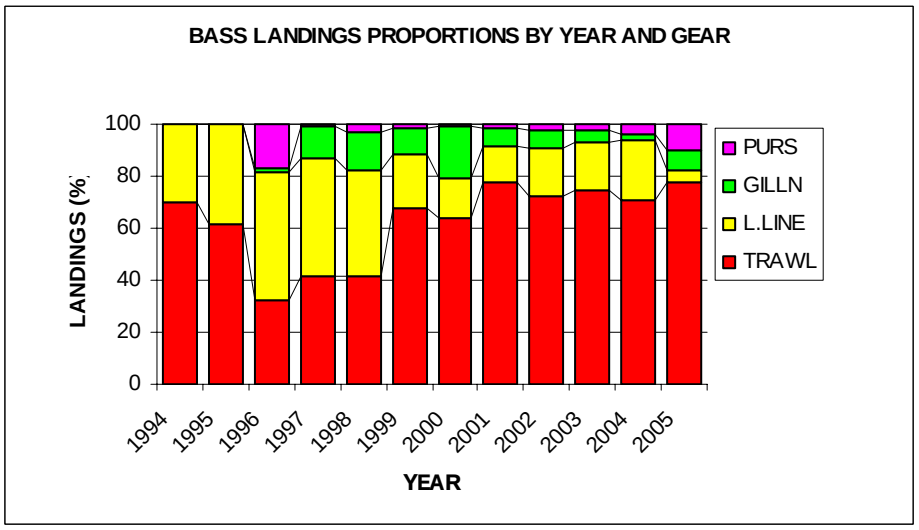


Figure 2. Sea bass landings proportions (%) by gear, in the period 1994-2005. (TRAWL: All bottom trawl metiers; L.LINE: Surface and Bottom Longline; GILLN: Trammel and Gillneter; PURS: Purse seiner).

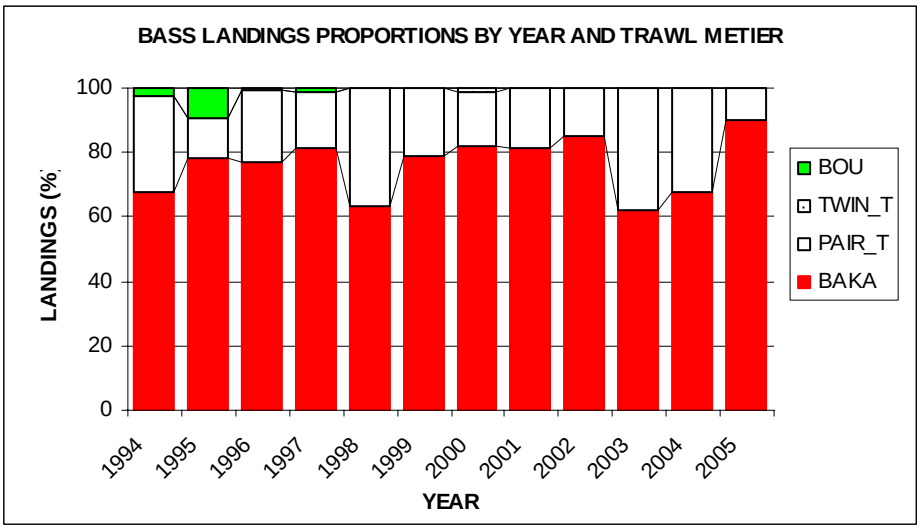


Figure 3. Sea bass landings proportions (%) by trawl metier, in the period 1994-2005. (BAKA: "Baka" otter bottom trawl; PAIR_T: VHVO Pair bottom trawl with very high vertical opening nets. BOU ("Bou" otter bottom trawl) and TWIN_T (Trawl with twin nets) disappeared in 2000

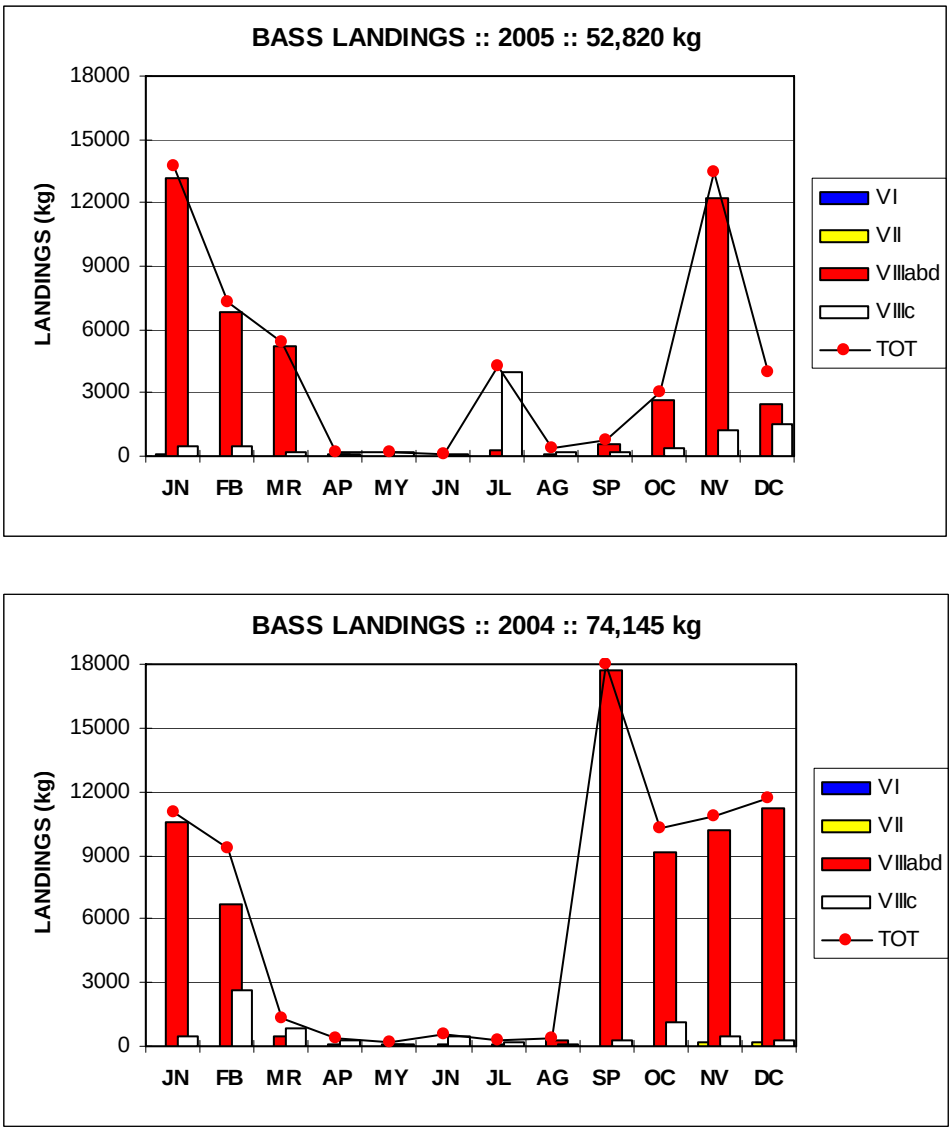


Figure 4. Monthly distribution of the Basque landings (kg) of Sea bass, in 2004 (and 2005, for comparison).

