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Report of the Working Group Elasmobranch Fishes (WGEF)

3–6 MARCH 2008

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CIEM Conseil International pour l'Exploration de la Mer

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Contents

1 Introduction

1.1 Terms of Reference

The Working Group Elasmobranch Fishes [WGEF] (Chair: Jim Ellis, UK) will meet in ICES HQ 3–6 March 2008 (in parallel with WGDEEP) and in ICCAT (Madrid) 1–5 September 2008 (in parallel with the ICCAT Shark Assessment subgroup).

The first sub-group will meet at a joint meeting with WGDEEP (in ICES HQ 3–6 March 2008) to:

a) Update the description of elasmobranch fisheries for deep-water and demersal species in the ICES area and compile landings, effort and discard statistics by ICES Subarea and Division;

b) Assess the stock identity and stock status of deep-water sharks in the ICES area;

c) Work toward the production of an ICES Cooperative Research Report on the "Status of Elasmobranchs in the NE Atlantic" by finalizing those chapters relating to deep-water sharks and demersal elasmobranchs;

d) Compile available photographic images of deep-water elasmobranchs and demersal skates and rays to support the production of a photo-ID key for the elasmobranchs of the ICES area, and draft a supporting key for the identification of deep-water and demersal elasmobranchs.

The second subgroup will meet at a joint meeting with the ICCAT Shark Assessment subgroup (in ICCAT (Madrid), 1–5 September 2008) to:

a) Update the description of elasmobranch fisheries for pelagic sharks in the ICES area and evaluate landings and discard statistics for North Atlantic stocks;

b) Assess the stock status of pelagic sharks (blue shark, shortfin mako, porbeagle) in the North Atlantic;

c) Work toward the production of an ICES Cooperative Research Report on the "Status of Elasmobranchs in the NE Atlantic" by finalizing those chapters relating to pelagic sharks and demersal elasmobranchs;

d) Compile available photographic images of pelagic elasmobranchs to support the production of a photo-ID key for the elasmobranchs of the ICES area, and draft a supporting key for the identification of pelagic elasmobranchs.

WGEF will work by correspondence to: Address the OSPAR request on *Raja clavata* with a deadline of 20 December 2007.

WGEF will report by 15 May to ACOM and LRC.

Table 1.1. Specific terms of reference addressed in the report.

Meeting	TOR	Description	Sections
1	a	Update descriptions of deep-water and demersal elasmobranch fisheries	2–5, 7, 13–20
	b	Assess the stock status and stock identity of deep-water elasmobranchs.	3–5
	c	Work toward the production of an ICES CRR	21
	d	Compile available photographic images	21
2	a	Update descriptions of elasmobranch fisheries for pelagic sharks	6, 8–12
	b	Assess the stock status and stock identity of deep-water elasmobranchs.	6, 8–12
	c	Work toward the production of an ICES CRR	21
	d	Compile available photographic images	21

1.2 Participants

The following WGEF members attended the first meeting in March 2008:

- Tom Blasdale UK (part time)
- Geir Blom Norway
- Maurice Clarke Ireland
- Guzman Diez Spain (Basque Country)
- Helen Dobby UK (Scotland)
- Jim Ellis (Chair) UK (England and Wales)
- Henk Heessen The Netherlands
- Kristin Helle Norway
- Graham Johnston Ireland
- Dave Kulka Canada
- José De Oliveira UK (England and Wales)
- Harriët van Overzee The Netherlands
- Mario Pinho Portugal (Azores)
- Francois Poisson France
- Bernard Seret France
- Charlott Stenberg Sweden
- Francisco Velasco Spain (by correspondence)

The following WGEF members attended the second meeting in September 2008:

- Maurice Clarke Ireland
- Jim Ellis (Chair) UK (England and Wales)
- Boris Fretzel-Beyme Germany
- Armelle Jung France
- Francois Poisson France
- Bernard Seret France

1.3 Background

The Study Group on Elasmobranch Fishes (SGEF), having been established in 1989, was re-established in 1995 and had meetings in that year, 1997 and 1999. Assessment of elasmobranch species had proved very difficult because of a lack of data. The 1999 meeting was held concurrently with the EC-funded Concerted Action Project meeting (FAIR CT98–4156) allowing for a greater participation from various institutes around Europe. The next meeting of the group was in 2002, where exploratory assessments were carried out for the first time. Assessments were attempted for 8 of the 9 case study species considered by the EC-funded DELASS Contract (CT99–055). The success of this meeting was as a consequence of the DELASS project, a three-year collaborative effort involving fifteen fisheries research institutes and two sub-contractors. Although much progress was made on methodology, there was still much work to be done. The main gap in the knowledge was a quantification of catches of elasmobranchs in the ICES area.

In 2002, SGEF recommended the group be continued as a Working Group. The medium-term remit of this WG being to adopt and extend the methodologies and assessments for elasmobranchs prepared by the EC-funded DELASS project; to review and define data requirements (fishery, survey and biological parameters) in relation to the needs of these analytical models and stock identity; and to carry out such assessments as are required by ICES' customers. In 2003, the first meeting of this group reviewed the final DELASS report, considered national and international sampling schemes, including those carried out under the EU Data Collection Regulation, and made arrangements to carry out assessments for such elasmobranch stocks.

In 2003, WGEF met in Vigo, Spain and worked to further the stock assessment work carried out under DELASS. In 2003, landings data were collated for the first time. This exercise was based on data from the FAO FISHSTAT database, data from national scientists and other data submitted to ICES. In 2004, WGEF worked by correspondence to collate and refine catch statistics for all elasmobranchs in the ICES area. This task was complicated by the use, by many countries, of generic reporting categories for sharks, rays and dogfish. WGEF evaluated sampling plans and their usefulness for providing assessment data.

In 2005, WGEF came under ACFM and was given the task of supporting the advisory process. This was because ICES has been asked by the European Commission to provide advice on certain species. This task was partly achieved by WGEF in that preliminary assessments have been provided for spurdog, kitefin shark, thornback ray (North Sea) and deep-water sharks (combined). ACFM produced advice on these species, basking shark and porbeagle, based on the WGEF report. A standard reporting and presentation format was adopted for catch data and best estimates of catch by species were provided for the first time (ICES, 2005).

In 2006, work continued on refining catch estimates and compiling available biological data (ICES, 2006). Progress was made in some ecoregions. Work was begun on developing standard reporting formats for length frequency, maturity and cpue data. WGEF continued to support the advisory process based on feedback from ACFM. The group developed a "roadmap" presenting an organizational plan for assessing the various stocks over the following 3 years.

In 2007, WGEF met in Galway, with the demersal elasmobranchs of three ecoregions (North Sea, Celtic Seas and Bay of Biscay/Iberian waters) subject to more detailed study and assessment (ICES, 2007a), with special emphasis on skates (Rajidae), given that these are some of the more commercially valuable demersal elasmobranchs in these shelf seas. It should be noted, however, that although there have been some historical tagging studies (and indeed there are also additional tagging studies ongoing), our knowledge of the stock structure and identity for many of these species is poor, and in most instances the assumed stock area equates with management areas.

In March 2008, WGEF met in parallel with WGDEEP to update assessments and advice for deep-water sharks and demersal elasmobranchs, and a WGEF subgroup met with an ICCAT shark subgroup in September 2008 to address pelagic sharks.

Overall the working group has been very successful in maintaining participation from a wide range of countries. Attendance has increased and reached a stable level in the past three meetings.

Stock assessment of many elasmobranchs is particularly difficult owing to a lack of species-specific catch data and the straddling and/or highly migratory nature of some of these stocks, especially with regards deep-water and pelagic sharks.

1.4 Future planning of the work of the group

To satisfy the requirement that each working group plans its short and medium term objectives WGEF presents a plan for the next two years. It is planned that WGEF will meet every year, because this approach keeps the momentum of the group. Assessments of stock status will usually be conducted on a two to three-yearly cycle. In order to facilitate the best assessments of each of the main species for which advice is sought, the group will deal with different species in different years. Table 1.2 presents this plan.

Table 1.2. Future planning of the work of the group. Plan for assessment of the main species (1=update of relevant information, including exploratory assessments, 2 = Assessment).

Stocks	Does ICES provide advice	2008	2009	2010
Spurdog	Yes	1	2	1
Portuguese dogfish and Leafscale gulper shark	Yes	2	1	1
Kitefin shark	Yes	2	1	1
Other deep-water sharks		1	1	1
Porbeagle	Yes	2	2	1
Basking shark	Yes	2	1	1
Blue shark in the North Atlantic		2	1	1
Shortfin mako in the North Atlantic		2	1	1
Tope in the NE Atlantic (and Mediterranean?)		1	1	1
Thresher shark in the NE Atlantic and Mediterranean		1	1	1
Other Pelagic species		1	1	1
Demersals in Barents Sea		1	1	1
Demersals in Norwegian Sea		1	1	1
Demersals in North Sea (III, IV, VIId)	Yes	1	1	2
Demersals at Iceland and east Greenland		1	1	1
Demersals at the Faroe Islands		1	1	1
Demersals in the Celtic Seas	Yes	1	1	2
Demersals in Biscay and Iberian waters	Yes	1	1	2
Demersals in the Azores and Mid Atlantic Ridge		1	1	1

This plan will allow for preparation of datasets in the years between assessments and for exploratory assessments to be undertaken. In the years where an assessment is not planned, data preparation, screening and checking will take place and the absence of a scheduled assessment in any given year does not imply that the relevant participants would not attend. Rather it is planned to spend the time preparing for the next scheduled assessment.

1.5 Current ICES Working Groups of relevance to the WG

1.5.1 Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK)

Several elasmobranchs are taken in North Sea demersal fisheries, including spurdog (see Section 2), tope (Section 10) and various skates and rays (Section 15). WGNSSK should note that the southwestern North Sea is the main part of the North Sea distribution of thornback ray *Raja clavata* and may also be an important nursery ground for some small shark species, such as tope and smoothhounds. Thornback ray is an important species in ICES Division IVc, and is taken in fisheries targeting sole (e.g. trawl and gillnet), cod (e.g. trawl, gillnet and longline), as well as in targeted fisheries.

1.5.2 Working Group on the Assessment of Northern Shelf Demersal Stocks (WGNSDS)

Several elasmobranchs are taken in the waters covered by WGNSDS, including spurdog (see Section 2), tope (Section 10) and various skates and rays (Section 18). WGNSDS should note that common skate *Dipturus batis*, which has declined in many inshore areas of northern Europe, may be locally abundant in parts of VIa. Thornback ray is abundant in parts of the Irish Sea, especially Solway Firth, Liverpool Bay and Cardigan Bay. The Lleyn Peninsula is an important ground for greater-spotted dogfish *Scyliorhinus stellaris*.

1.5.3 Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS)

Several elasmobranchs are taken in the waters covered by WGNSDS, including spurdog (see Section 2), tope (Section 10) and various skates and rays (Section 18). WGSSDS should note the Bristol Channel is locally important for smalleyed ray *Raja microocellata*, as well as being an important nursery ground for various small sharks (e.g. smoothhounds and tope) and skates and rays.

1.5.4 Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP)

In 2008, WGEF met in parallel with WGDEEP in order to assess and provide advice on deep-water sharks (see Sections 3–5). WGEF should continue to work closely with WGDEEP in addressing deep-water chondrichthyans.

1.5.5 Working Group on Fish Ecology (WGFE)

In 2008, WGEF met in parallel with WGFE. Collaborative studies with WGFE on topics such as important habitats for elasmobranchs could usefully be undertaken.

1.5.6 International Bottom Trawl Survey Working Group (IBTSWG)

In 2007 and 2008, IBTSWG have provided maps of the distribution of a variety of demersal elasmobranchs from the IBTS surveys in western areas (ICES, 2007b, ICES, 2008). WGEF considered that these plots provide useful information and hope that IBTSWG will continue such work in 2009.

WGEF would ask that IBTSWG provide comparable maps examining the overall distributions of lesser-known elasmobranchs (including *Dipturus batis, Leucoraja circularis* and *L. fullonica*) using all available IBTS survey data.

1.5.7 Stock Identification Methods Working Group (SIMWG)

In 2007, WGEF asked that SIMWG examined stock identification issues for demersal skates (Rajidae) in the North Sea, Celtic Seas and Bay of Biscay/Iberian ecoregions. Further collaboration between WGEF and SIMWG is required.

1.5.8 Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS)

There have been improvements in the collection of biological information for skates in fishery-independent trawl surveys and in the provision of species composition for skate catches. There are, however, some issues that need to be resolved, for example (i) ensuring accurate species-identification when reporting species composition from market sampling, and (ii) developing standardized and appropriate methods for raising species composition data.

One of the skate species for which ICES has been unable to provide advice is blonde ray *Raja brachyura*. This large bodied species has a patchy distribution and so is not sampled effectively in existing groundfish surveys. Given that this species is often landed with spotted ray *Raja montagui*, it is considered important that better differentiation between these species is required.

During 2008, data from sampling larger sharks were presented (see Sections 1.8.5 and 6.4), and protocols for ensuring robust and comparable data should be addressed. If large sharks are to be sampled by member states, then it is **recommended** that PGCCDBS provide member states with detailed methods on how length sampling should be undertaken.

1.5.9 Working Group on Fish Technology and Fish Behaviour (WGFTFB)

Annex 8 of ICES, 2007c provided a useful overview of technical issues relating to fisheries in the North Sea, northern shelf and southern shelf areas. In general, high fuel prices have led to some changes in fleet behaviour. For example, there has been a gradual shift in the Dutch beam trawl fleet from beam trawling to twin trawling for other species (e.g. *Nephrops*). Other fisheries have also directed more effort to *Nephrops*.

Changes that may have an effect on elasmobranch stocks include that Belgian beam trawlers are increasingly being equipped with 3D mapping sonar, which has opened up new areas to fishing (e.g. close to wrecks). Belgian trials with outrigger trawls have indicated a high bycatch of rays. French vessels have switched from anchovy and tuna pelagic trawling to bottom trawling for anglerfish in recent years, and this is likely to continue given the continued closure of the anchovy fishery. In 2008, FTFB provided further information on the bycatch of skates in outrigger trawls (see Sections 15 and 18), and are thanked for providing this information.

1.6 Other fisheries meetings of relevance to WGEF

1.6.1 ICCAT

ICCAT's Standing Committee on Research and Statistics (SCRS) Shark Species Group held a Data Preparatory Meeting (June 25–29, 2007) in Punta del Este (Uruguay). This meeting compiled data to facilitate assessments in 2008.

ICES WGEF met with this ICCAT subgroup in September 2008, and improved data for porbeagle were compiled (Section 6) and assessments for the North Atlantic stocks of blue shark (Section 8) and shortfin mako (Section 9) undertaken.

1.6.2 OSPAR

OSPAR Biodiversity Committee have tentatively accepted nominations for eight elasmobranchs to be listed as Threatened and Declining in the OSPAR area (see Section 21 of ICES, 2007 for the WGEF reviews of the original nominations). In 2008, WGEF also reviewed the nomination for thornback ray in the Celtic Seas ecoregion (see Section 21).

1.7 Mixed fisheries advice for 2007

The ICES mixed fisheries advice for the Celtic Seas and North Sea ecoregions was as follows:

Fisheries in the Celtic Sea, Southwest of Ireland, Western Channel, and northern part of the Bay of Biscay should in 2007 be managed according to the following rules, which should be applied simultaneously. They should fish:

- With no catch or discard of spurdog and cod in VIIe–k;
- without jeopardizing the recommended reduction in fishing mortality of sole and plaice in Divisions VIIfg; plaice and sole in Division VIIe; and Celtic Sea herring and VIa VIIbc herring;
- concerning deep-water stocks fished in Subareas VII and VIII, see Volume 9 (*of ICES Advice*);
- within the biological exploitation limits for all other stocks.

Demersal fisheries in Subarea VI should in 2006 be managed according to the following rules, which should be applied simultaneously. They should fish:

- without catch or discards of cod in Subarea VI;
- with the lowest possible catch for whiting in VIa;
- without catch or discards of spurdog;
- without jeopardizing the recommended reduction in fishing mortality of haddock in Division VIa;
- concerning deep-water stocks fished in Subarea VI, see Volume 9 (*of ICES Advice*);
- within the biological exploitation limits for all other stocks.

Fisheries in the Irish Sea VIIa should in 2006 be managed according to the following rules, which should be applied simultaneously. They should fish:

- without bycatch or discards of cod, sole, and spurdog, and with minimal catch of whiting;
- without jeopardizing the recommended reduction in fishing mortality of haddock;
- within the biological exploitation limits for all other stocks.

Furthermore, unless ways can be found to harvest species caught in mixed fisheries within precautionary limits for all those species individually, then fishing should not be permitted.

Fisheries in Division IIIa (Skagerrak–Kattegat), in Subarea IV (North Sea), and in Division VIId (Eastern Channel) should in 2007 be managed according to the following rules, which should be applied simultaneously:

Demersal fisheries

- with minimal bycatch or discards of cod;
- implement TACs or other restrictions that will curtail fishing mortality for those stocks mentioned above for which reduction in fishing pressure is advised;
- within the precautionary exploitation limits for all other stocks (see text table above);
- where stocks extend beyond this area, e.g. into Division VI (saithe and anglerfish) or are widely migratory (Northern hake), taking into account the exploitation of the stocks in these areas so that the overall exploitation remains within precautionary limits;
- with minimum bycatch of spurdog, porbeagle, and thornback ray and skate.

1.8 Data availability

1.8.1 Provision of data before working group

Given the earlier meeting of WGEF in 2008, not all national data were available, and those data provided were provisional. WGEF members felt that future meetings of WGEF should meet in June as (a) more landings data are available; (b) meeting outside the main spring assessment period should provide national laboratories with more time to prepare for WGEF, (c) it will minimize potential clashes with other assessment groups (which could result in WGEF losing the expertise of stock assessment scientists) and (d) given that there are not major year-to-year changes in elasmobranch populations (cf. many teleost stocks), the advice provided would be valid for the following year.