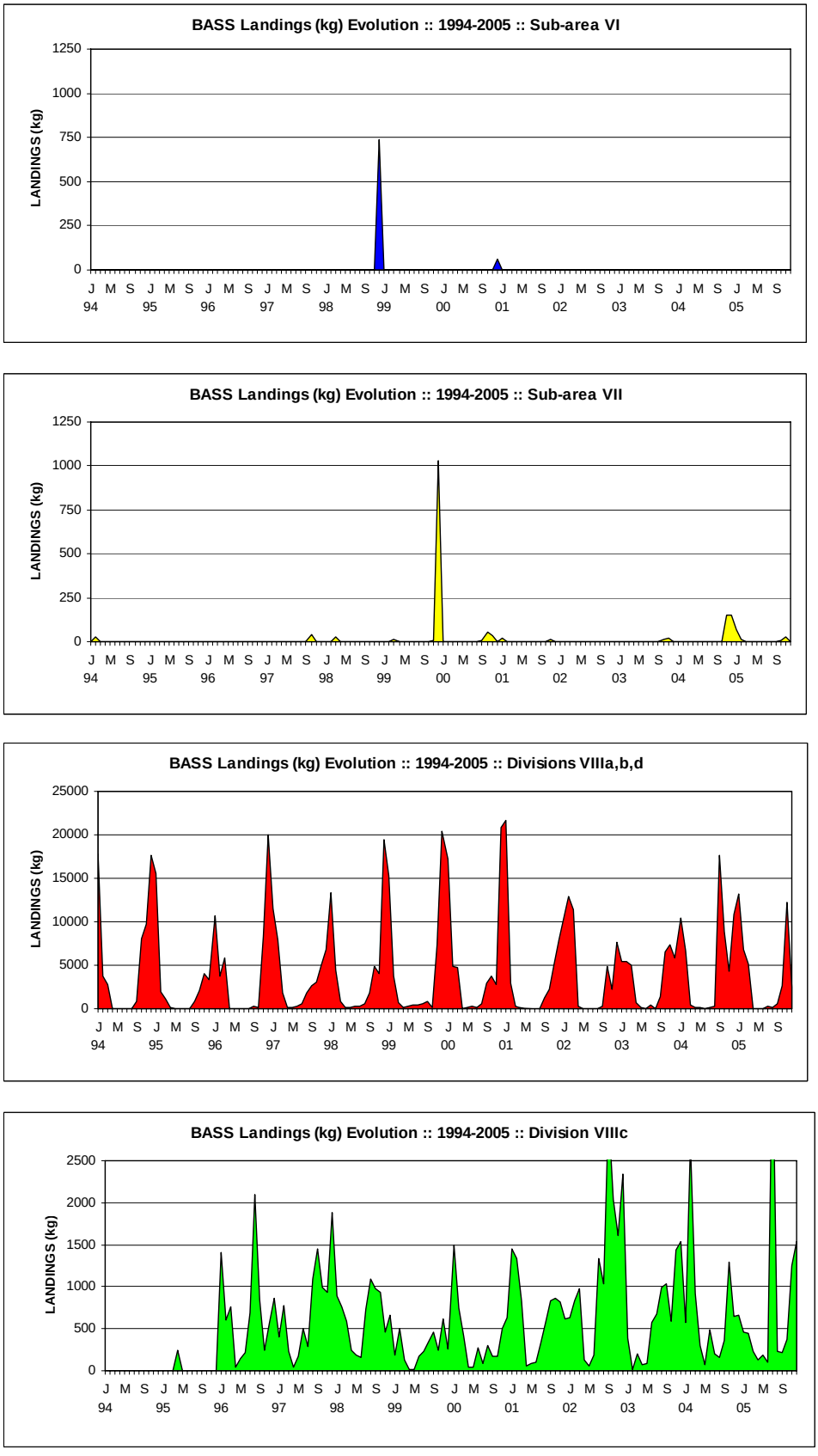
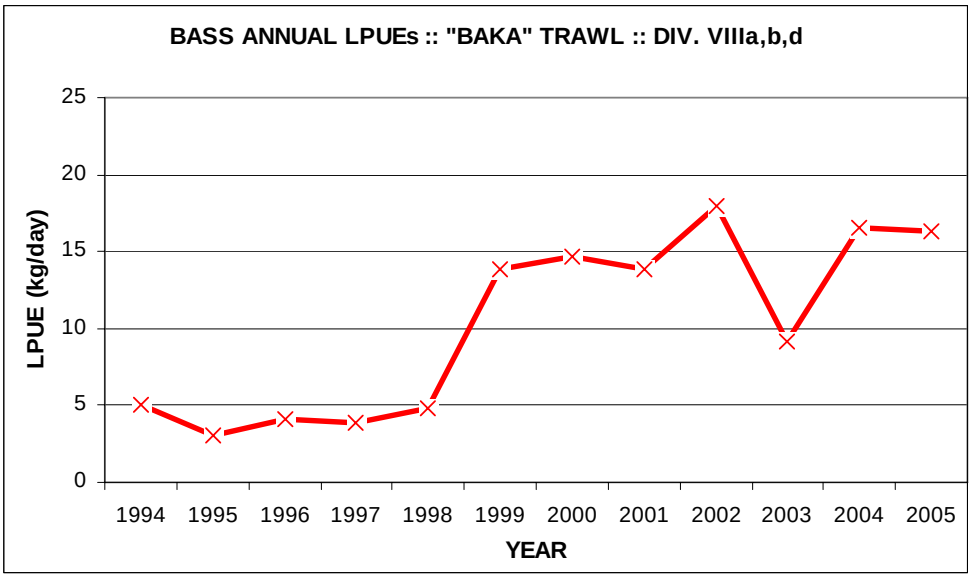


Figure 5. Monthly evolution of Sea bass landings (kg) by ICES Sub-area in the period 1994-2005.



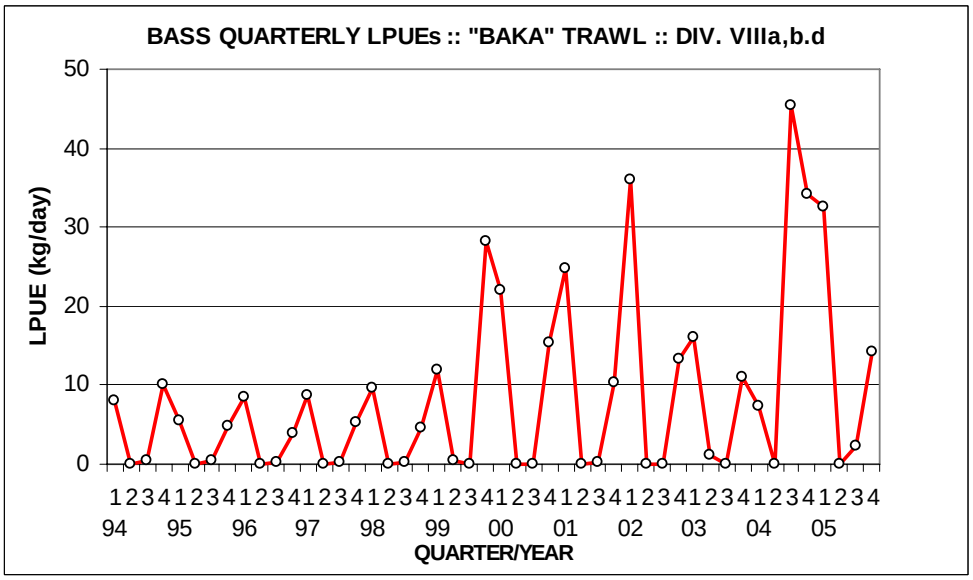


Figure 6. Sea bass landings per unit effort (LPUEs in kg/day), by year and by quarter, of "baka" otter bottom trawl fishing in Divisions VIIIa,b,d, and landing in Ondarroa (Basque Country. Spain), in the period 1994-2005.

Annex 3: Working document. Geometrical morphometry, surveys cohort and sampling optimisation analysis applied to Striped Red Mullet

by

K. Mahe, F. Coppin, S. Vaz, D. Le Roy, W. Louis, P. Koubbi & A. Carpentier.

Ifremer, Laboratoire Ressources Halieutiques
Centre de Boulogne sur mer
150 quai Gambetta
62200 Boulogne sur mer

I. Geometrical morphometry[2]

I. 1. Principle of the geometric morphometry

The morphometry is the morphological analysis of the organism by measurement; it is the study of the form and the external structure of the living beings. These studies are used for the recognition of the species, of their systematic (classification), their phylogeny (family ties) or for the identification of stocks or populations inter-connected spatially or not due to their habitats (Baumgartner, 1992).

One can note in certain fish the differences in proportions of the elements of the body following the stages of development. Thus, one will be able to note at a given age the females are larger than the males, which has consequences from a point of view of the demographic strategy of the species.

The geometrical morphometry has as a principle of drawing an image in wire of the outline of fish using a computer along different axes. That makes it possible to create reinforcement between different points or apex. The geometrical morphometry takes oblique and local measurements, and not of total measurements, like does it the traditional morphometry. The geometrical morphometry thus makes it possible to rebuild the shape of the animal. This method is based on the positioning of "homologous" points which one can easily place on all the individuals. These points correspond, for example, with the insertion of the fins, with the mouth... The first operation consists to point and post the apex on the numerical photography of fish. The second consists in tracing segments, and the third to calculate the distances between some of these apexes. According to Strauss and Bookstein (1982), three types of reinforcements are possible (Fig. 1):

- √ The triangulation which represents the form with juxtaposed triangles. If there are n points, one will obtain 2n-3 different distances.
- √ The Truss model consists of parallelepipeds with their diagonals by area of the body. One thus obtains triangles which recut the ones with the others in each area of the body. In an area of the body, each triangle between three apexes covers two other triangles partially. The number of distances is 5n/2-4.
- √ The redundant model consists of a reinforcement where each point is connected to all the other points. There is an important covering of the triangles between them. The number of distances is of 3(n-2).

2 This analysis was extracted from a study carried out in 2004-2005 (Mahé *et al*., 2005).

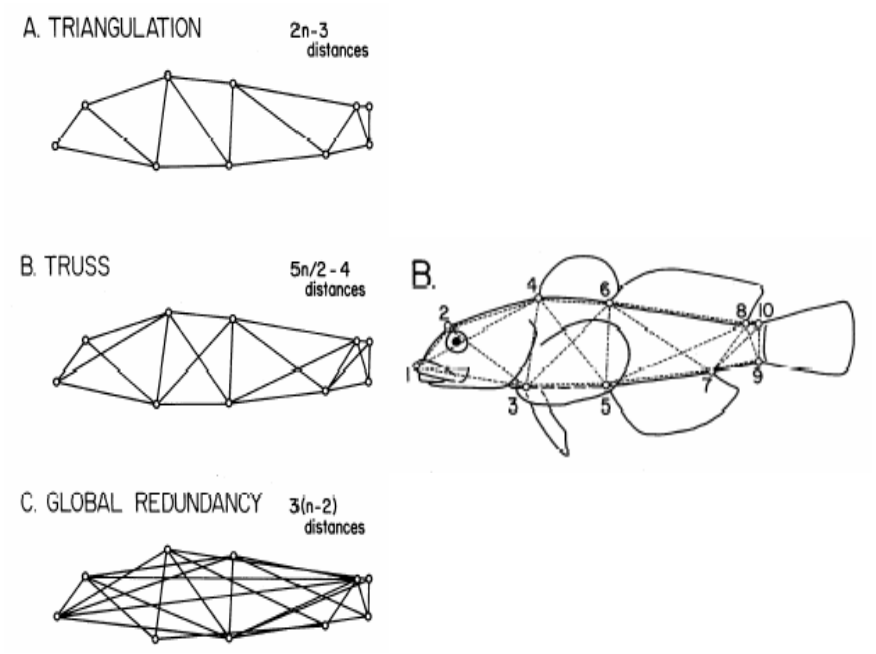


Fig. 1: Drawing of the 3 models starting from 10 homologous points

(Strauss & Bookstein, 1982).

The Truss model was here selected because it supports a limited covering of the triangles between them with a reasonable number of distances. In the triangulation, the small errors of measurement are propagated making the technique less precise. For the redundant model, that generates many measurements and statistically requires a too great number of samples (Strauss & Bookstein, 1982). This rebuilding comes from the Cartesian coordinates of the marks of reference and grants compensations for the errors of measurement.