The group agreed that cpue from surveys should be provided as disaggregated raw data, and not as compiled data. The group agreed that those survey abundance estimates that are not currently in the DATRAS database are also provided as raw data by individual countries.

WGEF recommends that MS provide better explanations of how national data for species and length compositions are raised to total catch, especially when there may be various product weights reported (e.g. gutted or dressed carcasses and livers and/or fins).

At present WGEF considers that discard data should be brought to the meetings of the group and collated there.

1.8.2 Landings data

In 2005–07, WGEF has collated landings data for all elasmobranchs in the ICES area. Although this task has been hampered by the use by so many countries of “nei” (not elsewhere identified) categories. Landings data (as extracted from ICES FishStat Database) have been collated in species-specific landings tables and stored in a WG archive. These data have been corrected as follows:

i) Replacement with more accurate data provided by national scientists.

ii) Expert judgements of WG members to reallocate data to less generic categories (usually from a “nei”category to a specific one).

The data in these archives are considered to be the most complete data and are presented in tabular and graphical form in the relevant chapters of this report.

WGEF aims to allocate progressively more of the “nei” landings data over time, and some statistical approaches have been presented to WGEF 2005 (ICES, 2006b; Johnston *et al*., 2006). However the working group’s best estimates are still considered inaccurate for a number of reasons:

(i) Quota species may be reported as elasmobranchs to avoid exceeding quota, which would lead to over-reporting.

(ii) Fishermen may not take care when completing landings data records, for a variety of reasons.

(iii) Administrations may not consider that it is important to collect accurate data for these species.

(iv) Some species could be underreported to avoid highlighting that bycatch is a significant problem in some fisheries.

(v) Some small inshore vessels may target (or have a bycatch of) certain species and the landings of such inshore vessels may not always be included in official statistics.

The data may also be imprecise as a result of revisions by reporting parties. WGEF aims to arrive at an agreed set of data for each species and will document any changes to these datasets in the relevant working group report.

From 2008, it is hoped that more species-specific recording of skate landings will be collected for the North Sea (see Section 15), and these data should be evaluated by WGEF in 2009.

1.8.3 Discards

Few discards data are available to WGEF, and more detailed studies of such datasets are required. Other issues that need to be considered for more detailed studies of discard data are species identification problems, and the problems of raising such data for those species that are only occasionally recorded or can be found in large numbers occasionally.

1.8.4 Stock structure

This report presents the status and advice of various demersal, pelagic and deep-water elasmobranchs by individual stock component. The identification of stock structure has been based upon the best available knowledge to date (see the stock specific chapters for more details). However, it has to be emphasized that overall, the scientific basis underlying the identity of many of these demersal and deep-water stocks is currently weak. In most of the cases, the identification of stock is based on the distribution and relative abundance of the species, limited knowledge of movements and migrations, reproductive mode and consistency with management units. Therefore, the WG considers that the stock definitions proposed in the report are only preliminary. The WG recommends that increased research effort be devoted to clarifying the stock structure of the different demersal and deep-water elasmobranchs being investigated by ICES.

1.8.5 Length measurements

Some nations are now providing data for larger sharks. The most commonly documented lengths for large sharks are total length (L_T) or fork length (L_F).

However, even these lengths are not taken identically between samplers. A review of this can be found in Francis (2006). The different length measurements that are discussed include:

- Flexed total length ($L_{T\ flex}$) – tip of snout to posterior tip of tail, with tail flexed down to midline.
- Natural total length ($L_{T\ nat}$) – as above but with tail in natural position and perpendicular drop down to midline.
- Calculated total length ($L_{T\ calc}$) – sum of the precaudal length and tail length.
- Fork length (L_F) – tip of the snout to fork in the tail.
- Precaudal length (L_{PC}) – tip of the snout to the origin of the upper lobe of the caudal fin.

Despite these defined measurements criteria sources of differentiation and error include:

1. Whether the measurement is made along a board, under the body or over the body (in which case the length will be larger as a result of body curvature).
2. Whether the animal is laid on the board/surface on its belly or side.
3. Whether the tail is depressed down onto a board-this in itself can create discrepancies, as the body depth of each animal will vary, and the tail may be depressed down farther than the midline if lying on its belly.
4. Where the measurement is made perpendicular to the board by eye-this can result in human error in judgement unless a rule in used to make that perpendicular line to the board.
5. Whether the tail is actually measured at all-i.e. fork or precaudal length, and whether the tail section is calculated rather than the actual observed measurement.

1.9 Methods and software

Many elasmobranchs are data poor, and the paucity of data can extend to:

- Landings data, which are often incomplete or aggregated.
- Life-history data, as most species are poorly known with respect to age, growth and reproduction.
- Commercial and scientific datasets that are compromised by inaccurate species identification (with some morphologically similar species having very different life-history parameters).
- Lack of fishery-independent surveys for some species (e.g. pelagic species) and the low and variable catch rates of demersal species in existing bottom-trawl surveys.

Hence, the work undertaken by WGEF often precludes the formal stock assessment process that is used for many commercial teleosts stocks, and the analyses of survey, biological and landings data are used more to assess the status of the species/stocks.

In 2008 WGEF focused on deep-water elasmobranchs, especially leafscale gulper shark and Portuguese dogfish (see Section 3), and pelagic elasmobranchs.

1.10 ICES cooperative research report

Over the past decade considerable progress has been made as far as our knowledge of elasmobranchs, their biology, fisheries and management in the Northeast Atlantic is concerned. This is mainly because of the EU co-funded DELASS-project that was proposed and carried out by the members of the ICES Study Group on Elasmobranch Fishes, the work done for two meetings of the STECF Elasmobranch subgroup in 2002 and 2003, and the reports produced over the last years by WGEF. During the meeting in 2006 the idea was launched to write an ICES Cooperative Research Report documenting our current state of knowledge.

A proposal for the structure of the report and the format for the chapters, worked out for demersal elasmobranchs in the North Sea, was presented during the 2008 meeting. In broad lines the structure and format will resemble the current Working Group report. WGEF has established a SharePoint site for holding text while in preparation, and aim to complete the report by correspondence in the coming year.

1.11 Working documents presented

The following working documents were presented:

Biseau, A. 2008a. French landings of Deepwater 'Sikis' sharks by species. ICES WGEF Working Document, 6 pp.

Biseau, A. 2008b. Preliminary analysis of the French Industry database on the deepsea fishery. ICES WGDEEP Working Document, 10 pp.

Figueiredo, I., Moura, T. and Bordalo-Machado, P. 2008. Revision and update of landing per unit effort data of deepwater sharks. Portuguese dogfish and leafscale gulper shark, in Portuguese longline fishery (1995–2006). ICES WGEF Working Document, 10 pp.

Moura, T. and Figueiredo, I. 2008. Portuguese dogfish and leafscale gulper shark from the Portuguese longline fishery: Length information. ICES WGEF Working Document, 2 pp.

Moura, T., Figueiredo, I. and Gordo, L. 2008. Analysis of genetic structure of the Portuguese dogfish *Centroscymnus coelolepis* caught in the NE Atlantic using mitochondrial DNA (control region). Preliminary results. ICES WGEF Working Document, 7 pp.

Velasco, F. and Blanco, M. 2008. Results on main elasmobranch species captured during the 2001–2007 Porcupine Bank (NE Atlantic) bottom-trawl surveys. ICES WGEF Working Document, 22 pp.

Vinnichenko, V. I. 2008. Russian deep-sea investigations and fisheries in the northeast Atlantic in 2007. ICES WGDEEP Working Document, 8 pp.

Additionally, two presentations were also given:

Geir Blom: Basking shark (*Cetorhinus maximus*). Norwegian conversion factors, regulations and catch statistics (Presentation only).

Jim Ellis, Gary Burt and Louise Cox: Thames skate tagging FSP (Presentation only).

1.12 References

Francis, M. P. 2006. Morphometric minefields-towards a measurement standard for chondrichthyan fishes. Environ Biol Fish (2006) 77:407–421.

ICES. 2005. Report of the Working Group on Elasmobranch Fishes (WGEF). 14–21 June 2005, Lisbon, Portugal. ICES CM 2006/ACFM:03. 229 pp.

ICES. 2006 Report of the Working Group on Elasmobranch Fishes (WGEF). 14–21 June 2006, ICES Headquarters. ICES CM 2006/ACFM:31. 291 pp.

ICES. 2007a. Report of the Working Group Elasmobranch Fishes (WGEF), 22–28 June 2007, Galway, Ireland. ICES CM 2007/ACFM:27. 318 pp.

ICES. 2007b. Report of the International Bottom Trawl Survey Working Group (IBTSWG), 27–30 March 2007, Sète, France. ICES CM 2007/RMC:05. 195 pp.

ICES. 2007c. Report of the ICES-FAO Working Group on Fish Technology and Fish Behaviour (WGFTFB), 23–27 April 2007, Dublin, Ireland. ICES CM 2007/FTC:06, 197 pp.

ICES. 2008. Report of the International Bottom Trawl Survey Working Group (IBTSWG), 31 March–4 April 2008, Vigo, Spain. ICES CM 2008 RMC:02. 228 pp.

2 Spurdog in the North East Atlantic

2.1 Stock distribution

Spurdog, *Squalus acanthias*, has a worldwide distribution in temperate and boreal waters. WGEF consider there to be a single North East Atlantic stock in ICES Divisions I–IX. See Section 2 of ICES (2006) for further details.

2.2 The fishery

2.2.1 History of the fishery

The peak fishery for North East Atlantic spurdog occurred in the 1960s–1980s. The development of this fishery is described in ICES, 2006 and Pawson *et al*., In press. The main fishing grounds for the NE Atlantic stock of spurdog are the North Sea (IV), West of Scotland (VIa) and Celtic Seas (VII) and in some years the Norwegian Sea (II). Outside these areas, landings are generally low. The main exploiters of spurdog are France, Ireland, Norway and the UK.

2.2.2 The fishery in 2007

No new information. The 5% bycatch quota for spurdog in the North Sea was not raised as a major issue, but this may have been because the comparable 25% skate and ray bycatch quota had a greater impact on fisheries. The 5% bycatch ratio, having been extended to other areas will likely have an impact on commercial fishery from 2008.

In 2008 Sweden introduced measures to restrict fishery on spurdog (see Section 2.2.4).

2.2.3 ICES advice applicable

ICES provided no new advice in 2007, and in 2006 ICES advised that**:**

'The stock is depleted and may be in danger of collapse. Target fisheries should not be permitted to continue, and bycatch in mixed fisheries should be reduced to the lowest possible level. A TAC should cover all areas where spurdog are caught in the Northeast Atlantic. This TAC should be set at zero for 2007.'

2.2.4 Management applicable

The following table summarizes ICES advice and actual management applicable for Northeast Atlantic spurdog during 2001–2008:

Year	Single stock exploitation boundary (tonnes)	Basis	TAC (IIa(EC) and IV) (tonnes)	TAC IIIa , I, V, VI, VII, VIII, XII and XIV (EU and international waters) (tonnes)	TAC I, V, VI, VII, VIII, XII and XIV (EU and international waters) (tonnes)	WG landings (NE Atlantic stock) (tonnes)
2001	No advice	-	8870	-	-	12547[1)]
2002	No advice	-	7100	-	-	9050
2003	No advice	-	5640	-	-	10132
2004	No advice	-	4472	-	-	8044
2005	No advice	-	1136	-	-	6592
2006	F=0	Stock depleted and in danger of collapse	1051	-	-	3771
2007	F=0	Stock depleted and in danger of collapse	841[(2)]	2828	-	2501
2008	No new advice	No new advice	631[(2,3)]		2004 [(2)]	
2009	F=0	Stock depleted and in danger of collapse		-		

[(1)] The WG estimate of landings in 2001 may include some misreported deep-sea sharks or other species;

[(2)] Bycatch quota. These species shall not comprise more than 5 % by live weight of the catch retained on board.

[(3)] For Norway: including catches taken with longlines of tope shark (*Galeorhinus galeus*), kitefin shark (*Dalatias licha*), bird beak dogfish (*Deania calceus*), leafscale gulper shark (*Centrophorus squamosus*), greater lantern shark (*Etmopterus princeps*), smooth lantern shark (*Etmopterus spinax*) and Portuguese dogfish (*Centroscymnus coelolepis*). This quota may only be taken in zones IV, VI and VII.

The TAC covering the area outside the EC waters of IIa and IV is during 2008 covering Subareas I, V, VI, VII, VIII, XII and XIV (EU and international waters) and is set to 2004 t. It is allocated between member states and is a bycatch quota, like the TAC for the North Sea, which means that spurdog "*shall not comprise more than 5 % by live weight of the catch retained on board*". This measure is designed to prevent fisheries targeting aggregations. Subarea IIIa is unregulated this year because Sweden and Denmark have asked for a separate TAC for this area.

The TAC for spurdog in the North Sea and the Norwegian Sea (IIa (EC) and IV) has been reduced annually, with the TAC in 2008 (631 t) based on a reduction of about 25% of that set in 2007.

In 2007 Norway introduced a general ban on fishing and landing of spurdog in the Norwegian economic zone and in international waters in ICES areas I–XIV. However, vessels less than 28 m in length are allowed to fish for spurdog with traditional gear inshore and in territorial waters (4 nm). Spurdog caught as bycatch in other fisheries have to be landed and the Directorate of Fisheries in Norway are allowed to stop the fishery when catches reach last years level. Norway has a 70 cm minimum landing size. This regulation is valid also for 2008.

Since the 1st of January 2008 it is forbidden to fish for spurdog with nets and longlines in Swedish waters. In trawl fisheries the species is only allowed to be taken as a bycatch. In fisheries with hand-held gear only one spurdog is allowed to be caught and kept by the fisher during a 24-hour period. The Swedish Board of

Fisheries can after an application give commercial fishers a permit to fish for spurdog, but the permits can only be granted if the applicant has reported catches of spurdog of at least 2000 kg during either 2005 or 2006.

2.3 Catch data

2.3.1 Landings

Total annual landings, as estimated by the WG for the NE Atlantic stock of spurdog are given in Table 2.1 and illustrated in Figure 2.1. Preliminary estimates of landings for 2007 were 2501 t, although this value will be revised next year. New landing data from France was made available to the WGEF, which have changed the total estimated landing data from 1983 onwards.

2.3.2 Discards

Estimates of total amount of spurdog discarded are not routinely provided although some discard sampling does take place.

A recent study on the estimated short-term discard mortality of otter trawl captured spurdog in the Northwest Atlantic demonstrated that mortality 72 h after capture was in some cases well below the currently estimated 50% for trawling (Mandelman and Farrington, 2006). When catch-weights exceeded 200 kg, there were increases in 72 h mortality that more closely approached prior estimates, indicating that as tows become more heavily packed, there was a greater potential for fatal damage to be inflicted. It should be noted that tow duration in this study was only 45–60 minutes, and additional studies on the discard survivorship in various commercial gears are required, under various deployment times.

2.3.3 Quality of the catch data

In addition to the problems associated with obtaining estimates of the historical total landings of spurdog attributable to the use of some generic dogfish landing categories, there can be some misreporting (ICES, 2006).

2.4 Commercial length frequencies

2.4.1 Landings length compositions

Length compositions were presented in ICES, 2006, and no new analyses of length data from either market sampling or discard trips were undertaken.

2.4.2 Quality of data

WGEF examined length frequency data collected from UK fishery landings (ICES, 2006), and future studies should examine any data that may also available for other fisheries involved in the spurdog fishery (e.g. from Norway, France and Ireland).

2.5 Commercial catch-effort data

No studies of commercial cpue data were undertaken.

2.6 Research vessel surveys

2.6.1 Availability of survey data

Fishery-independent survey data are available for most regions within the stock area. The following survey data were discussed in ICES (2006):

- English first-quarter Celtic Sea groundfish survey: years 1982–2002.
- English fourth-quarter Celtic Sea groundfish survey: years 1983–1988.
- English North Sea third-quarter groundfish survey 1977–2003.
- DARD (mainly quarter 3) Irish Sea groundfish survey 1991–2001.
- Scottish first-quarter west coast groundfish survey: years 1985–2006.
- Scottish fourth-quarter west coast groundfish survey: years 1985–2005.
- Scottish first-quarter North Sea groundfish survey: years 1985–2006.
- Scottish third-quarter North Sea groundfish survey: years 1985–2005.

Further examination of IBTS data will be conducted in future meetings of WGEF. Both Ireland and UK (England and Wales) now participate in the fourth quarter westerly IBTS surveys, and preliminary studies of these data will be undertaken in 2009.

2.6.2 Cpue

The overall trends in the various surveys examined in previous meetings have indicated a trend of decreasing occurrence and decreasing frequency of large catches (Figure 2.2), with catch rates also decreasing, although catch rates are highly variable (ICES, 2006). Future studies of survey data could usefully examine surveys from other parts of the stock area, as well as sex-specific and juvenile abundance trends.

2.6.3 Length distributions

No new information was presented.

2.7 Life-history information

Although there have been several studies in the North Atlantic and elsewhere describing the age and growth of spurdog (Holden and Meadows; 1962; Sosinski; 1977, Hendersen *et al*., 2001), routine ageing of individual from commercial catches or surveys is not carried out.

WGEF assumes the following sex-specific parameters in the length-weight relationship ($W=aL^b$) for Northeast Atlantic spurdog (Coull *et al*., 1989):

	A	B
Female	0.00108	3.301
Male	0.00576	2.89

where length is measured in cm and weight in grammes.

The proportion mature at length was assumed to follow a logistic ogive with 50% maturity at 80 cm for females and 64 cm for males. Values of female length at 50% maturity from the literature include 74 cm (Fahy, 1989), 81cm (Jones and Ugland, 2001) and 83 cm (Gauld, 1979).

The WG has assumed a linear relationship between fecundity (F) and total length (L):

F = 0.344.L–23.876 (Gauld, 1979).

More recent information on the fecundity-length relationship of spurdog caught in the Irish Sea indicates

F = 0.428.L–31.87 (n=179; Ellis and Keable, In press)

Natural mortality is not known, though estimates ranging from 0.1–0.3 have been described in the scientific literature (Aasen, 1964; Holden, 1968). WGEF has assumed a length dependent natural mortality with a value of 0.1 for a large range of ages, but higher values for both very small (young) and large (old) fish.

2.8 Exploratory assessment models

2.8.1 Previous assessments

No new assessments were conducted in 2007 (ICES, 2007) or 2008. Exploratory assessments undertaken in 2006 included a delta-lognormal GLM-standardized index of abundance and a population dynamic model. Preliminary results from this model confirmed that spurdog abundance has declined, and that the decline is driven by high exploitation levels in the past, coupled with biological characteristics that make this species particularly vulnerable to such intense exploitation (ICES, 2006).

Models developed in earlier studies of WGEF could be better developed if the following data were available:

- Selectivity parameters disaggregated by gear for the main fisheries (i.e. for various trawl, longline and gillnets).
- Appropriate indices of relative abundance from fishery-independent surveys, with corresponding estimates of variance.
- Improved estimates for biological data (e.g. growth parameters, reproductive biology and natural mortality).

Earlier meetings of SGEF and WGEF have attempted to undertake assessments of NE Atlantic spurdog. The methods employed during the 2002 SGEF meeting (ICES, 2002) and DELASS project (Heessen, 2003) included catch curve analysis and separable VPA using length distributions sliced according to growth parameters from the scientific literature, and a Bayesian assessment using a stock production model, with a prior for the intrinsic rate of increase set by demographic methods.

2.8.2 Simulation of effects of maximum landing length regulations

Earlier demographic studies on elasmobranchs indicate that low fishing mortality on mature females may be beneficial to population growth rates (Cortés, 1999; Simpfendorfer, 1999). Hence, measures that afford protection to mature females may be an important element of a management plan for the species. As with many elasmobranchs, female spurdog attain a larger size than males, and larger females are more fecund.

Preliminary simulation studies of various Maximum Landing Length (MLL) scenarios were undertaken by ICES, 2006, although better estimates of discard survivorship from various commercial gears are required to better examine the efficacy of such measures.

2.9 Quality of assessments

WGEF has attempted various analytic assessments of NE Atlantic spurdog using a number of different approaches (see ICES, 2006). Although these models have not proved entirely satisfactory (as a consequence of the quality of the assessment input data), these exploratory assessments and survey data all indicate a decline in spurdog.

2.9.1 Catch data

The WG has provided estimates of total landings of Northeast Atlantic spurdog and has used these, together with UK length frequency distributions in the assessment described above. However, there are still concerns over the quality of these data as a consequence of:

- uncertainty in the historical level of catches because of landings being reported by generic dogfish categories;
- uncertainty over the accuracy of the landings data because of species misreporting;
- lack of commercial length frequency information for countries other than the UK;
- low levels of sampling of UK landings and lack of length–frequency data in recent years;
- lack of discard information.

2.9.2 Survey data

Survey data are particularly important indicators of abundance trends in stocks such as this where an analytical assessment is not available. However, it should be highlighted that

- the survey data examined by WGEF cover only part of the stock distribution and analyses should be extended to other parts of the stock distribution.
- spurdog survey data are difficult to interpret because of the typically highly skewed distribution of catch-per-unit effort.

2.9.3 Biological information

As well as good commercial and survey data, the analytical assessments require good information on the biology of NE Atlantic spurdog. In particular, the WG would like to highlight the need for

- updated and validated growth parameters, in particular for larger individuals;
- better estimates of natural mortality.

2.10 Reference points

No reference points have been proposed for this stock.

2.11 Management considerations

Perception of state of stock

All analyses presented in previous reports of WGEF have indicated that the NE Atlantic stock of spurdog has been declining rapidly and is at its lowest ever level. Preliminary assessments making use of the long time-series of commercial landings data suggest that this decline has been going on over a long period of time and that the current stock size may only be a small fraction of its virgin biomass (<10%).

In addition, spurdog are less frequently caught in groundfish surveys than they were 20 years ago, and the preliminary analysis of Scottish survey data presented in 2006 (and in Dobby *et al.*, 2005) indicate significant declines in catch-rate (>75% decline in cpue since 1985). Input data are too limited to give an accurate estimate of current stock status in terms of absolute biomass and fishing mortality, but the illustrated trends in the stock biomass are undeniable.

Stock distribution

Spurdog in the ICES area are considered to be a single-stock, ranging from Subarea I to Subarea IX, although landings from the southern end of its range are likely also to include other *Squalus* species.

There should be a single TAC area. Although a new TAC has been established for other areas, given that northern Scotland is an important area for spurdog, separate TACs for the waters of VIa and IVa could result in area misreporting should the TAC for one area be more restrictive than the other.

Biological considerations

Spurdogs are long-lived, slow growing, have a high age-at-maturity, and are particularly vulnerable to high levels of fishing mortality. Population productivity is low, with low fecundity and a protracted gestation period. In addition, they form size- and sex-specific shoals and therefore aggregations of large fish (i.e. mature females) are easily exploited by target longline and gillnet fisheries.

Fishery and technical considerations

Those fixed gear fisheries that capture spurdog should be reviewed to examine the catch composition, and those taking a large proportion of mature females should be strictly regulated. Additional management measures which would deter the targeting of mature females could include, for example a maximum landings length (MLL). See Section 2.10 of ICES, 2006 for simulations on MLL.

North Sea fisheries are, since 2007, also regulated by a bycatch quota, and spurdog should not comprise more than 5% by live weight of the catch retained on board. This was extended to western areas in 2008.

Spurdog were historically subject to large targeted fisheries, but are increasingly now taken as a bycatch in mixed trawl fisheries. In these fisheries, measures to reduce overall demersal fishing effort should also benefit spurdog. However, a restrictive TAC in this case would likely result in increased discards of spurdog and so may not have the desired effect on fishing mortality if discard survivorship is low.

There is limited information on the distribution of spurdog pups, though they have been reported to occur in Scottish waters, in the Celtic Sea and off Ireland. The lack of accurate data on the location of pupping and nursery grounds, and their importance to the stock precludes spatial management for this species at the present time.

Although there is no EU minimum landing size for spurdog, there is some discarding of smaller fish, and it is likely that spurdog of <40 or 45 cm are discarded in most fisheries. The survivorship of discards of juvenile spurdog is not known.

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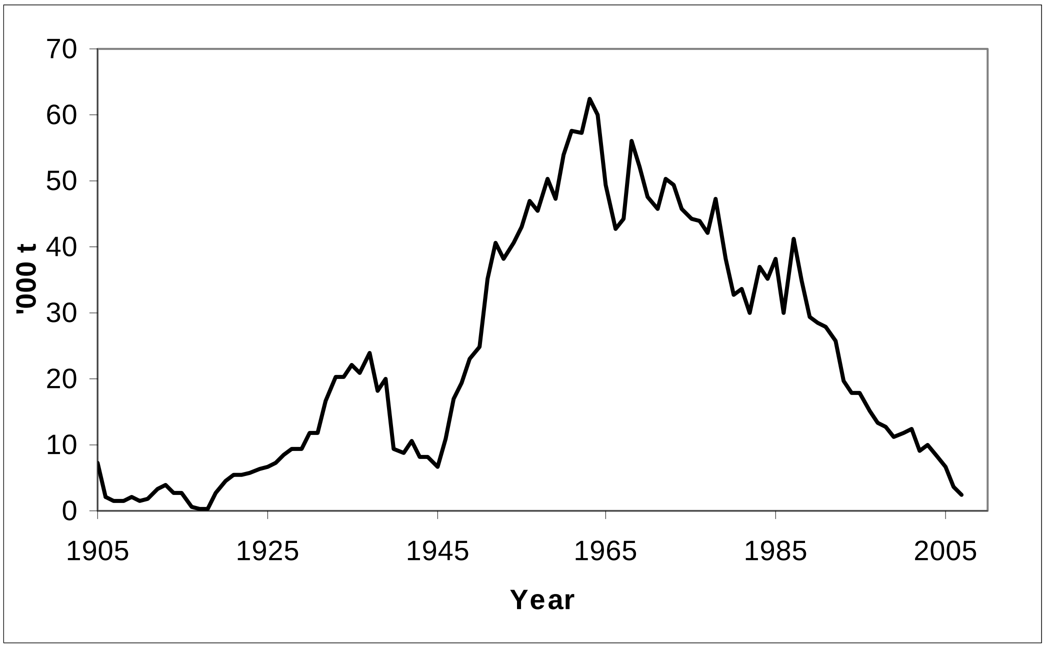
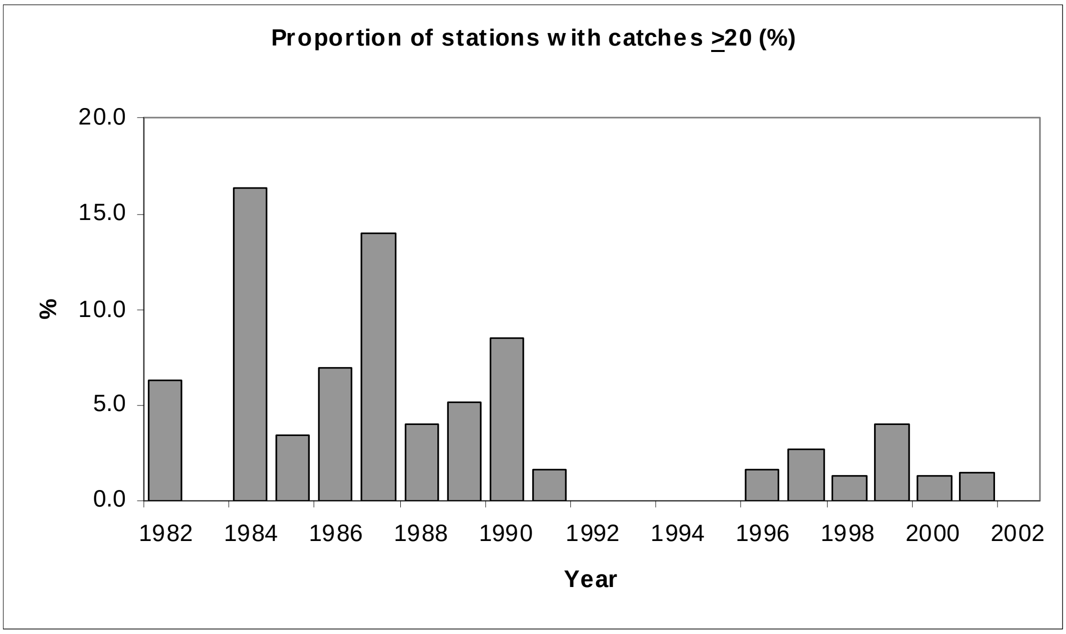


Figure 2.1 Northeast Atlantic spurdog. WG estimates of total international landings of NE Atlantic spurdog (1905–2007).



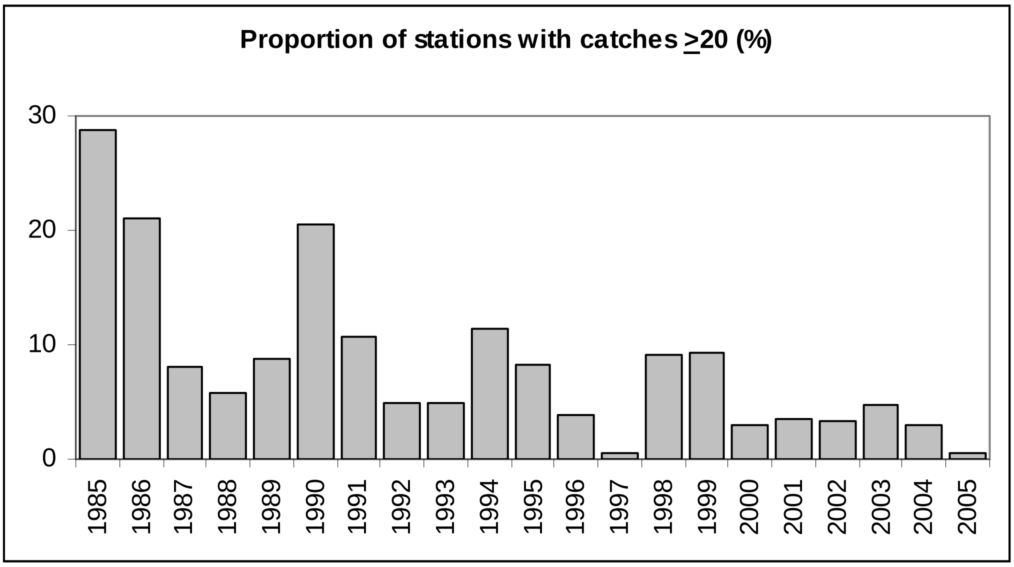


Figure 2.2 Northeast Atlantic spurdog. Proportion of survey hauls in the English Celtic Sea groundfish survey (1982–2002, top) and Scottish west coast survey (Q1, 1985–2005, bottom) in which cpue was ≥20 ind.h^{-1}. (Source: ICES, 2006).

Table 2.1 Northeast Atlantic spurdog. WG estimates of total landings of NE Atlantic spurdog (1947–2007).

Year	Landings (Tonnes)	Year	Landings (Tonnes)	Year	Landings (Tonnes)
1947	16 893	1968	56 043	1989	29 301
1948	19 491	1969	52 074	1990	28 370
1949	23 010	1970	47 557	1991	27 874
1950	24 750	1971	45 653	1992	25 667
1951	35 301	1972	50 416	1993	19 589
1952	40 550	1973	49 412	1994	17 854
1953	38 206	1974	45 684	1995	17 783
1954	40 570	1975	44 119	1996	15 215
1955	43 127	1976	44 064	1997	13 274
1956	46 951	1977	42 252	1998	12 769
1957	45 570	1978	47 235	1999	11 192
1958	50 394	1979	38 201	2000	11 706
1959	47 394	1980	32 711	2001	12 547
1960	53 997	1981	33 537	2002	9050
1961	57 721	1982	29 901	2003	10 132
1962	57 256	1983	36 942	2004	8044
1963	62 288	1984	35 229	2005	6592
1964	60 146	1985	38 063	2006	3771
1965	49 336	1986	29 994	2007	2501
1966	42 713	1987	41 361		
1967	44 116	1988	34 730		

3 Deepwater "siki" sharks in the Northeast Atlantic (IV–XIV)

3.1 Stock distribution

A number of species of deep-water sharks are exploited in the ICES area. This section deals with *Centrophorus squamosus* and *Centroscymnus coelolepis*, which are of greatest importance to commercial fisheries.

For the purposes of this section, the term "siki" is used to describe the combination of leafscale gulper shark and Portuguese dogfish. Although these species have very different biological traits, it has been necessary for ICES to combine them for assessment purposes. This is because landings data for both species were combined for some of the main countries for most of the time since the beginning of the fishery. The term "siki" as used here does not have the same meaning as in commercial fisheries, where it encompasses all commercially exploited deep-water sharks.

Leafscale gulper shark (*Centrophorus squamosus*) has a wide distribution in the NE Atlantic from Iceland and Atlantic slopes south to Senegal, Madeira and the Canary Islands. On the Mid-Atlantic Ridge it is distributed from Iceland to the Azores (Hareide and Garnes, 2001) The species can live as a demersal shark on the continental slopes (depths between 230–2400 m) or have a more pelagic behaviour, occurring in the upper 1250 m of oceanic water in areas with depths around 4000 m (Compagno and Niem, 1998). Available evidence suggests that this species is highly migratory (Clarke *et al.*, 2001, 2002). Available information reveals that pregnant females and pups are found in Portugal, both the mainland (Moura *et al.*, 2006 WD) and Madeira, whereas only pre-pregnant and spent females are found in the northern areas (Garnes, pers. comm.). In the absence of more clear information on stock identity, a single assessment unit of the Northeast Atlantic has been adopted.

Portuguese dogfish (*Centroscymnus coelolepis*) is widely distributed in the Northeast Atlantic. Stock structure and its dynamics are poorly understood. Specimens below 70 cm have been very rarely recorded in the NE Atlantic. There is a lack of knowledge of migrations, though it is known that females move to shallower waters for parturition and vertical migration seems to occur (Clarke *et al.,* 2001). The same size range and maturity stages exist in both the northern and southern ICES continental slopes. This information may suggest that, contrary to leafscale gulper shark, this species is not so highly migratory, though it is widely distributed. Preliminary genetic work (Moura *et al*., 2008 WD) did not reject the null hypothesis that there was no significant difference between the northern and southern areas.

In the absence of more clear information on stock identity, a single assessment unit of the Northeast Atlantic has been adopted. This does not consider that the biology and available information on distribution of these two species is different. However in the absence of better data, it is the best approach possible. Further genetic and other studies are still required on both species.

3.2 The fishery

3.2.1 History of the fishery

Fisheries taking these species were described extensively in ICES (2006), and little new information is available in 2008. STECF, 2006 presented a review of available information on deep-water shark gillnet fisheries. After the ban on gillnet fisheries in the northern area, gillnet and longline fisheries developed in Subarea VIII and Division IXb in 2006. New analyses of the French fishery are available from industry-science partnerships (Biseau, 2008b WD). This document demonstrates that there has been only a little change in the mean depth fished by the deep-water French fleet since 2000, but that new areas have been fished in this period. Biseau, 2008a WD reveals that there has been a slight tendency for catches of deep-water sharks to come from shallower depths, in the period 2000–2006. This possibly reflects the change in fishing pattern.

3.2.2 The fishery in 2007

C. squamosus and *C. coelolepis* are both taken in several mixed trawl fisheries and mixed longline fisheries, in the northern area. They are taken as a bycatch in other fisheries, for example the anglerfish gillnet fishery. There are directed longline fisheries in VIII and IXa.

Trial fishing by a Russian autoline longliner was described by Vinnichenko, 2008 WD. Leafscale gulper shark was the most frequent species. Catches were as follows:

Faroe Islands Vb		439 t out of 525 t in total. TLhis comprised 381 t of leafscale gulper shark and 58 t of Portuguese dogfish.
Reykjanes Ridge	XIVb1 and XIIa	61 t
Hatton Bank	XIIb and Vib1	0.8 t

3.2.3 ICES advice applicable

In 2006, ICES noted substantial declines in cpue series for both *C. coelolepis* and *C. squamosus* in Subareas VI, VII and XII, suggesting that the stocks of both species were depleted. Cpue for both species in the northern area had displayed strong downward trends leading to the conclusion that the stocks were being exploited at unsustainable levels. In Division IXa, cpue series, although short, appeared to be stable.