I. 2. Material and method

I. 2. A) Origin of fish

The fish for this morphometric study come from the groundfish surveys EVHOE from the Bay of Biscay and CGFS in the Eastern English Channel (Table. 1). All the photographs weren't retained for the analysis. The criteria of rejection of the photographs are as follows:

- √ measurements impossible to take because of fuzzy photographs or weak luminosity not compensable by the analysis of image,
- √ fish badly positioned, twisted, dissected, or mouth large open,
- √ missing scale into horizontal and vertical or illegible,
- √ dorsal or anal fins evil positioned for the take a image.

185 images out of 244 were retained bus answering the quality standards for the analysis of image and the numerical analysis. 128 fish come from campaigns CGFS and 57 of campaigns EVHOE for the years 2001 to 2003.

Table 1 : Number of fish retained for this study.

GROUNDFISH SURVEYS	YEAR	NUMBER OF INDIVIDUALS PHOTOGRAPHED	NUMBER OF INDIVIDUALS RETAINED
CGFS	2001	41	17
	2002	55	50
	2003	74	61
EVHOE	2002	16	0
	2003	58	57
Total		244	185

I. 2. B) Definition of the homologous points

The striped red mullet is characterized by the presence of: two dorsal fins, an anal fin, a pair of pelvic fins and a pair of pectoral fins. These characteristics allow the identification of 10 apexes located on the outline of the animal. The points composing this reinforcement were given in the publication of Strauss and Fuiman (1984), taken up by Koubbi and Costes (2000) on fish Antarctic and adapted to the needs of this study on the striped red mullet (Fig. 2).

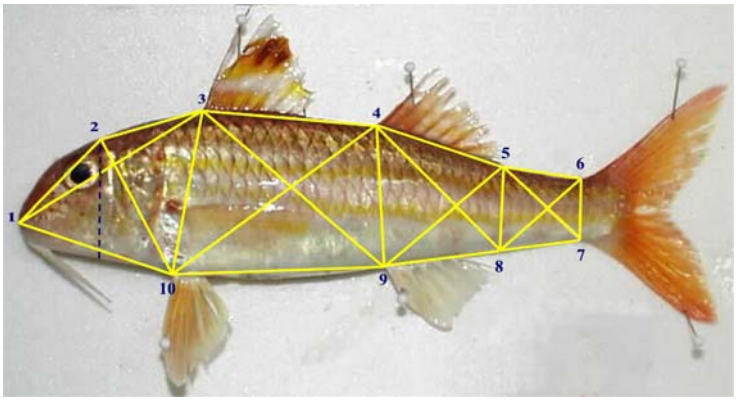


Fig. 2: Geometrical Morphometry according to model TRUSS (Strauss & Bookstein, 1982) applied to a striped red mullet with the presence of 10 homologous points.

I. 2. C) Analyse of images

For the photographs, the fish were spread out head on the left, deployed fins. A scale with horizontal and vertical reference mark was placed in order to gauge measurements on the photographs. The software of image analysis is Optimas 6. This software was configured by Coste (2000) to allow the pointing of the homologous points, to calculate the distances between these points according to the Truss model and to export measurements under the computation software Excel. Before measurements, each image must be gauged in X and Y to measure the distances in mm.

I. 2. D) Data processing

The 21 distances taken out of 185 fish were the subject of multivariate analyses in order to study if there are morphometric differences between:

- √ the sectors Eastern English Channel and the Bay of Biscay,
- √ sexes,

These parameters were used as explanatory variables.

The multivariate statistical analyses carried out are ordinations. these analyses allow to combine information of several tables. In this study, two tables were used:

- a principal data file which is the all measurements by segment for each individual, each box of the table is a measurement in mm; the variables (distance between homologous points) have each one a normal distribution to show it the kurtose and the coefficient of asymmetry and were thus not transformed.

- a set of explanatory variables, nominal (scientific countryside, sex).

The ACP (Analysis in Principal Components) is an analysis of indirect gradient based on a model of linear answer (Leps & Smilauer, 1999; ter Braak & Smilauer, 1998). The analysis carried out is based on measures of covariance between the variables (here distances between the homologous points). That makes it possible to know which segments of the body vary in the same manner. The explanatory variables don't intervene in ordination but are superimposed *a posteriori* on those to allow an indirect interpretation of the principal data file (Legendre & Legendre, 1998).

In the literature (Strauss & Bookstein, 1982; Strauss & Fuiman, 1984), the allometric analyses and the ACP show that these distances are related to the overall length of the individuals. This strong correlation prevents from studying the morphometric differences precisely. Thus, Redundancy Partial Analyses (RDA) were carried out. In a partial analysis, it is sometimes necessary to extract the variation explained by an explanatory data file to analyze the remaining variance. Variance explained by covariable (i.e. the variable the effect must be withdrawn), here the total length, is extracted before RDA is made (Leps & Smilauer, 1999). These covariables are often explanatory variables of important effect but of less interest, masking essential information.

The RDA is an extension of the multiple regressions to the modelling of the multivariate data (Legendre & Legendre, 1998). This technique takes into account simultaneously the linear relation between the principal data file and the explanatory variables. It is a forced version of the ACP in the sense that the ordination axes are forced to be linear combinations of the explanatory variables (Maddy & Brew, 1995). In this analysis, it is necessary to test and extract the explanatory variables influencing the principal data file. The RDA was used in combination with tests of permutation of Monte Carlo to explore the multilinear relations between the morphometry and the explanatory variables.

In these tests, the distribution of reference is simulated by repeated permutations of the observations. Thus, the explanatory variables are mixed and assigned in a random way with the principal data file. A test F is calculated on the initial data and is compared with those obtained on the permuted data. If the variable tested is significant, it is added to the model and the associated variance is withdrawn from the procedure. The variables of interests are added successively to the model according to a decreasing order of contribution and significance by a procedure of ascending selection step by step (Stepwise Forward Selection).

I. 3. Results

185 fish were retained for this study including 42 immature, 81 females and 62 males (Table. 2). The number of individuals studied during the Groundfish Surveys 2001 is weaker than the other years and the females in greater number. Numbers sampled used by scientific countryside and according to the stage of sexual maturity and the sex.

Table 2 : Numbers sampled used by Groundfish Surveys and according to the stage of sexual maturity and the sex.

GROUNDFISH SURVEYS	IMMATURES	FEMALES	MALES	TOTAL
CGFS2001	2	14	1	17
CGFS2002	0	20	30	50
CGFS2003	16	28	17	61
EVHOE2003	24	19	14	57
Total	42	81	62	185

I. 3. A) Allometries

The results of allometries between the 21 distances and the total lengths are given in table 3. The probabilities resulting from the comparisons of the slopes between the linear models between the two zones are given. When the probability related to the test is lower than

0,05, the slopes are then significantly different showing differences in allometries on these segments.

Fig. 3 indicates the segments where differences in slopes were observed. These segments are located on the all fish areas but exclude the thoracic part. Measurements related to the thoracic part are influenced by the abdominal zone which is associated the nutritional conditions.

Table 3 : Comparison of the models of linear regression between 21 distances from the model Truss and the total length (TL).

DISTANCE	BAY OF BISCAY	EASTERN ENGLISH CHANNEL	R^2 FITTED%	COMPARISON OF THE SLOPES OF THE MODELS – P -
D 1 – 2	D 1-2 = 2,94916 + 0,162189*TL	D 1-2 = 2,85997 + 0,149506*TL	94,42	0,031
D 1 – 3	D 1-3 = 5,84192 + 0,29456*TL	D 1-3 = 1,24221 + 0,299957*TL	96,60	0,054
D 1 – 10	D 10-1 = 0,72641 + 0,257524*TL	D 10-1 = 2,24952 + 0,229968*TL	95,34	0,001
D 2 – 10	D 2-10 = -2,88615 + 0,243114*TL	D 2-10 = -0,875129 + 0,221508*TL	96,97	0,001
D 2 – 3	D 2-3 = 2,93996 + 0,141864*TL	D 2-3 = -2,44253 + 0,16391*TL	92,93	0,001
D 3 – 10	D 3-10 = -1,90067 + 0,246944*TL	D 3-10 = -0,21511 + 0,231551*TL	95,97	0,047
D 3 – 4	D 3-4 = -0,375529 + 0,24345*TL	D 3-4 = -2,62131 + 0,248371*TL	96,00	0,537
D 3 – 9	D 3-9 = -2,65109 + 0,360012*TL	D 3-9 = -3,55569 + 0,346334*TL	97,67	0,111
D 4 – 10	D 4-10 = 0,702849 + 0,353581*TL	D 4-10 = -1,40915 + 0,3513*TL	96,26	0,835
D 4 – 5	D 4-5 = -0,96306 + 0,188061*TL	D 4-5 = -0,102013 + 0,173207*TL	94,09	0,036
D 4 – 8	D 4-8 = -1,59342 + 0,26106*TL	D 4-8 = -1,81431 + 0,245369*TL	97,43	0,015
D 4 – 9	D 4-9 = -3,29227 + 0,228186*TL	D 4-9 = -1,69976 + 0,208124*TL	95,84	0,004
D 5 – 6	D 5-6 = 0,421101 + 0,113487*TL	D 5-6 = 1,57907 + 0,108226*TL	86,65	0,447
D 5 – 7	D 5-7 = -0,169662 + 0,156337*TL	D 5-7 = 0,439527 + 0,148648*TL	92,77	0,251
D 5 – 8	D 5-8 = -2,11241 + 0,135527*TL	D 5-8 = -0,894163 + 0,125023*TL	94,67	0,031
D 5 – 9	D 5-9 = -1,91011 + 0,234247*TL	D 5-9 = 0,74729 + 0,210072*TL	96,59	0,000
D 6 – 7	D 6-7 = -1,73901 + 0,0964099*TL	D 6-7 = -0,29409 + 0,0861649*TL	95,23	0,001
D 6 – 8	D 6-8 = -2,24735 + 0,159457*TL	D 6-8 = 2,05462 + 0,140234*TL	93,95	0,002
D 7 – 8	D 7-8 = -0,1795 + 0,105858*TL	D 7-8 = 2,89737 + 0,0936494*TL	86,10	0,059
D 8 – 9	D 8-9 = 1,19008 + 0,16171*TL	D 8-9 = 0,924268 + 0,149674*TL	93,17	0,065
D 9 – 10	D 9-10 = 2,51137 + 0,292166*TL	D 9-10 = -1,95854 + 0,295721*TL	95,09	0,734