In 2006, ICES advised that no target fisheries should be permitted unless there were reliable estimates of current exploitation rates and stock productivity. ICES advised that the TAC should set at zero for the entire distribution area of the stocks and additional measures should be taken to prevent by catch of Portuguese dogfish and leafscale gulper shark in fisheries targeting other species.

No ICES advice was provided in 2007.

3.2.4 Management applicable

In 2007, the TAC for deep-water sharks in Subareas V, VI, VII, VIII and IX was 2472 t. In 2008, the TAC for these species in these areas was 1646 t. In 2007 and 2008, the TAC for deep-water sharks is set at 20 t annually in Subarea X, and 99 t in Subarea XII. These TACs apply to the following list of species: Portuguese dogfish (*Centroscymnus coelolepis*), leafscale gulper shark (*Centrophorus squamosus*), birdbeak dogfish (*Deania calceus*), kitefin shark (*Dalatias licha*), greater lanternshark (*Etmopterus princeps*), velvet belly (*Etmopterus spinax*), black dogfish (*Centroscyllium fabricii*), gulper shark (*Centrophorus granulosus*), blackmouth dogfish (*Galeus melastomus*), mouse catshark (*Galeus murinus*), Iceland catshark (*Apristurus* spp.). In Subarea X, *Deania hystricosum* and *Deania profundorum* are also on this list.

A number of effort regulations apply to these deep-water shark species. Council of the

EU Regulation (EC) No 2347/2002 sets maximum capacity and power (kW) ceilings on individual member states' fleets fishing for deep-water species. Council Regulation (EC) No 27/2005 set a limit of effort (killowat*days) at 90% the 2003 level for 2005, and in at 80% for 2006.

Council Regulation (EC) No 1568/2005 bans the use of trawls and gillnets in waters deeper than 200 m in the Azores, Madeira and Canary Island areas.

Council Regulation (EC) No 41/2007 banned the use of gillnets by Community vessels at depths greater than 600 m in ICES Divisions VIa, b, VII b, c, j, k and Subarea XII. A maximum bycatch of deep-water shark of 5% is allowed in hake and monkfish gillnet catches. This ban does not cover Subareas VIII or IX. In 2006, the ban on gillnetting applied to waters deeper than 200 m, but this was revised to 600 m, in 2007, following advice from STECF.

A gillnet ban in waters deeper than 200 m, is also in operation in the NEAFC regulatory Area (all international waters of the ICES Area). NEAFC also ordered the removal of all such nets from these waters by the 1st February 2006.

3.3 Catch data

3.3.1 Landings

Figure 3.1 shows landings trends by country, and Figure 3.2 shows trends by area. The working group estimates of total landings of mixed deep-water sharks, believed to be mainly Portuguese dogfish and leafscale gulper shark but possibly also containing a small component of other species, are presented in Table 3.1. In 2006, WGEF produced estimates of landings of each of these species (ICES, 2006). This has not been updated since. Biseau (WD 2008a) presented a split of French landings, by species. However this document uses a ratio of species abundance by depth derived in the 1990s that is no longer valid, as a consequence of declining relative abundance of Portuguese dogfish. It also includes as "sikis" small landings of other deep-water sharks. Therefore it is not used in this report.

It can be seen that landings have declined from around 10 000 t from 2001 to 2004, to about 1400 t in 2007 (Figures 3.1 and 3.2). Due to the gillnet bans, and it can be seen that the proportion of international landings from the gillnet fishing countries (UK and Germany) have declined. 2007 landings are the lowest since the fishery reached full development in the early 1990s and much lower than TACs available (2600 t).

3.3.2 Discarding

Discarding is thought to be negligible in the northern fishery. In southern areas, where shark abundance is relatively stable, it may be expected that discarding has increased, as a consequence of restrictive quotas for shark. Some discarding may have taken place in the earlier years, before markets were established. Some countries discarded certain species, for instance leafscale gulper sharks by Irish trawlers. Anecdotal information suggests some discarding of rotten deep-water sharks, as a consequence of excessive soak times, has been recorded in gillnet fisheries (Hareide *et al.*, 2005). In gillnet fisheries shallower than 600 m, there is no information on discarding, though the discard limit may lead to this practice.

3.3.3 Quality of the catch data

Historically, much of the catch data were aggregated. Although many nations have improved species-specific reporting of landings in recent years, some of these data may contain misidentifications.

There are no reliable estimates of levels of misreporting of these species but it is believed to be a minor problem. Immediately prior to the introduction of quotas for deep-water species in 2001, it is believed that some vessels may have logged deep-water sharks as other species in an effort to build up track record. It is also likely that, before the introduction of quotas for deep-water sharks, some gillnetters may have logged monkfish as sharks. Since the introduction of quotas on deep-water sharks in 2005, it is likely that some underreporting has occurred.

IUU fishing is also known to take place, especially in international waters.

3.4 Commercial catch composition

3.4.1 Species composition

No new information is available on species composition of generic landings. In 2005, WGEF split all generic landings to species level, based on available information. This process has not continued but it did illustrate the relative decline in Portuguese dogfish landings in recent years.

3.4.2 Length composition

Length frequency information is provided for 2007 from the Portuguese fishery (Moura and Figueiredo, 2008 WD). This demonstrates the same length range for these species as in previous years (Figure 3.3).

3.4.3 Quality of catch and biological data

WGEF finds it difficult to quantify landings data when MS report data for both live weight and for livers. This potentially can lead to duplication of data and overestimation of landings. WGEF asks all MS to explain how landings of livers are raised to total live weight, and to report if duplication could be happening.

3.5 Commercial catch-effort data

In 2006, WGEF summarized all the available cpue series. In 2008, standardized lpue from Portuguese longliners data are presented by Figueriedo *et al.*, 2008 WD, see Figures 3.4 and 3.5. The series for Portuguese dogfish demonstrates a gradual decline in values with less variance in recent years, whereas that for leafscale gulper shark is more or less stable. In the time available it was not possible to fully evaluate this new study. Otherwise, no new information was available.

3.6 Fishery-independent surveys

FRS has conducted deep-water surveys (depth range 300–1900 m) in Division VIa since 1996. Since 1998 the survey has been reasonably consistent about survey design, gear deployed and area covered (Jones *et al.*, 2005). The survey uses a large commercial trawl (made by Jackson) and is towed for a period of 1.5–2 hours at speeds of 3–3.5 knots. Initially, the survey was carried out on a biennial basis, but since 2004 has been carried out annually. Tables 3.3 and 3.4 demonstrate the coverage of hauls by depth strata and latitude. Note that the survey in 1998 was more limited in that it did not extend as far north or south, nor into areas quite as deep as the other surveys, and in 2005 and 2007 there were no stations in the shallowest strata.

Figure 3.5 shows the percentage of hauls by depth range (<500 m, 500–1 000 m and ≥1000 m) containing leafscale gulper shark and Portuguese dogfish. The results demonstrate little trend for leafscale gulper shark, but a decline in the deeper strata for Portuguese dogfish. However, it should be highlighted that this survey has relatively few stations per depth strata and covers only a small proportion of the spatial distribution of these stocks.

3.7 Life-history information

No new information since 2006.

3.8 Assessments

No new assessments were conducted in 2008.

3.9 Quality of assessments

No new assessments were conducted in 2008.

3.10 Reference points

U_{lim} is set at 0.2* virgin biomass and Upa is set at 0.5* virgin biomass (ICES, 1998). This is in common with other deep-water stocks. However because abundance indices do not correspond to the start of the fishery these points cannot always be used.

3.11 Management considerations

On the basis of their life-history parameters, being slow-growing and late maturing, these two species are considered highly vulnerable to exploitation.

Cpue of both species has demonstrated a strong decline in northern areas (Subareas V, VI, VII and XII). In Subarea IX, cpue appears to be stable for leafscale gulper, though declining somewhat for Portuguese dogfish. There is no new information, in 2008, to alter our perception that the stocks of these species are depleted. In particular, that Portuguese dogfish is strongly depleted in the northern area.

The ban on gillnetting in VI and VII has led to some diversion of effort to IVa, VIII and IX and also to West Africa. These landings from IXb, are in a new, previously unexploited area. WGEF expresses concern that new fisheries are developing in VIII and IXb, without prior evaluation of sustainable catches having been carried out.

IUU fishing is known to take place in international waters, and this may be continuing.

Further studies of biology and stock discrimination are still required, as fishing on these species expands to new areas.

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Table 3.1 Deepwater "siki" sharks in the Northeast Atlantic. Working group estimate of combined landings of Portuguese dogfish and leafscale gulper shark (t) by ICES area.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
IV a	-	12	8	10	140	63	98	78	298	227	81	55	1	3	10	16	5	4	4	3
Va	-	-	-	-	1	1	-	-	-	-	5	-	1	-	-	-	-	-	-	-
Vb	-	-	140	75	123	97	198	272	391	328	552	469	410	475	215	300	229	239	195	579
VI	-	8	6	1013	2013	2781	2872	2824	3639	4135	4133	3471	3455	4459	3086	3855	2754	1102	638	731
VII	-	-	-	265	1171	1232	2087	1800	1168	1637	1038	895	892	2685	1487	3926	3477	842	323	92
VIII	-	-	6	70	62	25	36	45	336	503	605	531	361	634	669	746	674	376	208	22
IX	560	507	475	1075	1114	946	1155	1354	1189	1311	1220	972	1049	1130	1198	1180	1125	1033	1325	366
X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
XII	-	-	-	1	2	7	9	139	147	32	56	91	890	719	1416	849	767	134	-	1
XIV	-	-	-	-	-	-	-	-	-	9	15	-	-	-	12	4	-	-	-	61
Unknown Area																		1323	34	-
	560	527	635	2509	4626	5152	6455	6512	7168	8182	7705	6484	7059	10105	8093	10876	9031	5054	2727	1855

Table 3.2 Deepwater "siki" sharks in the Northeast Atlantic. Working group estimate of combined landings of Portuguese dogfish and leafscale gulper shark (t) by country.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
France	-	-	140	1288	3104	3468	3812	3186	3630	3095	3177	3079	3519	3684	2103	1454	1189	866	744	844
UK (Scotland)	-	20	14	24	165	469	743	801	576	766	1007	625	623	2429	1184	1594	1135	802	184	78
UK (E&W)	-	-	-	104	80	174	387	986	1036	2202	1494	1019	413	320	335	4027	3610	1533	537	23
Ireland	-	-	-	-	-	-	-	33	5	-	3	2	138	454	577	493	764	381	113	36
Iceland	-	-	-	-	1	1	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Spain (Basque C)	-	-	-	-	-	-	-	-	286	473	561	450	280	608	621	719	563	359	78	-
Portugal	560	507	481	1093	1128	946	1155	1354	1189	1314	1260	1036	1108	1151	1198	1180	1125	1033	1072	366
Germany	-	-	-	-	148	91	358	92	164	106	40	214	265	431	518	640	-	79	-	-
Estonia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	4	-	-	-	-
Latvia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	14	40	28	-	-	-	1
Poland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-
Russia																				500
Spain (Galicia)	-	-	-	-	-	-	-	-	-	-	-	-	572	615	1381	737	626	-	-	-
Faroe Island	-	-	-	-	-	3	-	60	282	226	158	54	23	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-	-	5	118	399	75	-	19	-	-	-
Total	560	527	635	2509	4626	5152	6455	6512	7168	8182	7705	6484	7059	10105	8093	10876	9031	5053	2727	1849

Table 3.3 Deepwater "siki" sharks in the Northeast Atlantic. FRS deep-water survey. Depth distribution of hauls per year.

	Depth range			
	< 500 m	500–1000 m	1000+ m	Total
1998	2	17	1	20
2000	6	13	15	34
2002	5	11	16	32
2004	4	11	11	26
2005	0	7	12	19
2006	1	15	18	34
2007	0	9	13	22
Total	18	83	86	187

Table 3.4 Deepwater "siki" sharks in the Northeast Atlantic. FRS deep-water survey. Distribution of hauls by latitude.

	Latitude					
	55	56	57	58	59	Total
1998	0	7	8	5	0	20
2000	6	10	8	9	1	34
2002	8	12	4	8	0	32
2004	7	8	8	3	0	26
2005	0	4	8	7	0	19
2006	7	9	9	8	1	34
2007	4	6	6	3	3	22
Total	32	56	51	43	5	187

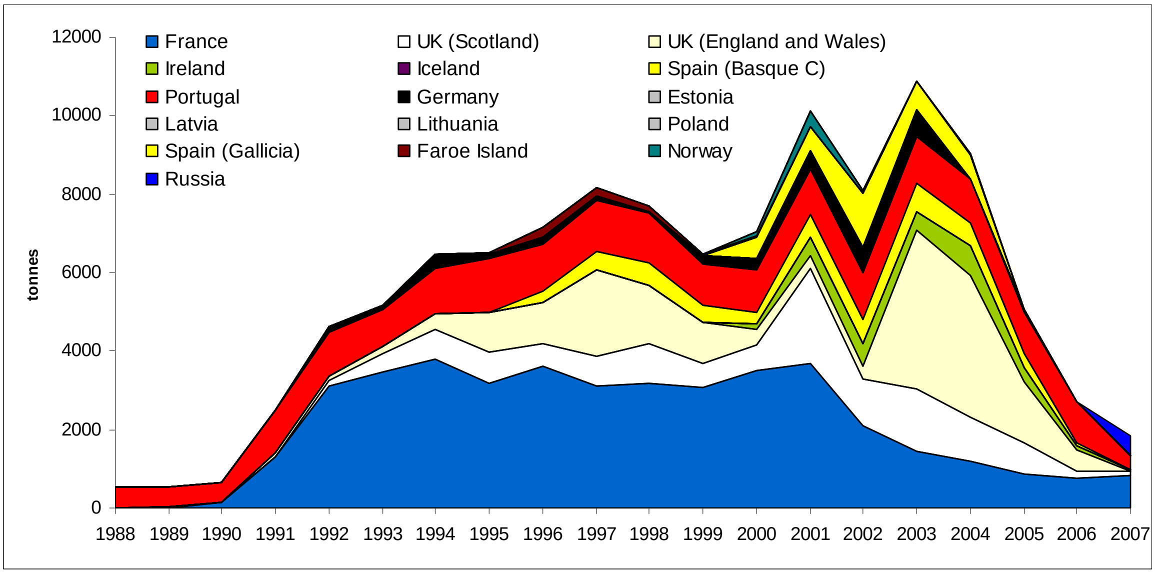

Figure 3.1 Deepwater "siki" sharks in the Northeast Atlantic. Working group estimates of landings, by country.

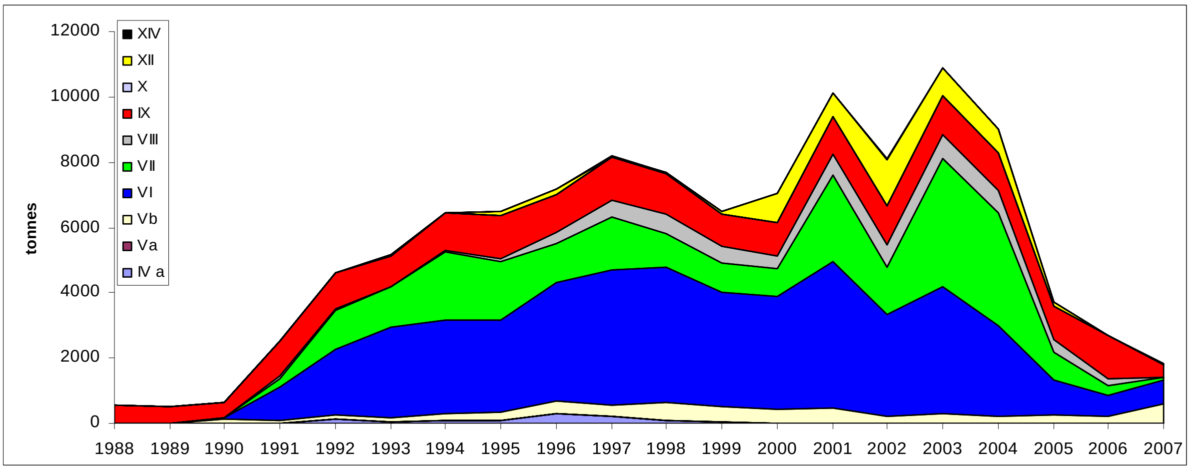

Figure 3.2 Deepwater "siki" sharks in the Northeast Atlantic. Working group estimates of landings, by ICES Subarea.

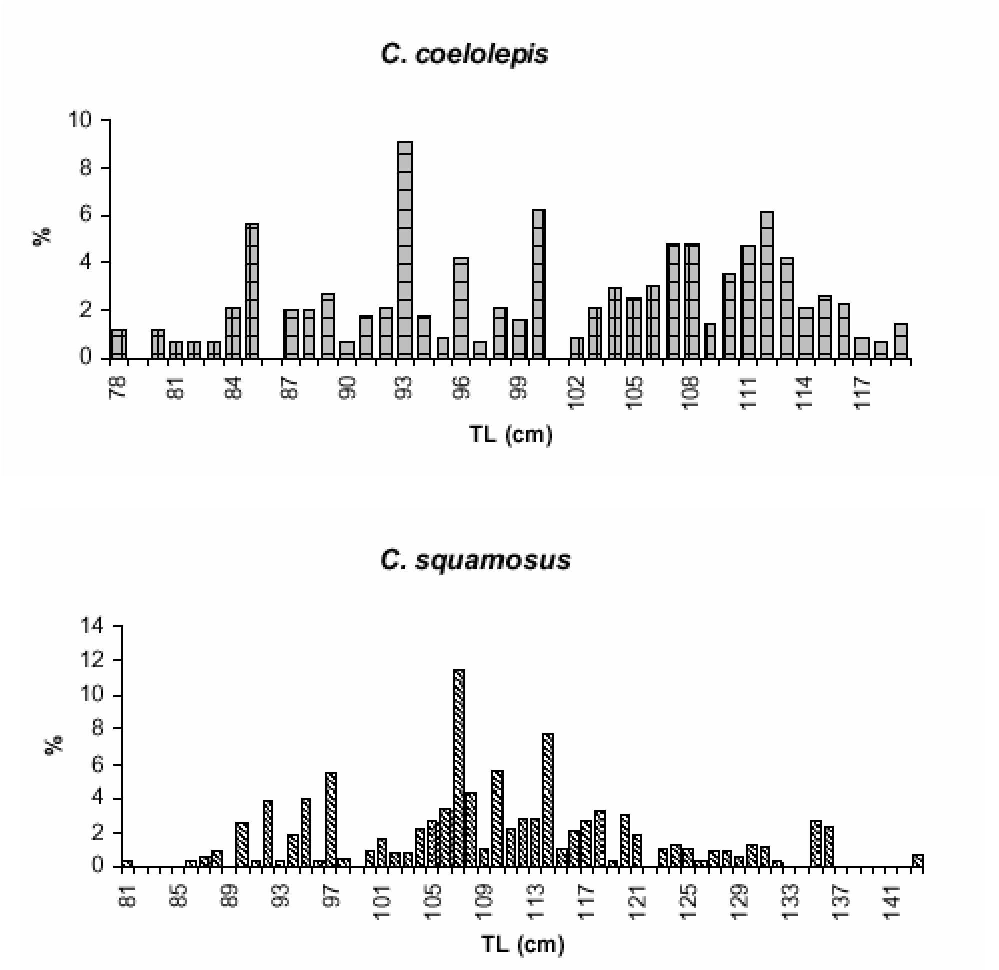

Figure 3.3 Deepwater "siki" sharks in the Northeast Atlantic. Length frequencies from Portuguese landings in IXa.

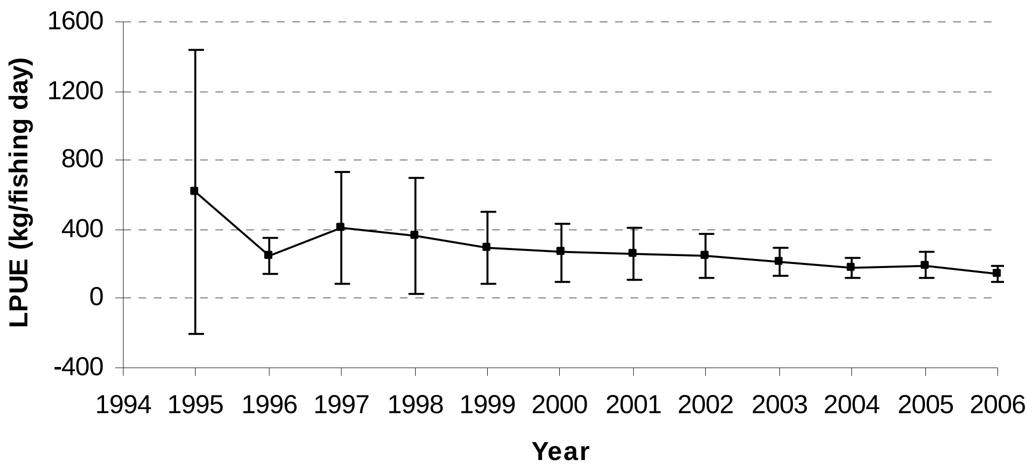

Figure 3.4 Deepwater "siki" shark in the Northeast Atlantic. Portuguese dogfish, Portuguese longline mean annual lpue +/- std. deviation for ICES Subarea IX (Figueiredo *et al.*, 2008 WD).

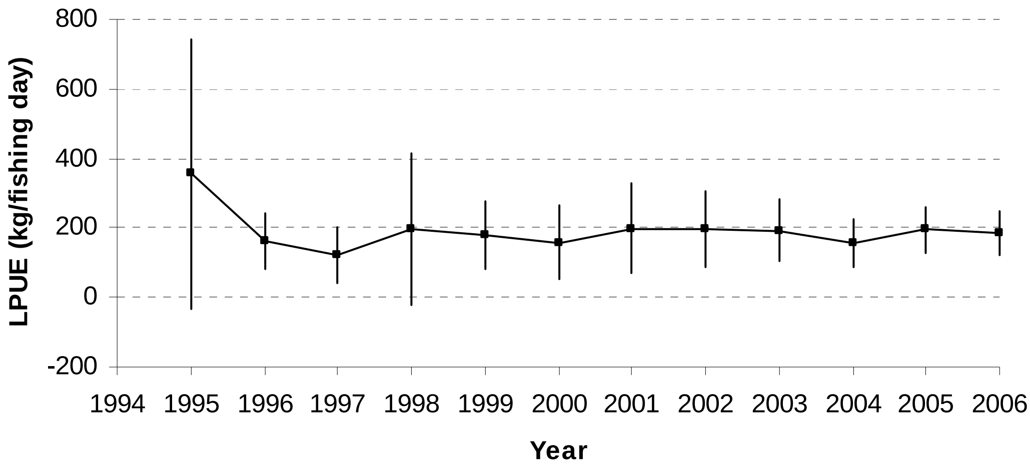

Figure 3.5 Deepwater "siki" shark in the Northeast Atlantic. Leafscale gulper shark, Portuguese longline mean annual lpue +/- std. deviation for ICES Subarea IX (Figueiredo *et al.*, 2008 WD.)

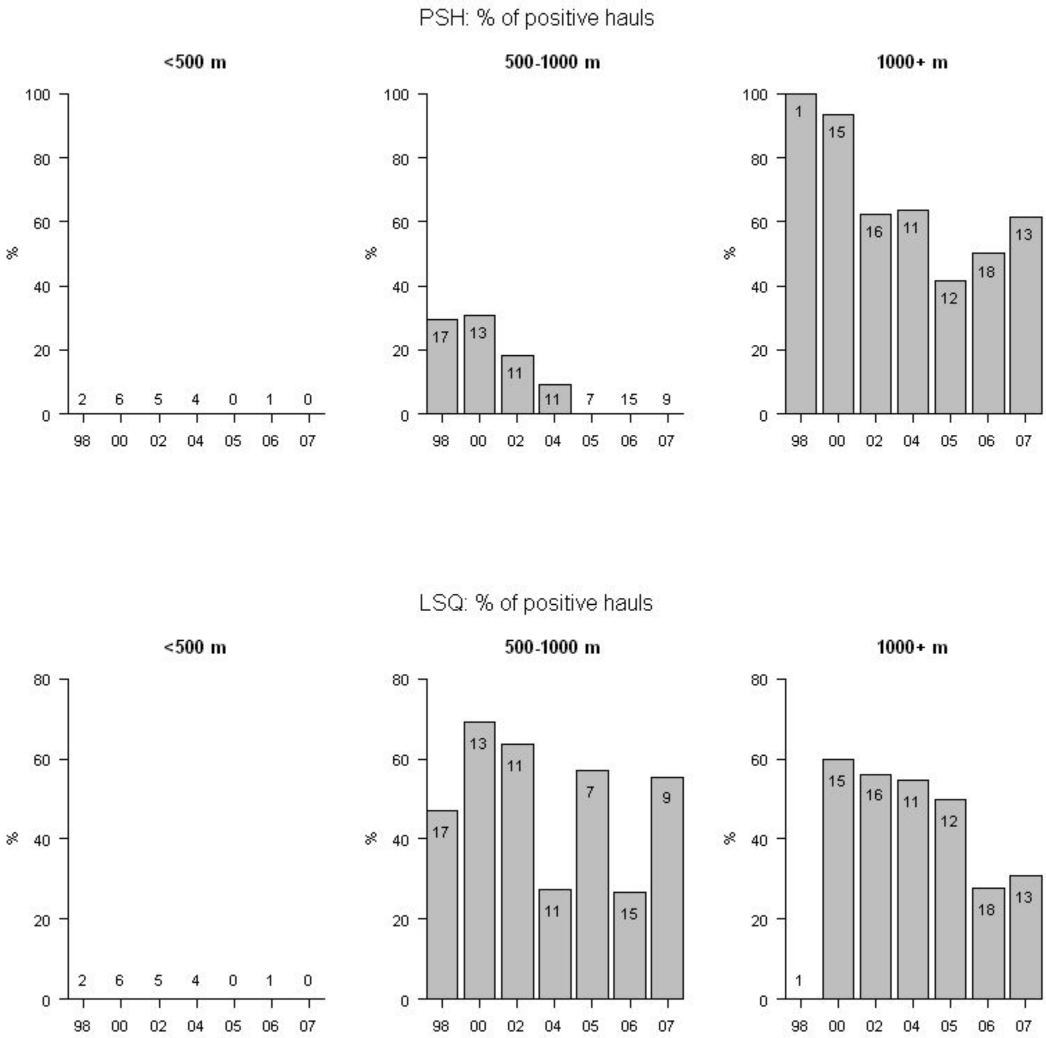

Figure 3.6 Deep-water "siki" shark in the Northeast Atlantic. Percentage of hauls containing Portuguese dogfish (PSH, above) and leafscale gulper shark (LSQ, below) from Scottish deep-water surveys in Subarea VI since 1998. Number of hauls in each depth band is also indicated.

4 Kitefin shark in the Northeast Atlantic (entire ICES Area)

4.1 Stock distribution

Kitefin shark *Dalatias licha* is widely distributed in the deeper waters of the North Atlantic (from Norway to northwestern Africa and the Gulf of Guinea, including the Mediterranean Sea and Northwest Atlantic). The stock identity of kitefin shark in the NE Atlantic is unknown. However the resource seems to be more abundant in the southern area of the Mid Atlantic Ridge (ICES Area X).

Elsewhere in the NE Atlantic, kitefin shark is recorded infrequently. Kitefin shark has a low abundance in Subareas V–VII. It is caught as bycatch in mixed deep-water fisheries in these areas, though in much lesser abundance than the main deep-water sharks (see Section 3), and the species composition of the landings is not accurately known.

For assessment purposes the Azorean stock is considered as a management unit (ICES Subarea X).

4.2 The fishery

4.2.1 History of the fishery

The directed fishery on the Azores stopped at the end of the 1990s because it was not profitable. Kitefin shark in the North Atlantic is currently a bycatch in other fisheries. A detailed description of the fisheries can be found in Heessen, 2003 and ICES, 2003.

4.2.2 The fishery in 2006 and 2007

Historically, landings from the Azores began in the early 1970s and increased rapidly to over 947 t in 1981 (Figure 4.1). From 1981–1991 landings fluctuated considerably, following the market fluctuations, peaking at 937 t in 1984 and 896 t in 1991. Since 1991 the reported landings have declined linearly, possible as a result of economic problems related to markets. Since 1988 a bycatch has been reported from mainland Portugal with 282 t in 2000 and 119 t in 2003.

Kitefin from the Azores is now a bycatch from different deep-water fisheries, with landings in the 2004–2007 period less than about 10 t.

4.2.3 ICES advice applicable

ICES provided no new advice in 2007, in 2006 ICES advised: "This stock is managed as part of the deep-sea shark fisheries. No targeted fisheries should be permitted unless there are reliable estimates of current exploitation rates and sufficient data to assess productivity. It is recommended that exploitation of this species should only be allowed when indicators and reference points for future harvest have been identified and a management strategy, including appropriate monitoring requirements has been decided upon and is implemented".

4.2.4 Management applicable

Deepwater sharks are subject to management in Community waters and in certain non-Community waters for stocks of deep-sea species (EC no 2270/2004 article 1). Fishing opportunities (TAC) for stocks of deep-sea shark species for Community vessels were presented in an Annex (EC no 2270/2004 and EC no 2015/2006 annex part 2). A list of species was given to be considered in the group of 'deep-sea sharks'.

The 2007–2008 TAC for V, VI, VII, VIII and IX for these species is 2472 t. In Subarea X the TAC is 20 t and in Subarea XII 99 t.

4.3 Catch data

4.3.1 Landings

The landings reported from each country, for the period 1988–2007 are given in Table 4.1 and total historical landings from 1972–2007 in Figure 4.1.

Although the UK (E&W), France and Ireland have official reported landings of kitefin shark in these areas, it is considered by the group that these have been misidentified, and are more likely to be either Portuguese dogfish or leafscale gulper shark.

4.3.2 Discards

No new information. Three individuals were recorded as bycatch in Irish horse mackerel fisheries in ICES Subarea VIIc at 300 m depth.

4.3.3 Quality of catch data

Deepwater sharks taken in the Azores are usually gutted, finned, beheaded and also skinned. Only the trunks and, in some cases, the livers are used. Data from observers or fishing logbooks are not available. Species misidentification is a problem with deep-water sharks. Official landings come exclusively from the commercial first sale of fresh fish on the auctions. Landings that are not sold on the auctions, as the frozen or processed fish, are not taken into account in the statistics provided to ICES. In some areas it is known that some additional Azorean catches are not contained in the reported data. Therefore, data in Table 4.1 are an underestimate of total landings.

4.4 Commercial catch composition

No new information.

4.5 Commercial catch-effort data

No new information.

4.6 Fishery-independent surveys

There is no new information available. Existing surveys (the Azorean longline survey) rarely catch kitefin shark (only 25 individuals were caught during the last 10 years), because the survey is not designed for the species, and will not provide reliable indices of relative abundance (Pinho, 2005 WD).

4.7 Life-history information

There is no new information available.

Individuals less than 98 cm are not observed in the region suggesting that probably spawning and juveniles occurs in deep water or non-exploited areas. Male kitefin shark are more available to the fishery at 100 cm (age 5) and females at 120 (age 6).

4.8 Exploratory assessment models

4.8.1 Previous assessments of stock status

Stock assessments of kitefin shark were made during the 1980s, using equilibrium Fox production model (Silva, 1987). The stock was considered intensively exploited with the average observed total catches (809 t) near the estimated maximum sustainable yield (MSY=933 t). An optimum fishing effort of 281 days fishing bottom nets and 359 man trips fishing with handlines were suggested, corresponding approximately to the observed effort.

During the DELASS project (Heessen, 2003) a Bayesian stock assessment approach using three cases of the Pella-Tomlinson biomass dynamic model with two fisheries (handline and bottom gillnets) was performed (ICES, 2003, 2005). The stock was considered depleted based on the probability of the Biomass 2001 being less than BMSY.

4.8.2 Stock assessment

No new assessment of the species status was undertaken, because no new data were available.

4.9 Quality of assessments

No new assessments were undertaken. Commercial data need to be examined in relation to the price of liver oil.

4.10 Reference points

In common with other deep-water stocks, U_{lim} is set at 0.2* virgin biomass and U_{pa} is set at 0.5* virgin biomass (ICES, 1998).

4.11 Management considerations

Preliminary assessment results suggest that the stock may be depleted, to about 50% of virgin biomass. However, further analysis is required to better understand the status of the stock, particularly analysing the effect of liver oil prices on the fishery.

The working group considers that the development of a fishery must not be permitted before data become available in order to have a more precise idea about the sustainable catch. If an artisanal fishery was to be established it should be accompanied by a scientifically robust experimental fishery.

4.12 References

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Table 4.1 Kitefin shark in the Northeast Atlantic. Working group estimates of landings (t) of Kitefin Shark *Dalatias licha*.

Country	Subarea	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
France	VII	.	.	.	.	.	.	.	.	.	.	.
UK Scotland	Vb, VI	.	.	.	.	.	.	.	.	.	.	.
UK (E&W)	VI, VII,VIII	.	.	.	.	.	.	.	.	.	.	.
Ireland	X		.	.	.	.	.	.	.	.	.	.
Germany	VII	.	.	.	.	.	.	.	.	.	.	.
Portugal	VI, IXa	149	57	7	12	11	11	11	7	4	4	6
Portugal (Azores)	X	549	560	602	896	761	591	309	321	216	152	40
Total		698	617	609	908	772	602	320	328	220	156	46

Table 4.1 continued Kitefin shark in the Northeast Atlantic. Working group estimates of landings (t) of Kitefin Shark *Dalatias licha*.

Country	Subarea	1999	2000	2001	2002	2003	2004	2005	2006	2007
France	VII, VIII	.	.	.	.		+	+	3	0
UK Scotland	Vb, VI	.	.	.	.	+	+	8	0	+
UK (E&W)	VI, II,VIII	.	.	.	.	+	+	+	2	5
Ireland	X	.	.	.	.	.	.	0	0	
Germany	VII	.	.	.	.	.	.	21	0	
Portugal	VI, IXa	14	282	176	5	119	2	3	6	3
Portugal (Azores)	X	31	31	13	35	25	6	14	10	7
Total		45	313	189	40	144	9	47	21	14

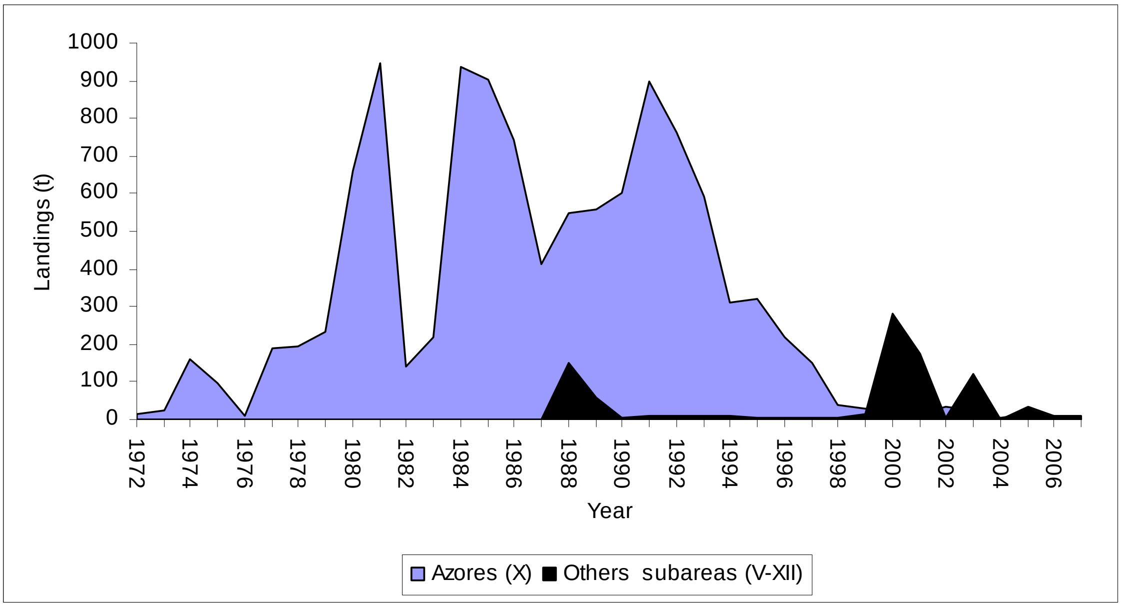

Figure 4.1 Kitefin shark in the Northeast Atlantic. Total landings of kitefin by ICES statistical areas.