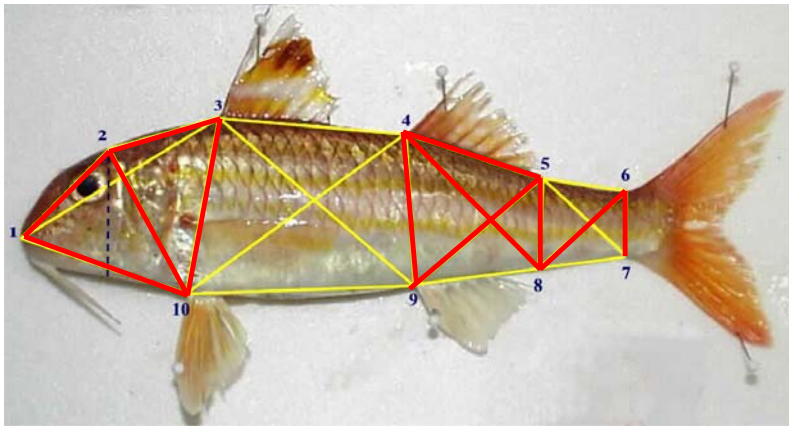


Fig. 3 : Segments showing the significant differences in allometries with the total overall length between the striped red mullets of Eastern English Channel and the Bay of Biscay.

I. 3. C) Multivariate analyses

The Principal Components Analysis on the morphometry (Fig. 4) indicates that the first principal component (first axis) is related to the total lengths. This component accounts for 97% of the total information of the points group, showing that there is a very strong correlation between the various distances between the homologous points and the body size, the body weight being also related to the individual size. The index K also is much correlated with the size but is a little shifted axis 1. The additional variable concerning the Eastern English Channel shows that there are differences between fish of the Bay of Biscay and those of the Eastern English Channel but this difference is marked little by this analysis.

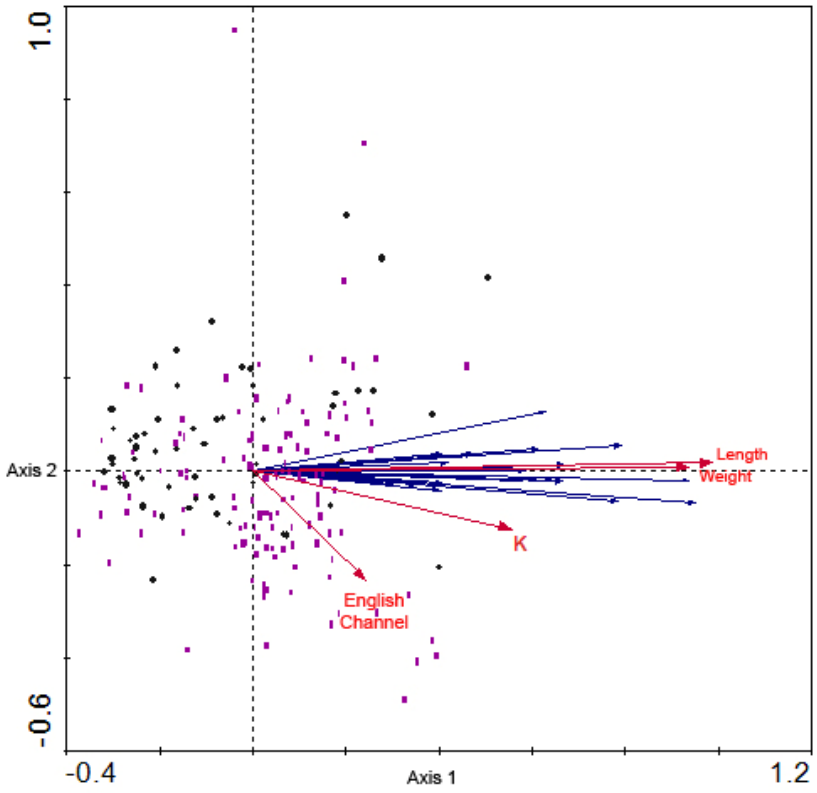


Fig. 4: Principal Components Analyze on the morphometry of the striped red mullets of Eastern English Channel (square purple) and of the Bay of Biscay (black rounds) integrating the different distances between the homologous points (blue arrows) and the additional explanatory variables (red arrows).

The too strong correlations with the fish size mask the real morphological differences between sexes and geographical sectors. A partial RDA was thus carried out (Fig. 5). This analysis separates fish from the Bay of Biscay (EVHOE) from those of the Eastern English Channel (CGFS), as indicated by the vector "Channel" and those of the different groundfish surveys or the distribution of fish (points) according to their source. However, for the Eastern English Channel, the fish of 2001 are very clearly separated from those of 2002 and 2003.

The size and the orientation of the vectors concerning the sex show that there is a light sexual dimorphism related to morphology, but that the morphological difference is clearer when one compares mature individuals compared to immature individuals.

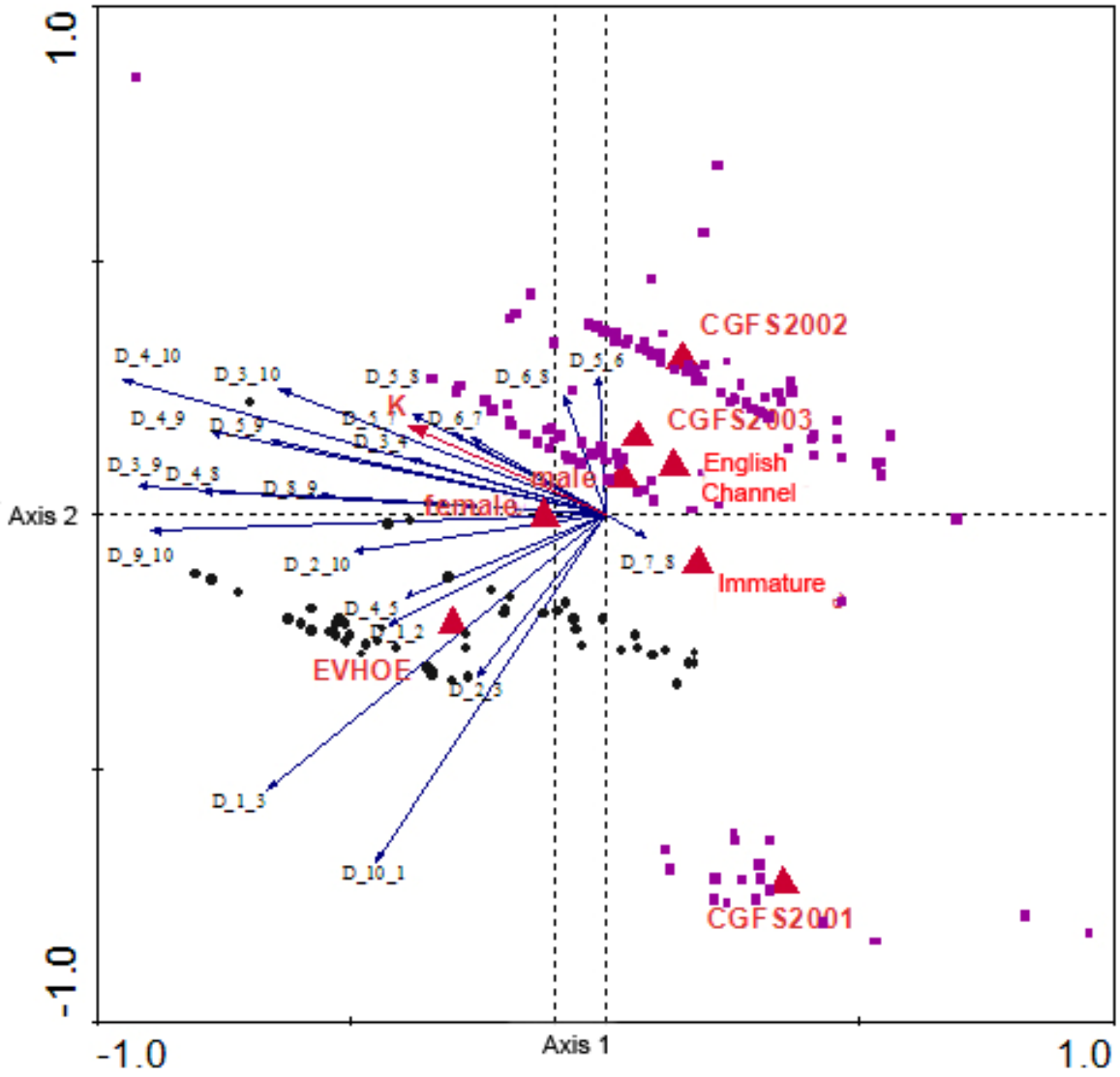


Fig. 5: RDA on the morphometry of the striped red mullets of Eastern English Channel (square purple) and of the Bay of Biscay (black rounds) integrating the different distances between the homologous points (blue arrows) and the additional explanatory variables (red arrows).

The morphometric differences between the sectors seem to be related to morphological differences at head and dorsal 2 levels (Fig. 6), as indicated by the vectors of the low left quarter of RDA.

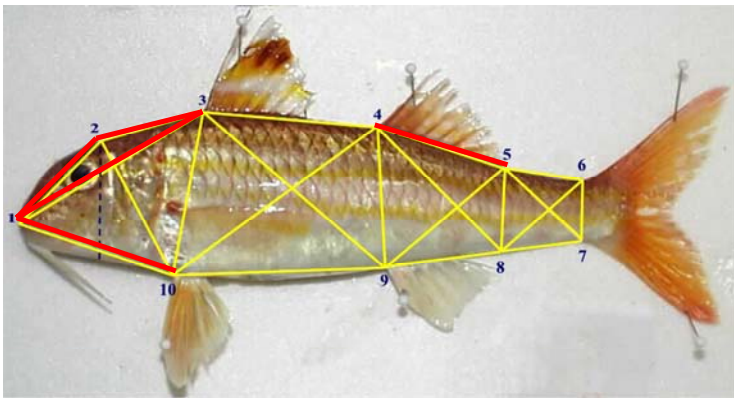


Fig. 6 : Segments (red) showing the morphological differences between the striped red mullets of Eastern English Channel and the Bay of Biscay.

The vectors around the negative part of axis 1 and the quarter high left of RDA (Fig. 5) correspond to the segments of the body on the level of the trunk, with the area delimited with the back by the end of the dorsal fins 2 and anal and with the height of the caudal part. RDA indicates that these measurements would be influenced slightly by the sex, more particularly for the females. The influence of the sex seems limited because the females are not pregnant and the morphology of the abdomen not influenced by the volume occupied by the gonads. At the reproduction season, one would find certainly differences related to the sexual condition.

The geometrical morphometry is thus a first important stage to determine differences between geographical sectors and thus between stock, because it highlighted the relevance to initially consider an Atlantique stock and a stock in Channel-North Sea.

However, it should be reinforced by a genetic study which covered the various geographical areas of the Bay of Biscay in the north of the North Sea to be able to identify different stocks.

II. Cohort analysis

Annual survey abundance indices (numbers per hour) have been log transformed[3], because common assessment techniques refer to such transformed variables. Ua,y,f is the (logarithmic) abundance index for age a, year y, and survey f. Correlation coefficients calculated over years between the Ua,y,f and Ua+1,y+1,f offer a first indication of the ability of survey f to track year class strength effects.

Table 4 : Annual survey abundance indices (ln transformed data) by year class from 1988 to 2004.

	Age				
Années	0	1	2	3	4
1988		-2,275	-1,504	-1,259	-0,917
1989	3,2299	3,3448	-2,222		-3,178
1990	-1,194	0,3972	0,915	-1,057	-2,742
1991	-0,598	-1,384	0,0331	-1,151	-2,474
1992	0,2456	2,1521	1,3344	-0,664	-3,171
1993	-3,631	0,4021	0,9468	-0,697	-1,418

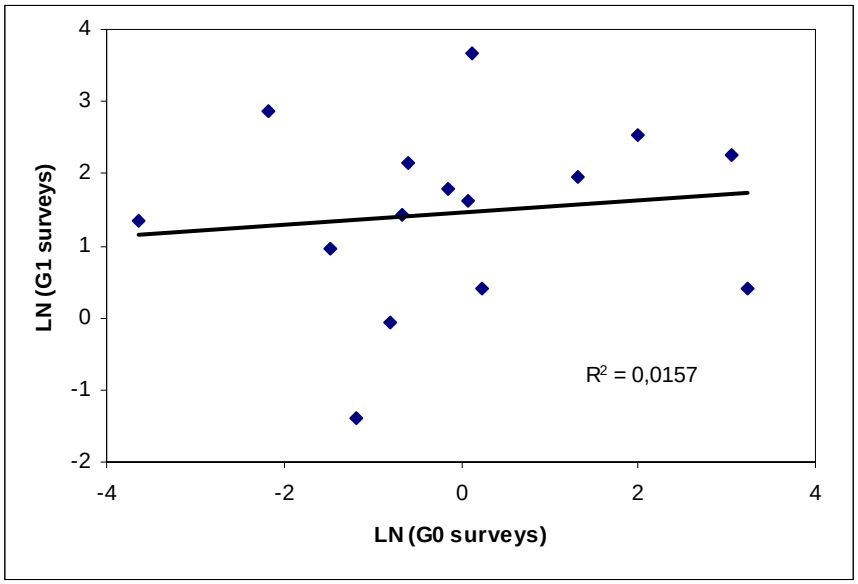
[3] Transformation has been performed after the calculation of an annual abundance index, built in the standard way upon an arithmetic combination of the non transformed basic data (*in* Beare *et al.*, 2003).

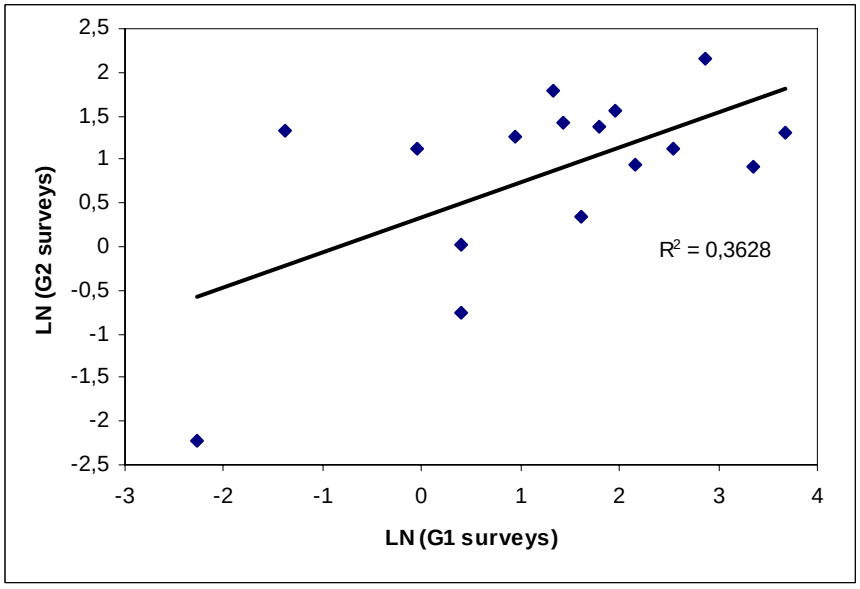
1994	1,3101	1,3378	-0,749	-2,059	-2,235
1995	-0,14	1,9478	1,7834	-0,761	-1,808
1996	-2,176	1,8007	1,5682	-0,545	-2,274
1997	1,9832	2,8668	1,3682	-0,135	-0,953
1998	-1,473	2,5371	2,1448	-0,278	-1,145
1999	0,0701	0,9449	1,1188	-0,188	-1,34
2000	-0,809	1,6196	1,2702	-0,936	-1,446
2001	-0,662	-0,054	0,3398	-1,002	-2,014
2002	0,1348	1,4293	1,1286	-1,068	-2,023
2003	3,0619	3,6802	1,4137	-0,616	-1,636
2004	-0,022	2,2512	1,301	-0,807	-2,42

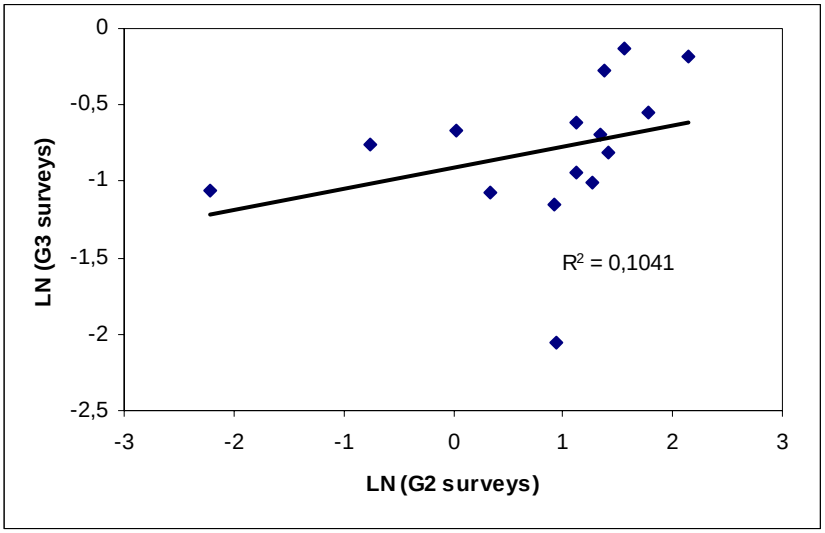
Table 5: Within-survey consistency: correlation coefficients (r) and number of observations.

AGE	R	N
0 / 1	0,125	15
1 / 2	0,602	16
2 / 3	0,323	15
3 / 4	0,488	15

(n) for Striped Red Mullet (ln transformed data).


LN (G1 surveys)
LN (G0 surveys)
R2 = 0,0157
4
3
2
1
0
-1
-2
-4
-2
0
2
4


LN (G2 surveys)
LN (G1 surveys)
R2 = 0,3628
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
-3
-2
-1
0
1
2
3
4



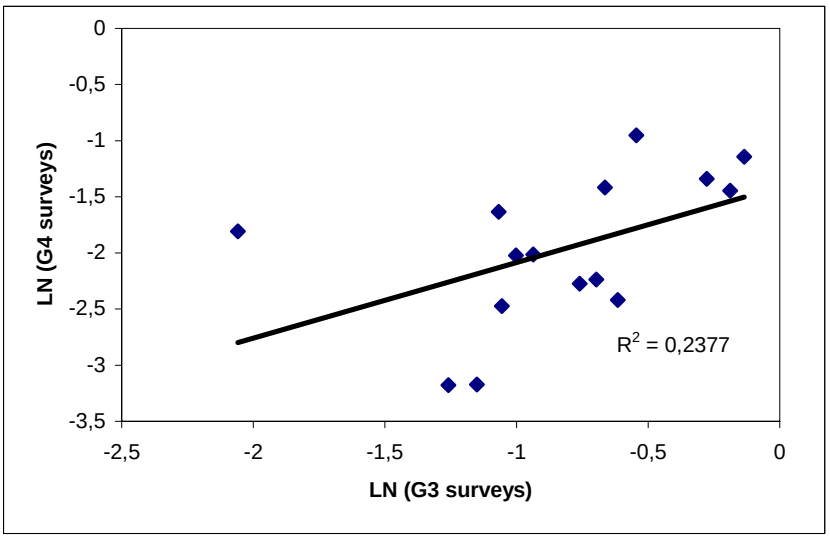


Fig. 7: Plots for within-survey consistency for Striped Red Mullet (in Eastern English Channel).