5 Other deep-water sharks and skates from the Northeast Atlantic (ICES Subareas IV–XIV)

5.1 Stock distributions

The present section includes information about deep-water elasmobranch species other than Portuguese dogfish and leafscale gulper shark (see Section 3) and kitefin shark (see Section 4). In general, these species have lower commercial value than the species dealt with in the previous section. Little information exists on the majority of the species presented here other than annual landings data for some species, which are probably incomplete.

The species and generic landings categories for which landings data are presented are: Gulper shark (*Centrophorus granulosus*), birdbeak dogfish (*Deania calceus*), longnose velvet dogfish (*Centroselachus (Centroscymnus) crepidater*), black dogfish (*Centroscyllium fabricii*), velvet belly (*Etmopterus spinax*), blackmouth catshark (*Galeus melastomus*), Greenland shark (S*omniosus microcephalus*), lantern sharks *nei* (*Etmopterus* spp.), and 'aiguillat noir' (may include *C. fabricii, C. crepidater* and *Etmopterus* spp).

14 species of skate (Rajidae) are known from deep water in this area: Arctic skate (*Amblyraja hyperborea*), Jensen's skate (*Amblyraja jenseni*), Krefft's skate (*Malacoraja kreffti*) roughskin skate (*Malacoraja spinacidermis*), deep-water skate (*Rajella bathyphila*), pallid skate (*Bathyraja pallida*), Richardson's skate (*Bathyraja richardsoni*), Bigelow's skate (*Rajella bigelowi*), round skate (*Rajella fyllae*), Mid-Atlantic skate (*Rajella kukujevi*), spinetail skate (*Bathyraja spinicauda*), sailray (*Dipturus lintea*), Norwegian skate (*Dipturus nidarosiensis*) and blue pygmy skate (*Neoraja caerulea*). Most of these species are poorly known. Species such as *Dipturus batis* and *Leucoraja fullonica* may occur in deep water, but their main areas of distribution extend to much shallower waters and they are not considered in this section.

5.2 The fishery

5.2.1 History of the fishery

Most catches of other deep-water shark and skate species are taken in mixed trawl, longline and gillnet fisheries together with Portuguese dogfish, leafscale gulper shark and deep-water teleosts. These fisheries were described in some detail in Section 3 of ICES, 2005 and updated in Section 3 of this report.

Divisions VIII, IX and X

Gulper shark *Centrophorus granulosus* was the main target of a directed longline fishery for deep-water sharks, which started in 1983 in northern Portugal (STECF, 2003), but has now finished. The species is occasionally captured by the Portuguese black scabbardfish longline fishery in Subarea IX. In 2006, UK gillnetters targeted Portuguese dogfish and leafscale gulper sharks in Subarea VIII and IX with a bycatch of gulper shark, birdbeak dogfish and longnose velvet dogfish (See Table 3.3). Other deep-water species are captured by artisanal fisheries operating in ICES Subareas IX and X. The crustacean trawl fishery operating in Subarea IX captures species such as birdbeak dogfish, black mouth catshark and lantern sharks, but these are mainly discarded.

Subareas IV, V, VI, VII, XII and XIV

Several species of deep-water shark and skate are caught as bycatch in mixed deep-water trawl fisheries in Subareas VI, VII and XII. Many of the species considered here were formerly discarded by these fisheries, however, in more recent years species such as longnose velvet dogfish and black dogfish have increasingly been retained and landed.

Greenland shark is caught as bycatch mainly in Norwegian, Faroese and Icelandic longline fisheries for ling, tusk and Greenland halibut. In recent years, most reported landings are from Iceland (Figure 5.1). Norway conducted a directed fishery for this species between 1800 and 1960 (Moltu, 1932; Rabben 1982). Until 1900, the fishery was conducted in fjords and coastal areas. After 1900 the fishery expanded to offshore grounds and in 1927 to distant waters in the Denmark Strait and East Greenland. Only the liver was landed by Norwegian vessels. The landings of liver after 1910 are shown in Figure 5.2. No conversion factor for liver weight to whole weight is established for this species.

5.2.2 The fishery in 2007

Targeted gillnet and longline fisheries for deep-water sharks formerly operated in Subareas VI and VII. The principal target species were Portuguese dogfish and leafscale gulper sharks with a bycatch of gulper shark, birdbeak dogfish and longnose velvet dogfish. Since 2007, setting of gillnets at depths greater than 600 m has been banned-this may have led to an increase in longlining for these species and has led to displacement of gillnetting effort to Subareas IV, VIII and IX (see STECF, 2006)

5.2.3 ICES advice applicable

ICES advice on deep-water sharks mainly relates to the species mentioned in Section 3 and kitefin shark (Section 4). No specific advice is given for the shark and skate species considered here.

5.2.4 Management applicable

In EC waters, a combined TAC is set for a group of deep-water sharks. These include Portuguese dogfish, leafscale gulper shark, birdbeak dogfish, kitefin shark, greater lanternshark (*Etmopterus princeps*), velvet belly, black dogfish, gulper shark, blackmouth catshark, mouse catshark (*Galeus murinus*) and Iceland catshark (*Apristurus* spp.). In Subarea XII, rough longnose dogfish (*Deania histricosa*) and arrowhead dogfish (*Deania profundorum*) are added to this list.

In 2007, the TAC for deep-water sharks in Subareas V, VI, VII, VIII and IX is 2472 t. In 2008, the TAC for these species in these areas will be reduced to 1646 t. In 2007 and 2008, the TAC for deep-water sharks is set at 20 t annually in Subarea X and 99 t in Subarea XII.

No TACs apply to deep-water skates.

5.3 Catch data

5.3.1 Landings

Gulper shark *Centrophorus granulosus*

Reported landings of gulper shark are presented in Table 5.1and in Table 5.10. Five European countries have reported landings: UK (England and Wales), UK (Scotland), France, Spain and Portugal.

The trend of Portuguese landings in Subarea IX reflects the activity of the target longline fishery mentioned above. The Portuguese landings from Subarea X are considered underestimated because the species is mainly discarded (Pinho, 2005, 2006 WD). Other countries reported very small landings from Subareas VI and VII since 2002. Reported landings of this species by UK vessels in Subareas VI and VII are considered to be misidentified leafscale gulper sharks. In 2006, the total catch was 187 t for all Subareas, but in 2007, only Portugal reported landings of gulper shark (62.2 t: 4.7 t from trawl fisheries and 57.5 t from artisanal fisheries).

Birdbeak dogfish Deania calceus

Reported landings of birdbeak dogfish are presented in Table 5.2 and in Table 5.10. Four European countries have reported landings of Birdbeak dogfish: UK (England and Wales), UK (Scotland), Spain and Portugal from Subareas IX and VII. In 2006, the total catch was 96 t for all Subareas. In 2007, 7 t were caught during a Russian longline survey off Faroe in Subarea Vb (Vinnichenko, 2007 WD; Anon., 2008).

The Portuguese landings from Subareas IX and X are considered underestimated because the species is mainly discarded. The majority of Spanish landings are from Subarea XII, where values have been decreasing. No Spanish data are available for 2004.

Spanish bottom-trawl surveys performed between 2001 and 2007 on the Porcupine Bank (Velasco and Blanco, 2008 WD) demonstrated that the abundance of the birdbeak dogfish was variable but represented 0.5% of the total fish biomass on average; the maximum abundance was observed between 750–800 m depth; the total length ranged from 18–118 cm with two modes at 70–72 cm and 85–99 cm. (Figures 5.8–5.9).

Longnose velvet dogfish *Centroscymnus crepidater*

Reported landings of longnose velvet dogfish are presented in Table 5.3 and in Table 5.10. Six European countries have reported landings: UK (England and Wales), UK (Scotland), France, Spain and Portugal and Ireland, from Subareas VI, VII, VIII and IX.

Landings in 2005 were the highest recorded, largely as a consequence of the inclusion of catches from UK gillnetters. France reported landings from almost every Subarea/division considered, however, the figures were very low. Spain presented annual values over 50 t per year in Subarea XII in 2000 and 2001, but after that no data were made available. The Portuguese landings from Subareas IX and X are considered underestimated because the species is mainly discarded.

In 2006, the total catch was 409 t for all Subareas; in 2007, 17 t were reported by Ireland (2 t in Subarea VI), France (2 t in Subarea Vb) and UK (13 t in Subareas VIIIc, d and IXa, b).

Black dogfish *Centroscyllium fabricii*

Reported landings of black dogfish are presented in Table 5.4 and in Table 5.10. Four European countries have reported landings: UK (England and Wales), Iceland, France and Spain, from Subareas IVa, Vb, VII and XII.

France has reported the majority of the landings of black dogfish in the ICES area, since starting to report landings in 1999. French annual landings on the species have decreased from about 400 t in 2001 to 35 t in 2006. These landings are mainly from Division Vb and Subarea VI. Iceland reported few landings, all from Division Va. The largest annual landings reported by Spain came from Subarea XII in 2000 (85 t) and 2001 (91 t). In 2007, only France reported catch of black dogfish (1.2 t), mainly from

Subarea Vb.

Landings of this species may also be included in the grouped category "Aiguillat noir" and other mixed categories including siki sharks.

Vinnichnecko (2007 WD) reported on Russian deep-sea investigations in the NE Atlantic in 2007, stating that black dogfish were most often caught between 1000–1200 m depth, the catch per haul varied from 2–10 kg, the length of the specimens ranged from 53–87 cm total length, and their weight from 610 g to 3700 g; the immature specimens were predominantly males (91.7%), whereas 51.7% of females were mature.

Velvet belly *Etmopterus spinax*

Reported landings of velvet belly are presented in Table 5.5 and in Table 5.10. Three European countries have reported landings of velvet belly: Denmark, UK (England &Wales) and Spain, from Subareas IV, VI, VII and VIII.

Greatest landings are from Denmark. Landings began in 1993, peaked in 1998 at 359 t and have since declined to less than 10 t. UK landed 8 t in 2005 but no catch was reported in 2006 and 2007.

Spanish bottom-trawl surveys performed between 2001 and 2007 on the Porcupine Bank (Velasco and Blanco, 2008 WD) demonstrated that velvet belly accounted for 0.3% of the total fish biomass with yields varying from 0.3–4.9 kg /haul; the maximum abundance was observed between 300–350 m depth; the total length range was 2 cm (newborns) to 52 cm, with a clear mode at 36–37 cm (Figures 5.10 – 5.11).

Lantern sharks *nei* Etmopterus spp.

Reported landings of lantern sharks *nei* are presented in Table 5.7 and in Table 5.10. Three European countries have reported landings: France, Spain and Portugal, from Subareas IV, Vb, VI and VII.

Portuguese landings mainly referred to *Etmopterus spinax* and *Etmopterus pusillus,* however only a very small proportion of catches of these species is retained.

French landings began in 1994, peaked at 3000 t in 1996 then declined to less than 10 t by 1999. There is doubt as to whether these landings are actually of this species and further investigations are required. Spanish landings began in 2000, peaked at over 300 t in 2002. Spanish landings data have not been available since 2003. Landings of these species may also be included in the grouped category "Aiguillat noir" and other mixed categories. In recent years, French landings of *Etmopterus princeps* have been included in siki sharks.

No catch was reported in 2006 and 2007.

Blackmouth dogfish *Galeus melastomus*

Reported landings of blackmouth dogfish are presented in Table 5.6 and in Table 5.10. Three European countries have reported landings: Ireland, Spain and Portugal, in Subareas VI, VII, VIII, IXa and X.

Portuguese landings began in 1990, rose to over 30 t in 1996 and have remained steady at that level. Spanish landings began in 1996, peaked at 35 t in 2002 and have since declined to low levels.

In 2006, Spain (Basque country) and Portugal reported altogether 32 t from Subareas VIII and IXa. In 2007, Portugal reported a total catch of 24 t of blackmouth dogfish (3 t from trawl fisheries and 21 t from artisanal fisheries) from Subarea X.

Spanish bottom-trawl surveys performed between 2001 and 2007 on the Porcupine Bank (Velasco and Blanco, 2008) demonstrated that the blackmouth dogfish represented 1.7% of the total fish biomass, with an increase from 2001 to 2005 (5.4 kg/haul in 2001 to 17.8 kg/haul in 2005), then a strong drop in 2006. Maximum abundance was observed between 400–800 m depth; the total length ranged from 8–79 cm with modes at 44–50 and 65 cm (Figures 5.6–5.7).

"Aiguillat noir"

This is a generic category only used by France to record landings on small, deep-water squaloid sharks, including black dogfish, longnose velvet dogfish and lantern sharks *nei*. Reported landings started in 2000 (249 t) then declined from 266 t in 2001 to 1 t in 2007.

Greenland shark *Somniosus microcephalus*

The Greenland shark was regularly caught by Icelandic fisheries in Subareas Va and XIV. The catch reached 86 t in 1998, then declined to 60 t in 2004. Iceland reported 54 t in 2005, 29 t in 2006 and 2 t in 2007 in Subarea Va. Since, no catch has been reported.

In 2007, Portugal reported a catch of 0.7 t from Subarea V. (Table 5.10).

Knifetooth shark *Scymnodon ringens*

The knifetooth shark is rarely reported as separate species as it is generally included in aggregated categories, however UK (Scotland) reported 61 t in 2005 and Portugal 63.5 t in 2007 in Subarea X. (Table 5.10).

Spanish bottom-trawl surveys performed between 2001 and 2007 on the Porcupine Bank (Velasco and Blanco, 2008 WD) demonstrated that the knifetooth shark represented 0.2% of the total fish biomass, with yields varying from 3.2 kg/haul in 2004 to 0.5 kg/haul in 2005. Maximum abundance was observed between 600–700 m depth, the total length frequency distribution demonstrated three modes at 40–41 cm, 72–74 cm and 104–107 cm (Figures 5.12–5.12).

Angular rough shark *Oxynotus centrina*

The angular rough shark is caught irregularly by the Portuguese fisheries in Subarea IXa. The catch was 53 t in 2006, no catch was reported in 2007 (Table 5.10).

Bluntnose sixgill shark *Hexanchus griseus*

Bluntnose sixgill shark is sporadically caught by UK, French and Portuguese fisheries in Subareas VII, VIIIa and X respectively. The catches vary from 1 to 2 t / year.

Deep-water catshark of the genus *Apristurus*

Several species of deep-water catshark of the genus *Apristurus* (*A. laurussoni, A. melanoasper, A. aphyoides, A. manis* and *A. microps*) are caught, sometimes in large amounts, since the development of deep-sea trawl fisheries on the NE Atlantic continental slopes in the 1990s. No country has so far reported catches of these deep-water catsharks as they are generally discarded because they have no commercial value (rather small size and soft bodied sharks).

Deep-water skates *Rajidae*

Little information is available on landings of deep-water skates. It is likely that some deep-water species are included in landings data under the generic category of "Raja rays *nei*". Some species-specific landings data are available for *Dipturus lintea* in Subareas V and XIV (Table 16.1) but this is likely to be incomplete. *Dipturus nidarosiensis* accounted for 1% of skates recorded in biological sampling in Irish ports between 2001 and 2007. Many of the species considered here have low commercial value and are generally discarded. Other species live beyond the depth range of commercial fisheries and are therefore rarely caught.

Scientific surveys have recently reported the occurrence of less common deep-water skates (e.g. *Neoraja caerulea*, *Amblyraja hyperborean*, *Amblyraja jenseni*, *Rajella bigelowi*, *Rajella bathyphylla*, *Bathyraja pallida*, *Bathyraja richardsoni*, *Bathyraja spinicauda*), but sometimes demonstrating local concentrations. When caught by commercial fisheries, these skates are generally discarded.

Deep-water *chimaeras*

Chimaeras (mainly *Chimaera monstrosa*) and longnose chimaeras (*Rhinochimaeridae*) have been caught regularly since the development of deep-water trawling fisheries on the NE Atlantic continental slopes in the 1990s. They are often discarded, but since 1999, France reports catches peaking at 812 t in 2001, then declining to 365 t in 2007. UK reported 4 t in 2006 and 6 t in 2007 of rabbit fish in Subarea VI.

5.3.2 Discards

Little information is available on discards of other deep-water sharks and skates but discarding rates were thought to be high for many species, although evidence suggests that some fisheries are now retaining the smaller species shark species. Some information on discarding of these species in French and Scottish fisheries in Subarea VI can be found in Allain *et al.*, 2002, Blasdale and Newton, 1998 and Crozier, 2003 WD.

5.3.3 Quality of the catch data

Unknown quantities of deep-water species are landed in grouped categories such as "sharks *nei*", "Dogfish *nei*" and "Raja rays *nei*", so catches presented here are probably underestimated. Landings reported by UK vessels for 2003/2004 were considered to be unreliably identified and were therefore amalgamated into a mixed deep-water sharks (siki) category together with Portuguese dogfish and leafscale gulper shark. In 2005/2006 UK landings, most species were considered to be reliably identified however, reported landings of gulper shark are still considered to be unreliable and have been added to landings of leafscale gulper shark.