The within survey correlation is rather variable between surveys and age groups. The correlation for the youngest striped red mullet (age 0-1) is poor for both surveys while correlation for the oldest age groups (age 1-2, age 3-4) is good for both surveys.

Furthermore, cohort plots from abundance indices by year class from the various surveys are shown. This is done in order to investigate whether the slopes for the different cohorts are similar, especially for neighbouring cohorts. It appears that the slopes vary not much.

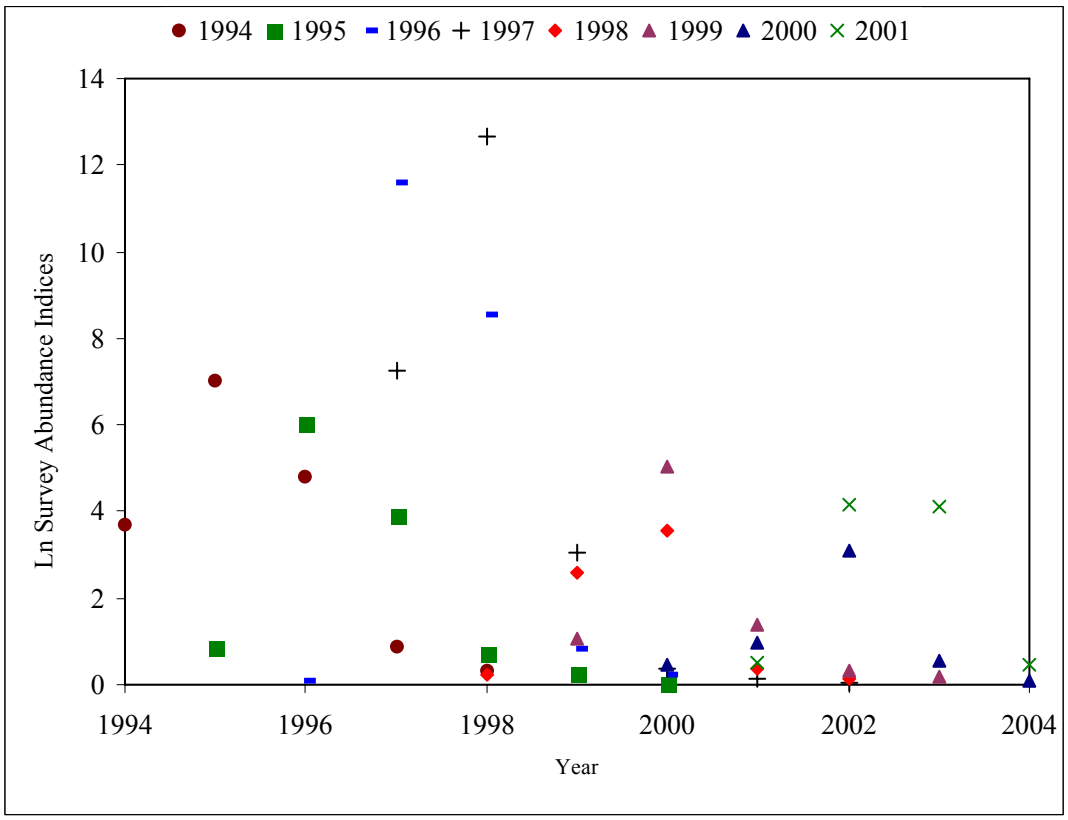
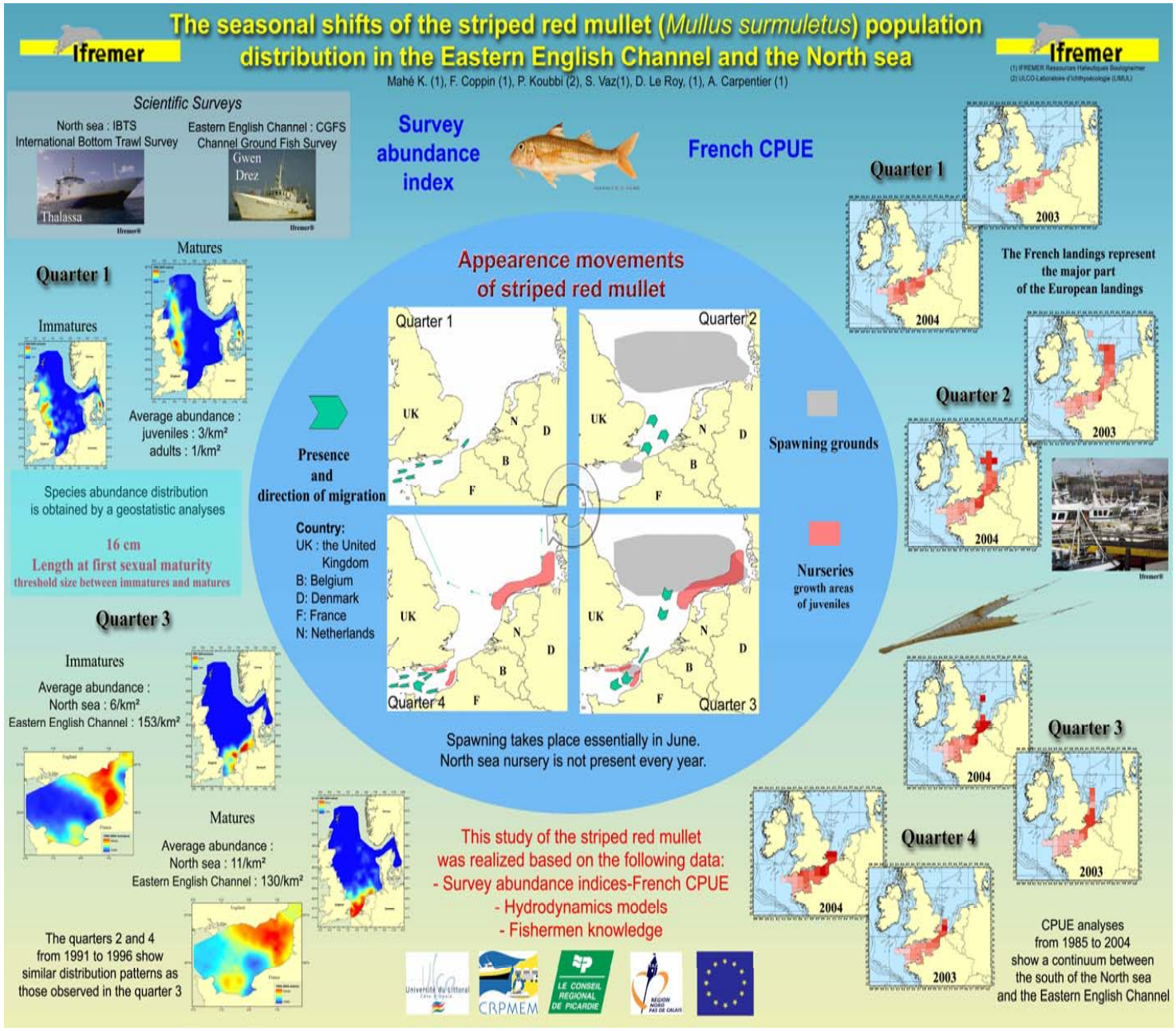


Fig. 8: Cohort plots from survey abundance indices by year class. Year Classes 1994-2001.

Cohort analysis by annual survey abundance index (CGFS) is difficult because CGFS is just done in the Eastern English Channel (subdivision VIId). It seems that for this species, the Eastern English Channel couldn't be separate to south of the North Sea.


The seasonal shifts of the striped red mullet (Mullus surmuletus) population distribution in the Eastern English Channel and the North sea
Ifremer
Mahé K. (1), F. Coppin (1), P. Koubbi (2), S. Vaz(1), D. Le Roy, (1), A. Carpentier (1)
Scientific Surveys
North sea : IBTS International Bottom Trawl Survey
Eastern English Channel : CGFS Channel Ground Fish Survey
Thalassa
Gwen Drez
Survey abundance index
French CPUE
Appearence movements of striped red mullet
Quarter 1
Quarter 2
Quarter 3
Quarter 4
UK
N
D
B
F
Presence and direction of migration
Country:
UK : the United Kingdom
B: Belgium
D: Denmark
F: France
N: Netherlands
Spawning grounds
Nurseries
growth areas of juveniles
Spawning takes place essentially in June.
North sea nursery is not present every year.
Matures
Immatures
Average abundance :
juveniles : 3/km²
adults : 1/km²
Species abundance distribution is obtained by a geostatistic analyses
16 cm
Length at first sexual maturity
threshold size between immatures and matures
Average abundance :
North sea : 6/km²
Eastern English Channel : 153/km²
Average abundance :
North sea : 11/km²
Eastern English Channel : 130/km²
The quarters 2 and 4 from 1991 to 1996 show similar distribution patterns as those observed in the quarter 3
2003
2004
The French landings represent the major part of the European landings
CPUE analyses from 1985 to 2004 show a continuum between the south of the North sea and the Eastern English Channel
This study of the striped red mullet was realized based on the following data:
- Survey abundance indices-French CPUE
- Hydrodynamics models
- Fishermen knowledge
CRPMEM
LE CONSEIL REGIONAL DE PICARDIE

III. Sampling optimization

Table 3.1: Objectives and realization.