5.4 Commercial catch composition

No new information is available.

5.5 Commercial catch-effort data

No new information is available.

5.6 Fishery-independent surveys

5.6.1 Greenland demersal surveys in XIVb

Groundfish research surveys were done by Iceland in Division Va and by Greenland and Germany in XIVb (Jørgensen, 2006 WD), covering the area between 61º45' N and 67º N at depths from 400 to 1500 m. The surveys are conducted with an ALFREDO III trawl. Nine elasmobranch species were caught and these are discussed in Section 16 of this report. Total catches of elasmobranch species are demonstrated in Table 16.2.

5.6.2 Scottish deep-water surveys in Division VIa

FRS has conducted deep-water surveys (depth range 300–1900 m) to the West of Scotland since 1996. Since 1998, these have been reasonably consistent about survey design, gear and area covered. *Chondricthyan* species diversity in the survey peaks between 1000–1500 m with 11 species of skates and six chimaera species.

The most abundant species (in terms of catch rates, $kg.h^{-1}$) are *C. crepidator* and *D. calceus*. A more detailed preliminary analysis of the catch rates of eight of the deep-water shark species is presented in Jones *et al.*, 2005. Spatial distribution of catches of eight deep-water shark species is presented in Figure 5.3.

Jones *et al.*, 2005 conducted a preliminary analysis of cpue of 8 deep-water sharks caught in Scottish surveys between 1998 and 2004 (Figure 5.4). Cpue in the surveys was also compared with cpues from exploratory fishing by MAFF in the 1970s (Figure 5.5). These comparisons must be treated with caution as Scottish surveys over period have not been entirely standardized with respect to the depth range fished and the historical surveys used very different gear.

5.6.3 Future coordination of deep-water surveys

Future, internationally coordinated surveys along the continental slope will provide information on these elasmobranchs.

5.7 Life-history information

Coelho and Erzini, 2007 published the results of a study on the population of *Etmopterus pusillus* from southern Portugal. They provided different growth models with the following biological parameters: first maturity 38 cm TL and 7 years for male, and 38 cm TL and 9 years for female; maximum age 13 years for male and 17 years for female; ovarian fecundity varying from 2–18 oocytes.

5.8 Exploratory assessment models

No assessments studies were conducted so far for the lesser-known deep-water sharks.

5.9 Quality of assessments

No assessments undertaken.

5.10 Reference points

No reference points have been proposed for any of these species.

5.11 Management considerations

In the continental slopes of Europe these species should be managed in a multispecies context with particular attention to the management of leafscale gulper shark and Portuguese dogfish (Section 3) and kitefin shark (Section 4)

5.12 References

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Table 5.1 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of gulper shark.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
UK (England and Wales)	+	+	+	+	+	+	+	2	n.a.	+	+	.
UK (Scotland)	+	+	+	+	+	+	+	23	17	+	0	.
Ireland	+	+	+	+	+	+	+	2	n.a.	n.a.		.
Portugal	242	291	187	95	54	96	159	203	89	62	104	62.2
Spain	+	+	+	+	+	+	8	+	n.a.	n.a.	0	.
Total	242	291	187	95	54	96	167	230	106	62	104	62.2

Table 5.2 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of birdbeak dogfish.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Russia												7
Spain	.	.	.	.	.	.	5	n.a.	n.a.	n.a	0	.
UK (England and Wales)	.	.	.	.	.	.	.	+	+	47	20	.
UK(Scotland)	.	.	.	.	.	1	+	3	38	2	0	.
Portugal	.	.	.	.	13	37	67	72	157	145	74	.
Total	.	.	.	.	13	38	72	75	195	194	94	7

Table 5.3 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of longnose velvet dogfish.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Ireland												2
France	.	.	.	+	+	+	13	10	8	6	0	2
UK (Scotland)	.	.	.	+	+	+	+	21	7	97	128	.
UK (England and Wales)	.	.	.	.	.	.	.	+	+	113	281	13
Portugal	.	.	.	.	1	3	4	2	1	.	.	.
Spain	.	.	.	.	85	68	n.a.	n.a.	n.a.	n.a.	0	.
Total	.	.	.	+	86	71	17	33	16	216	409	17

Table 5.4 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of black dogfish.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
France	.	.	.	+	382	395	47	90	49	.	35.1	1.2
Iceland	4	.	.	.	.	.	+	+	n.a.	.	.	.
UK (England and Wales)	.	.	.	.	.	.	.	+	+	5	.	.
Spain	.	.	.	.	85	91	n.a.	n.a.	n.a.	.	.	.
Total					467	486	47	90	49	5	35	1.2

Table 5.5 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of velvet belly.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Denmark	8	32	359	128	25	52	.	.	.		.	.
UK (England and Wales)	.	.	.	.	.	.	.	.	.	8	.	.
Spain	.	.	.	.	.	.	85	n.a.	n.a.		.	.
Total	8	32	359	128	25	52	85	n.a.	n.a.	8	0	0

Table 5.6 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of blackmouth dogfish.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Ireland	.	.	.	.	.	.	.	+	1	.	.	.
Spain (Basque c.)	.	.	+	.	+	.	.	.	+	.	4	.
Spain	4	3	6	2	4	1	35	1	.	4		.
Portugal	35	29	22	23	39	36	52	29	57	38	29	24
Total	39	32	28	25	43	37	87	30	58	41	32	24

Table 5.7 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of lantern sharks NEI.

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
France	846	2388	2888	2150	2043	+	+	+	+	+	+	.	.	.
Spain	.	.	.	.	.	.	38	338	99	n.a.	n.a.	.	.	.
Portugal	+	+	+	+	.	.	+	.	.	.	+	+	0.02	.
Total	846	2388	2888	2150	2043	+	38	338	99	+	+	+	0	0

Table 5.8 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of "*aiguillat noir*".

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
France	.	.	.	.	249	266	29	54	56	12	4	1
Total	.	.	.	.	249	266	29	54	56	12	4	1

Table 5.9 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings of Greenland sharks.

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Iceland	38	42	44	61	71	86	50	45	57	57	61	66	n.a.	29	2.7
Total	38	42	44	61	71	86	50	45	57	57	61	66	n.a.	29	2.7

Table 5.10 Other deep-water sharks and skates from the Northeast Atlantic. Working group estimates of landings by species.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Gulper Shark	1056	801	958	886	344	423	242	291	187	95	54	96	167	230	106,4	62,2	187	62
Birdbeak Dogfish											13	38	72	75	195	194,4	96	7
Black Dogfish											467	486	47	90	49	5	36	1
Longnose Velvet Dogfish											86	71	17,246	32,849	15,862	216,081	409	17
Velvet Belly				27	+	10	8	32	359	128	25	52	85	n.a.	n.a.	8	0	0
Blackmouth Dogfish	17	17	16	20	37	29	39	32	28	25	43	37	87	30	58,3	41,4	32	24
Lantern Shark NEI					846	2388	2888	2150	2043	+	38	338	99	+	+	+	0	0
Aiguillat noir											123	165	11	37	21	5	0	1
Greenland Shark	54	58	68	38	42	44	61	71	86	50	45	57	57	61	66	0	29	3
Angular Roughshark															74,7	98,5	52	0
	1127	876	1042	971	1269	2894	3238	2576	2703	298	894	1340	642,246	555,849	586,262	630,581	841,581	115

Table 5.11 Other deep-water sharks and skates from the Northeast Atlantic. Ecological and biological parameters of various deep-water sharks.

Vernacular names: English French Spanish	Scientific name	Depth range in m	Size TL in cm	Maturity size male	Maturity size female	Mode reproduction	Fecundity	Size at birth in cm	Length / Weight	Longevity	IUCN
Gulper shark Squale-chagrin commun Quelvacho	*Centrophorus granulosus*	50 1440	150	# 60-80	> 96	ovoviviparous		30-42			VU
Black dogfish Aiguillat noir Tollo negro merga	*Centroscyllium fabricii*	180 1600	107			ovoviviparous	14		a = 0.0009 b = 3.420		-
Longnose velvet dogfish Pailona à long nez Sapata negra	*Centroselachus crepidater*	230 1500	130	64-68	82	ovoviviparous	4-8	28-35	a = 0;0024 b =3.250	54	LC
Birdbeak dogfish Squale-savate Tollo pajarito	*Deania calcea*	60 1490	122	85	105	ovoviviparous	6-12	29-34	a = 0.0012 b = 3.260	female: 35 male: 32	LC
Velvet belly Requin-lanterne Negrito	*Etmopterus spinax*	70 2490	60	33-36		ovoviviparous	6-20		a = 0.0018 b = 3.240		-

Vernacular names: English French Spanish	Scientific name	Depth range in m	Size TL in cm	Maturity size male	Maturity size female	Mode reproduction	Fecundity	Size at birth in cm	Length / Weight	Longevity	IUCN
Blackmouth catshark Chien espagnol Pintarroja bocanegra	*Galeus melastomus*	55 1873	90			oviparous	13		a = 0.0025 b = 3.020		-
Bluntnose sixgill shark Requin griset Canabota gris	*Hexanchus griseus*	0 2500	482	315-400	400-482	ovoviviparous	22-108	60-75	a = 0.0135 b = 3.000		LR/nt
Angular roughshark Centrine commune Cerdo marino	*Oxynotus centrina*	60 777	150	50	50	ovoviviparous	7-8				-
Greenland shark Laimargue du Groenland Tollo de Groenlandia	*Somniosus microcephalus*	0 2200	730	244-427	244-427	ovoviviparous			a = 0.0114 b = 3.000		NT

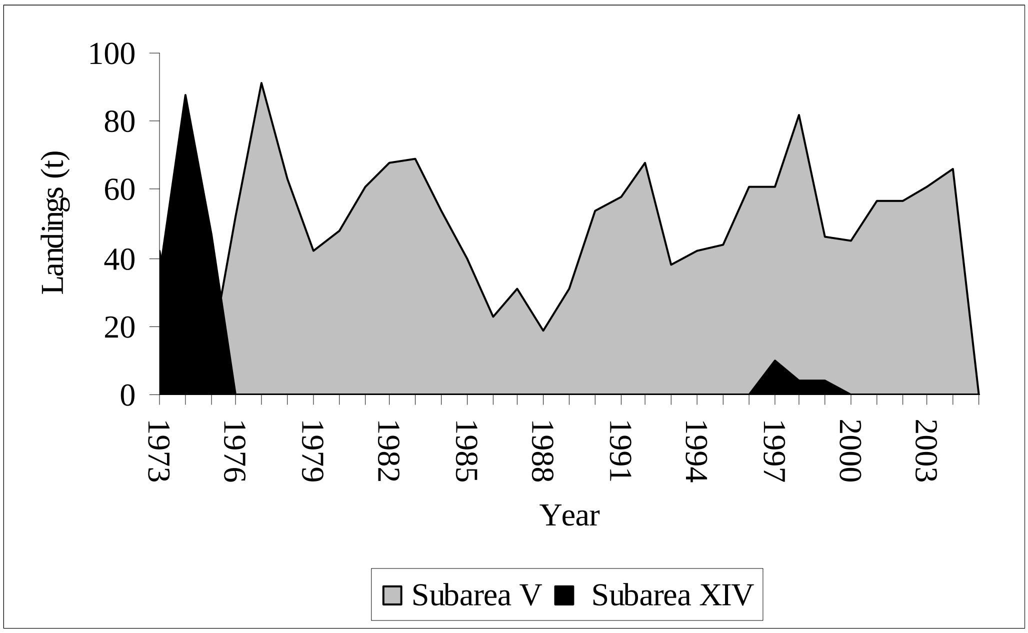

Figure 5.1 Other deep-water sharks and skates from the Northeast Atlantic. Landings of Greenland shark from Subareas V and XIV.

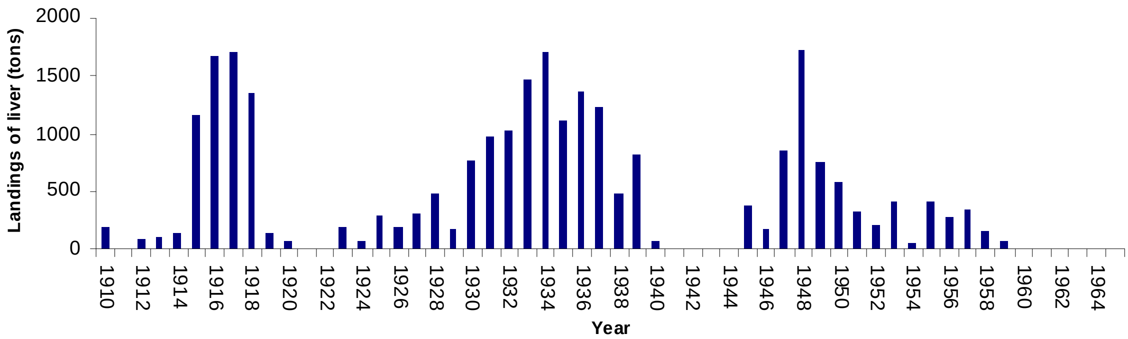

Figure 5.2 Other deep-water sharks and skates from the Northeast Atlantic. Time-series of landings of Greenland shark livers from Norway (Hareide, 2006 WD).

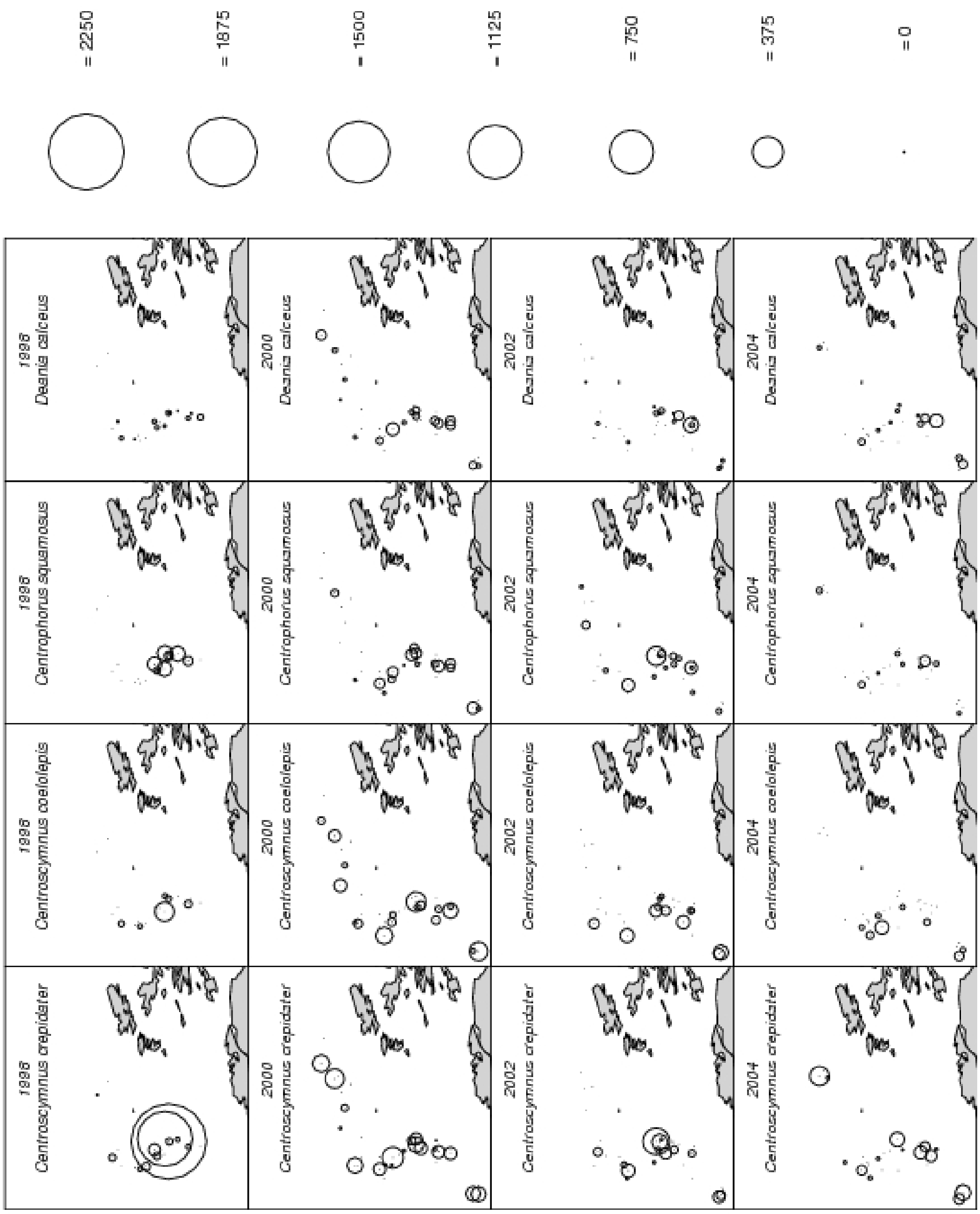

Figure 5.3 Other deep-water sharks and skates from the Northeast Atlantic. Spatial distribution and relative abundance (kg per hour) of four deep-water Squaliform species recorded during the FRS deep-water surveys, 1998–2004.