DCR 2006 OBJECTIVES	675
Measurements really done	1941

Table 3.2: Sampling effort repartition.

	QUARTER 2		QUARTER 3		QUARTER 4	
COMMERCIAL CAT	SAMPLES NUMBER	INDIVIDUALS NUMBER	SAMPLES NUMBER	INDIVIDUALS NUMBER	SAMPLES NUMBER	INDIVIDUALS NUMBER
10 (1/2)	1	27	1	43	0	0
10 (2/3)	2	20	1	14	0	0
20	2	87	2	65	1	31
30	1	23	9	597	1	64
40 (6/8)	2	84	5	370	2	183
40 (8/10)	0	0	0	0	0	0
50	0	0	0	0	2	308
Total	8	241	18	1089	6	586

Sampling optimization is realized for the sampling 2006 to the Striped Red Mullet in the Eastern English Channel in relation with landings in 2005. This analysis is realized with the S+ package1.

The level of striped red mullet yearly sampling by commercial size seems to have a good relationship with landings except for 40. This commercial category is the most caught and the effort should be increased. The sampling effort by quarter should be restabilized to obtain a more homogenous sampling by quarter. The first quarter hasn't been sampled because there are few landings during this period.

1 S+ Package is described in a Working Document available in annex of 2004 WKSCMFD (Vigneau & Mahevas, 2004) and in ICES, 2005.

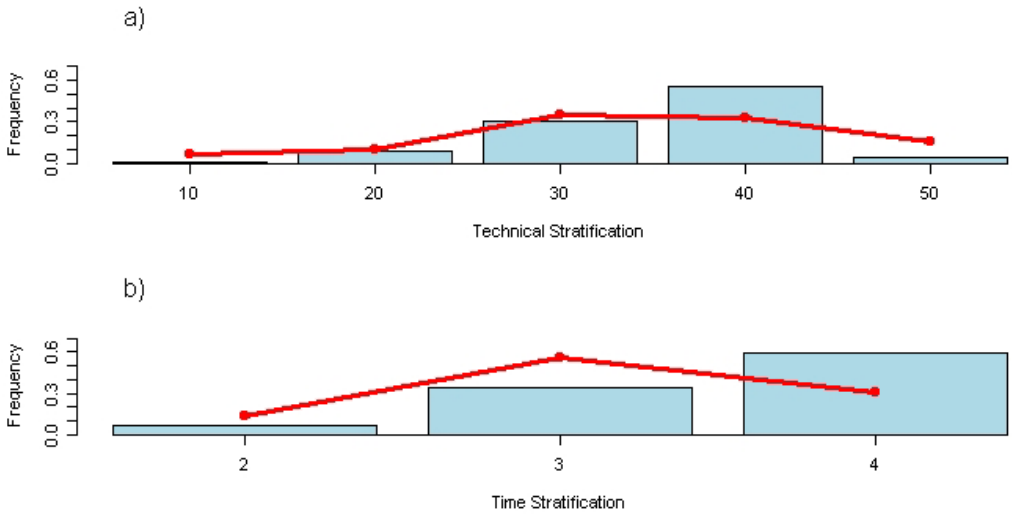


Fig. 3.1: Relative importance of samples (in number sorted by a) b) Quarter, compared to the relative importance of the landings (red line).

The individual number by commercial size increases from the biggest to the smallest, by the opposite of the mean weight. We can then consider that the sampling by commercial size justifies itself completely.

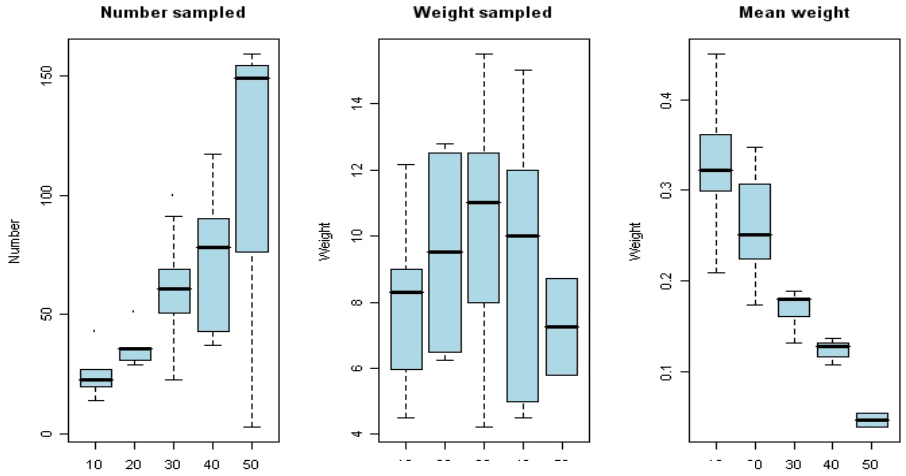


Fig. 3.2: Between sampling units heterogeneity. Bowplot showing the median, 25 and 75 percentile, 5 and 95 percentile and extreme values.

The length between 14 and 25 cm represents 90% of striped red mullet landings. This size interval is strongly correlated to the commercial sizes 30, 40 and 50 (Fig 3.4). With a CV smaller than 20% (14.98%), one can consider that the yearly sampling is well representative of the landing's length structure.

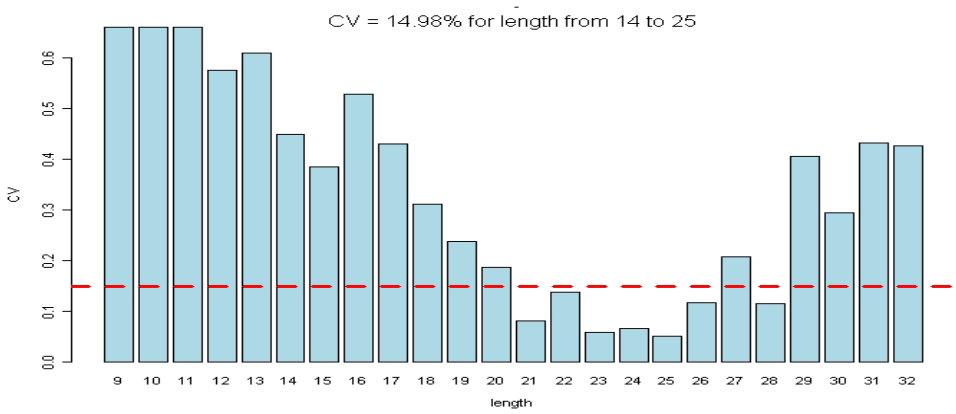


Fig. 3.3: CV estimations to the length.

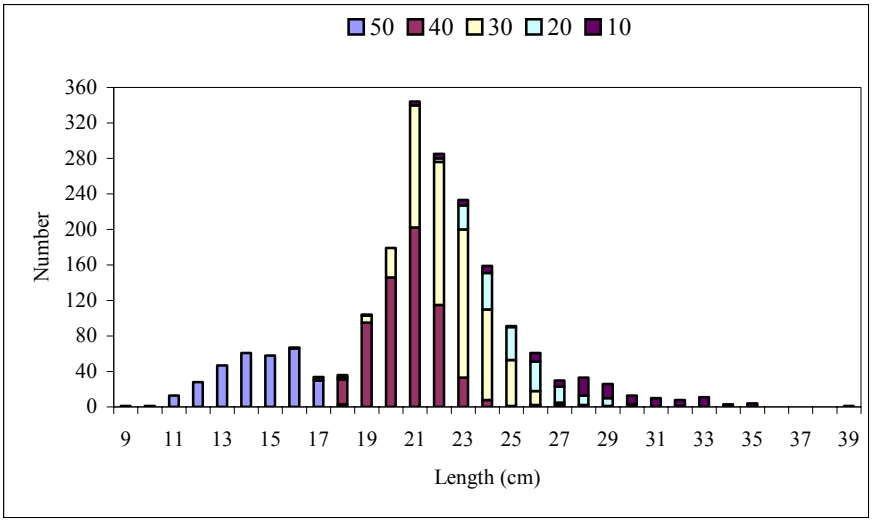


Fig. 3.4: Striped red mullet length sampling.

As the Fig 3.2, the delta value results show that the commercial sizes are still classified around the mean axis from the biggest commercial categories to the smallest. The sampling of 10 and 20 categories are heterogeneous and can not really be distinguished, probably resulting of fisherman sorting in relation with the fish market. Conversely the 30, 40 and 50 sampling unit are relatively homogeneous except for two units of commercial category 40. Only two samples of category 50 were done because it just appeared at the end of the year.

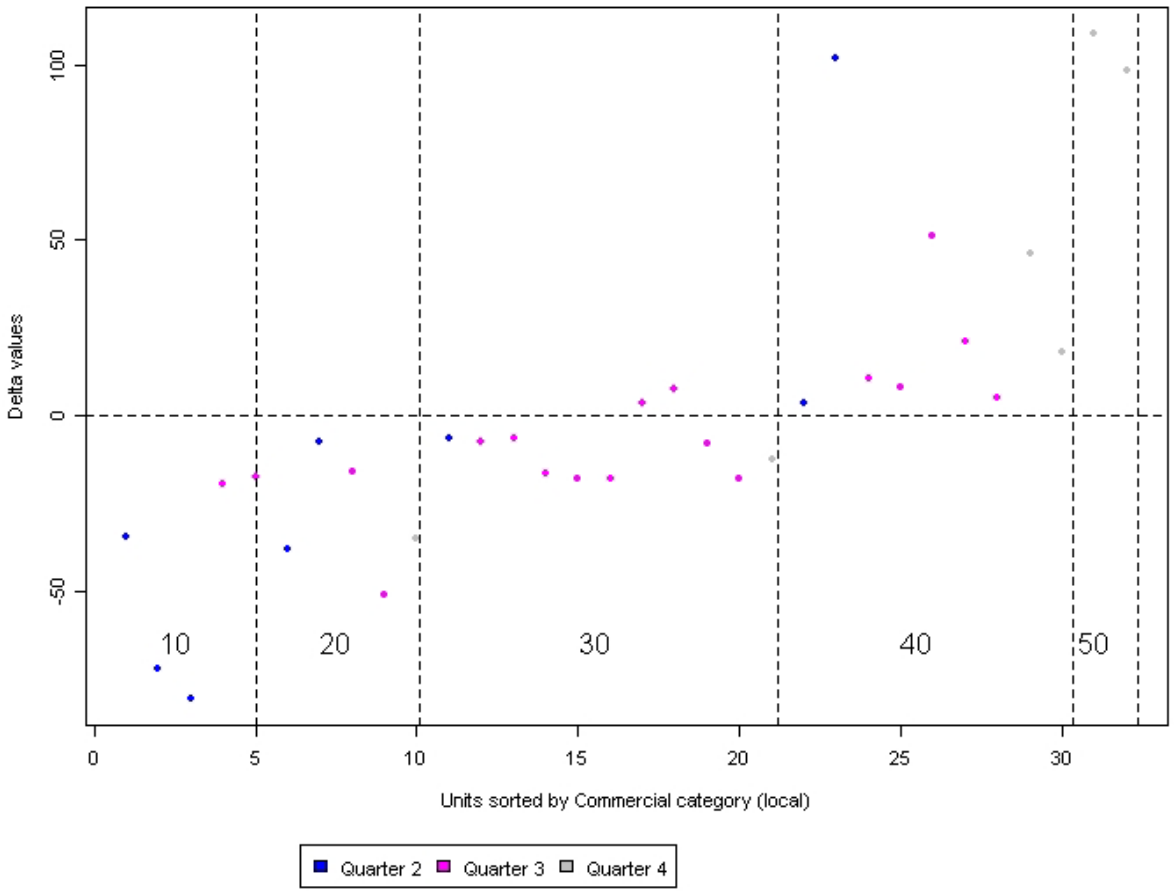


Fig. 3.5: Delta values sorted by Commercial category.

Although the yearly sampling effort was quite good (Fig. 3.1), in fact the figure 3.6 shows us that the temporal repartition has to be straightened. The best sampling repartition by commercial category seems to in the third quarter, except for the category 50 which was measured only in the fourth quarter.

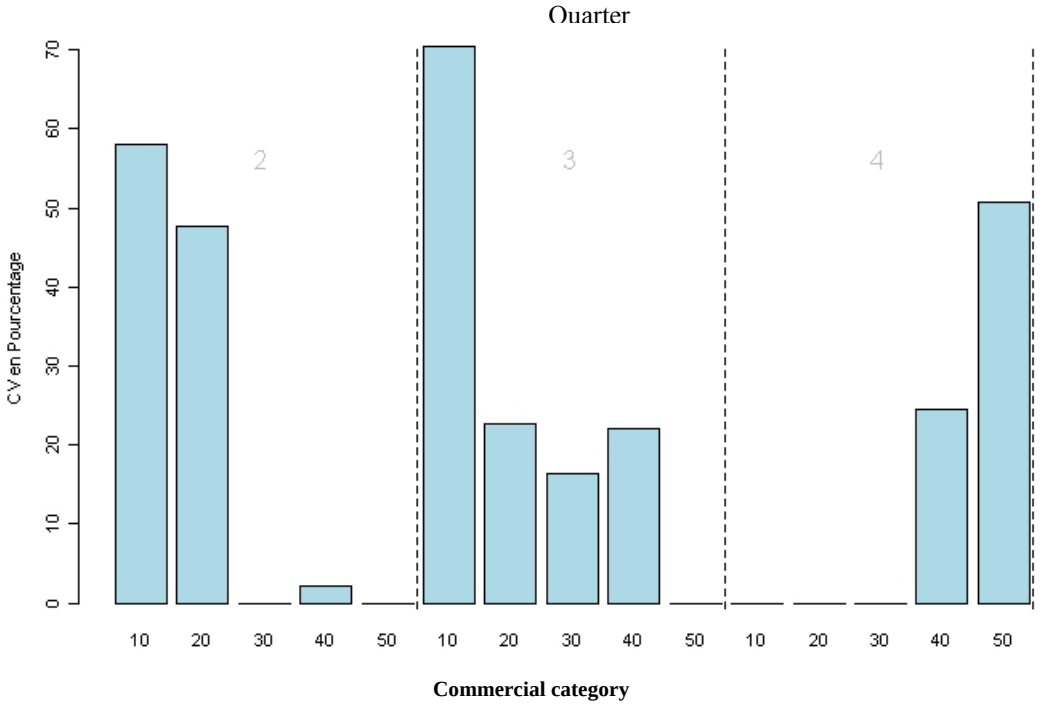


Fig. 3.6: CV estimations for all commercial categories by quarter.

Conclusion :

It appears necessary to start a study with 3 research orientations:

- √ The follow-up of the state of sexual maturity during the year for this species (need to supplement the study of 2004-2005 (Mahé *et al*., 2005)).
- √ Tagging study (at the time of the scientific surveys like IBTS, CGFS, EVHOE to follow displacements of this species
- √ An analysis of the geometrical morphometry coupled to a genetic study applied to the striped red mullet of the Bay of Biscay to the North Sea to try to identify various stocks for this species

This study could be undertaken over 2 or 3 years and be controlled by IFREMER. It is necessary to better knowledge and to identify various stocks from the Bay of Biscay to the north of the North Sea.

References :

Beare, D., Castro, J., Cotter, J., van Keeken, O., Kell, L., Laurec, A., Mahé, J.-C., Moura, O., Munch-Petersen, S., Nielsen, J.R., Piet, G., Simmonds, J., Skagen, D. & Sparre, P.J., 2003. Evaluation of Research Surveys in relation to management advice. *Final Report to European Commission Director-General Fisheries, EVARES - FISH/2001/02*, 324p.

ICES. 2005. Report of the Workshop on Sampling Design for Fisheries Data (WKSDFD), 1-3 February 2005, Pasajes, Spain. ICES CM 2005/ACFM:11, 78 pp.

Mahé, K., Destombes, A., Coppin, F., Koubbi, P., Vaz, S., Le Roy, D. & Carpentier, A., 2005. Le rouget barbet de roche *Mullus surmuletus* (L. 1758) en Manche orientale et mer du Nord. Rapp. Contrat Ifremer/CRPMEM Nord-Pas de Calais, 187p.

Annex 4: WGNEW terms of reference 2008

The **Working Group on Assessment of New MoU Species** [WGNEW] (Co-Chairs: Henk Heessen, Netherlands and Jean-Claude Mahé, France) will meet in Boulogne for three days in 2008 to:

consider possibilities for fish stock assessments/input to management processes/indicators of the following species: sea bass, flounder (except for the Baltic) common dab (except for the Baltic), lemon sole, brill (except for the Baltic), turbot (except for the Baltic), witch flounder, red gurnard, tub gurnard, grey gurnards, striped red mullet and John dory, through

1) review of knowledge on stock structure,
2) existing fisheries monitoring programmes and surveys including the EU Data Collection Programme,
3) existing databases made available for fish stocks assessment.

WGNEW will report by xx of YYYY to ACFM and LRC.

Supporting Information

PRIORITY:	High. The new MoU lists these species as new and extra species for which EC and NEAFC want advice on their management.
SCIENTIFIC JUSTIFICATION AND RELATION TO ACTION PLAN	The MoU between the EC and ICES lists a number of new species for which the EC wants routine advice from ICES regarding management of the fishery on them. This WG is regarded to deal with the issues for the fish species mentioned.
RESOURCE REQUIREMENTS:	No specific resource requirements, beyond the need for members to prepare for and participate in the meeting.
PARTICIPANTS:	10–15
SECRETARIAT FACILITIES:	Production of report
FINANCIAL:	
LINKAGES TO ADVISORY COMMITTEES:	ACFM
LINKAGES TO OTHER COMMITTEES OR GROUPS:	RMC and LRC
LINKAGES TO OTHER ORGANISATIONS:	

Annex 5: Recommendations

RECOMMENDATION	ACTION
1. Section 4: Sea bass The WG reiterates the recommendation of SGBASS 2003 that implementation of 'input' controls (preferably through technical measures aimed at protecting juvenile fish, in conjunction with entry limitations into the offshore fishery in particular) should be promoted, and that 'output' controls (such as TACs) are inappropriate. This is because bass is, in general, a bycatch species caught in mixed fisheries and TAC limitation may induce discards in such fisheries.	
2. Section 4: Sea bass There are many uncertainties within both the SURBA analysis of the international dataset and the analysis of the UK dataset, one of the most important being a lack of knowledge on the catches of recreational fishers. Therefore the WG also reiterates the recommendation of SGBASS 2003 that due to these uncertainties, the precautionary approach indicates that effort should not be allowed to increase.	
3. Section 4: Sea bass Finally, the WG re-iterates the recommendation of SGBASS, namely to maintain and improve monitoring of 0-group and pre-recruitment abundance, and to improve our understanding of environmental effects on bass distribution and abundance.	
4. Section 5: Striped red mullet (stock identity) The results of the morphometry of red mullet should be supplemented by a genetic study. The Working Group recommends that such a study to identify various stocks from the North Sea to the Bay of Biscay, be included in a pilot or small scale project. The results of a cohort consistency analysis carried out on the CGFS data supposes exchanges of striped red mullet with adjacent areas which reinforces the need for such a study	
5. The WG recommends that John dory (*Zeus faber*) should be included in the WGNEW ToR's.	