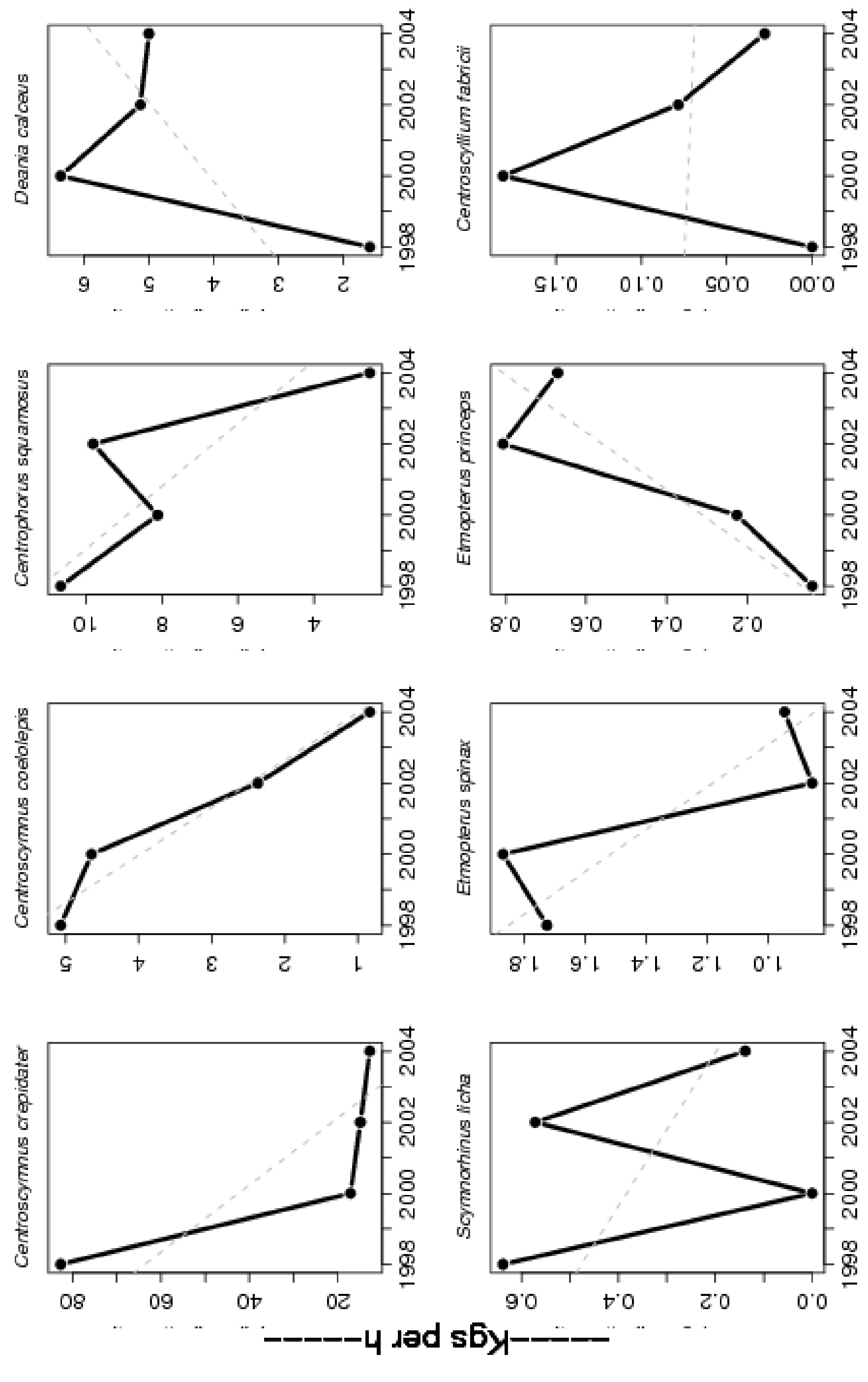

Figure 5.4 Other deep-water sharks and skates from the Northeast Atlantic. Change in cpue (kg per hour) in Scottish surveys in Division VIa between 1998 and 2004 for eight deep-water species.

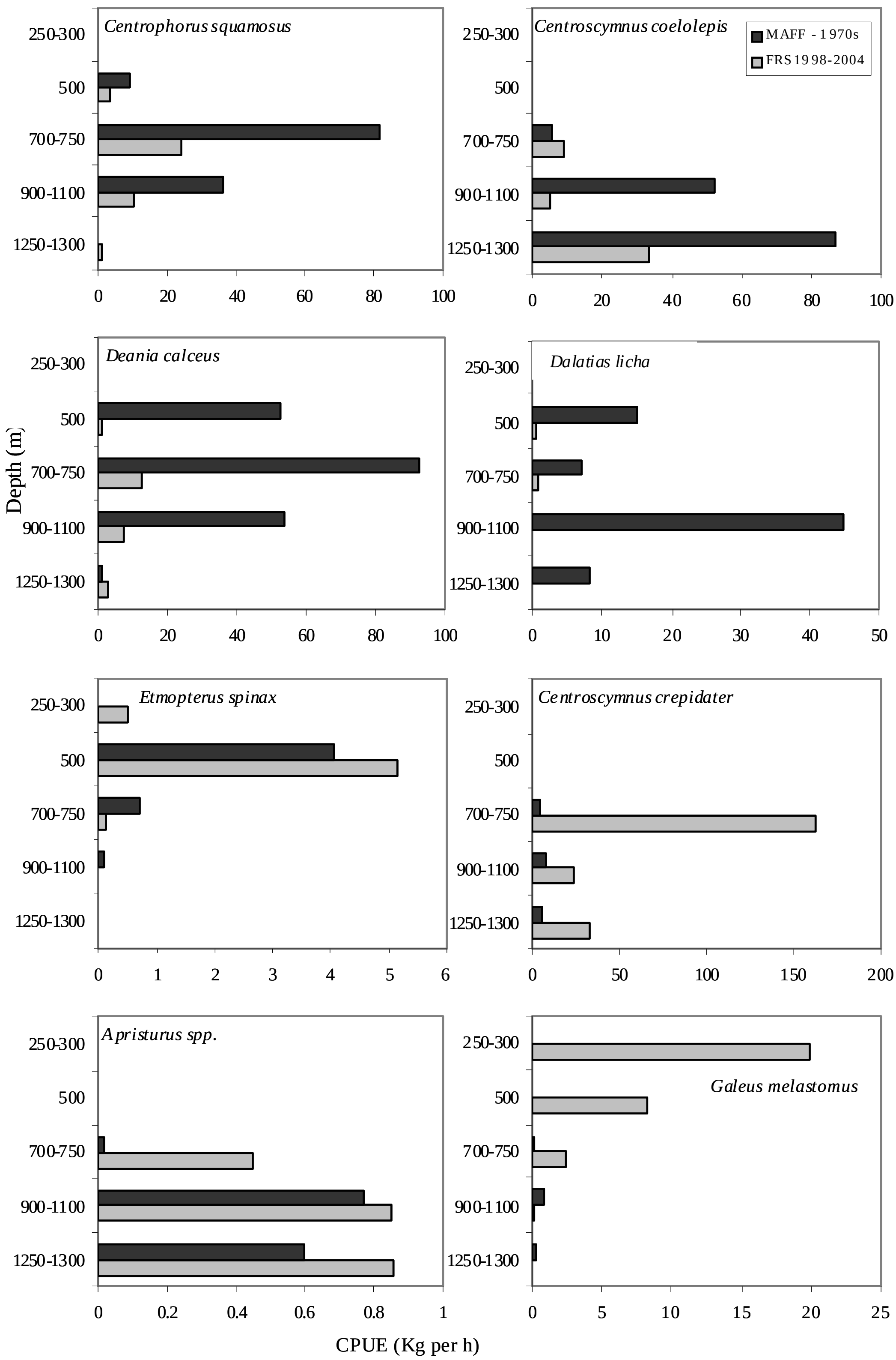

Figure 5.5 Other deep-water sharks and skates from the Northeast Atlantic. Comparison of catch rates (kgs per hour) for eight species of deep-water shark caught during MAFF and FRS deep-water surveys. Note: in this plot all the data from the FRS and MAFF surveys are pooled.

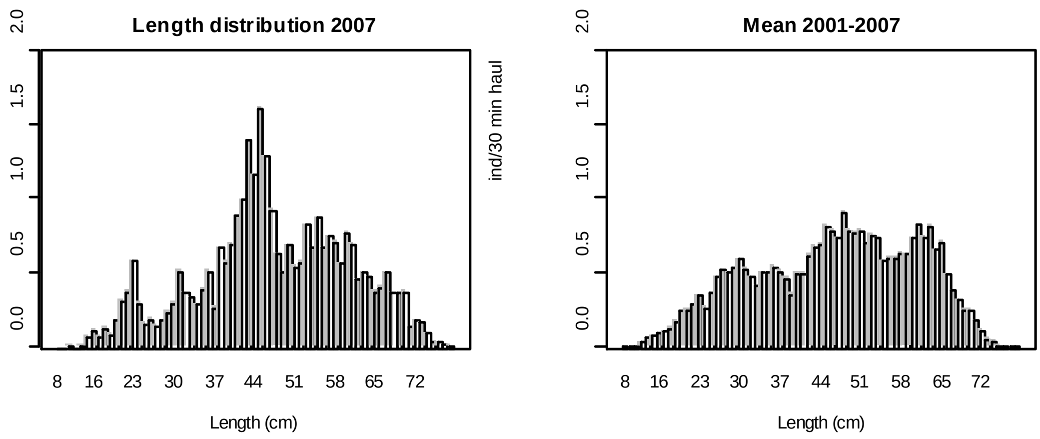

Figure 5.6 Other deep-water sharks and skates from the Northeast Atlantic. Stratified length distributions of blackmouth catshark (*G. melastomus*) in 2007 in Porcupine survey, and mean values during Porcupine Survey time-series (2001–2007; from Velasco and Blanco, 2008).

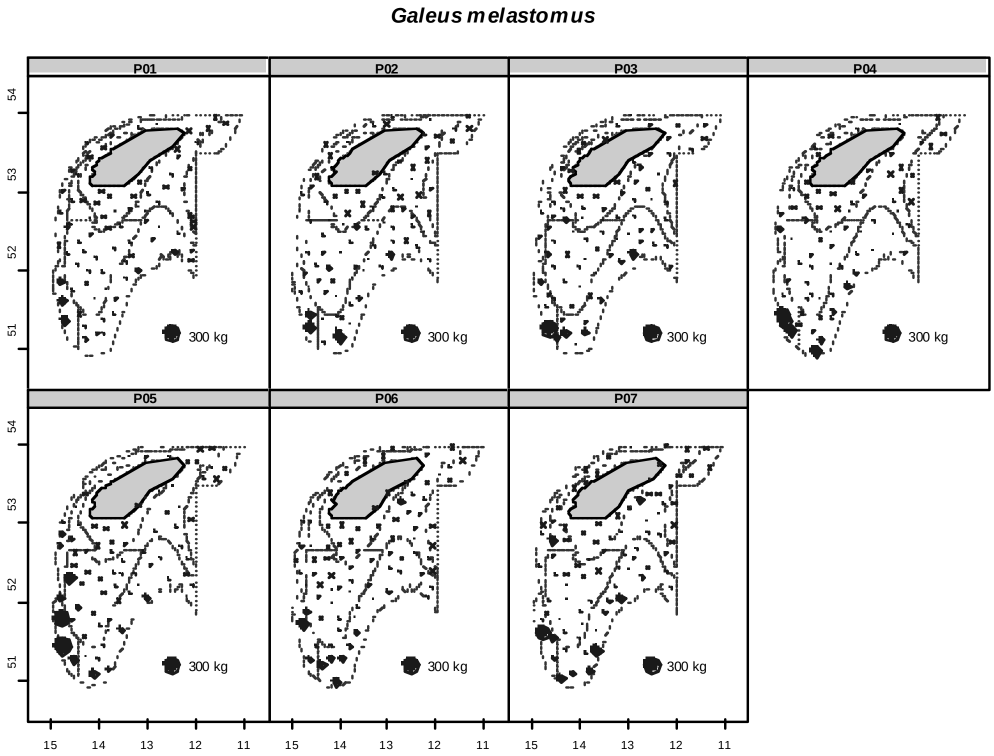

Figure 5.7 Other deep-water sharks and skates from the Northeast Atlantic Geographic distribution of blackmouth catshark (*G. melastomus*) catches (kg/30 min haul) during Porcupine surveys time-series (2001–2007; from Velasco and Blanco, 2008).

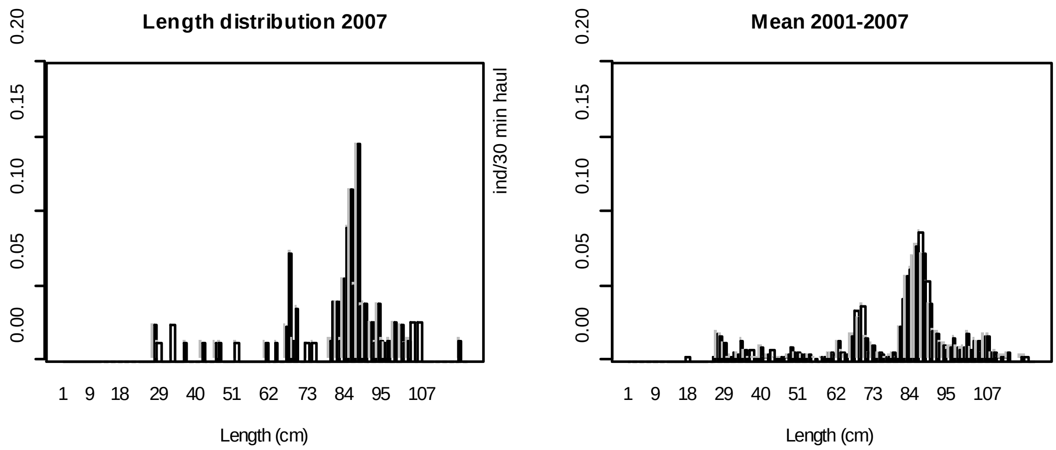

Figure 5.8 Other deep-water sharks and skates from the Northeast Atlantic Stratified length distributions of birdbeak dogfish (*D. calcea*) in 2007 in Porcupine survey, and mean values during Porcupine Survey time-series (2001–2007; from Velasco and Blanco, 2008).

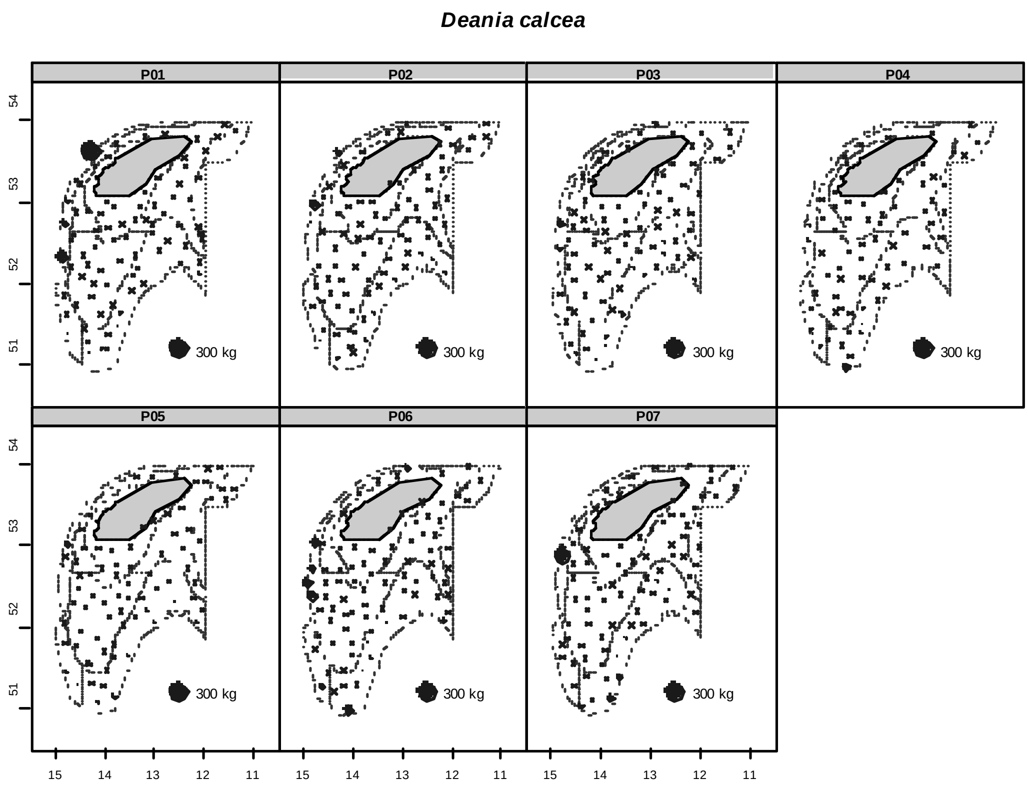

Figure 5.9 Other deep-water sharks and skates from the Northeast Atlantic Geographic distribution of birdbeak dogfish (*D. calcea*) catches (kg/30 min haul) during Porcupine surveys time-series (2001–2007; from Velasco and Blanco, 2008).

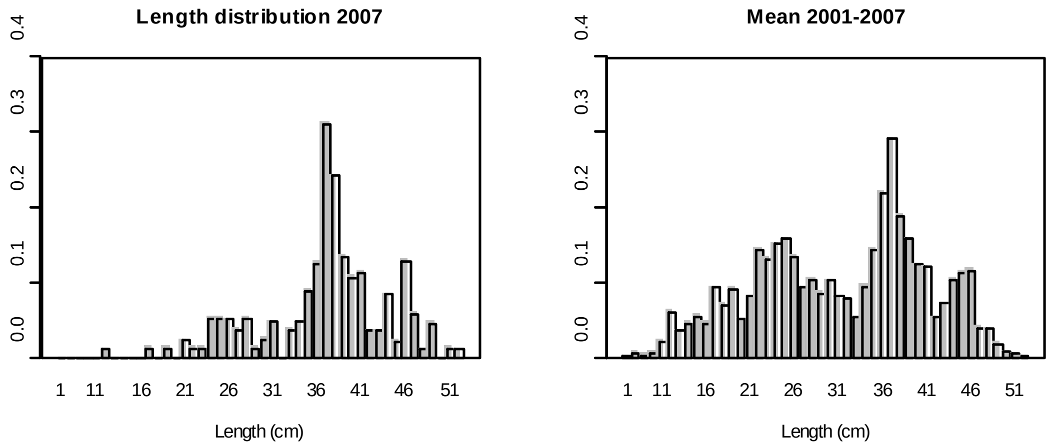

Figure 5.10 Other deep-water sharks and skates from the Northeast Atlantic Stratified length distributions of velvet belly (*E. spinax*) in 2007 in Porcupine survey, and mean values during Porcupine Survey time-series (2001–2007; from Velasco and Blanco, 2008).

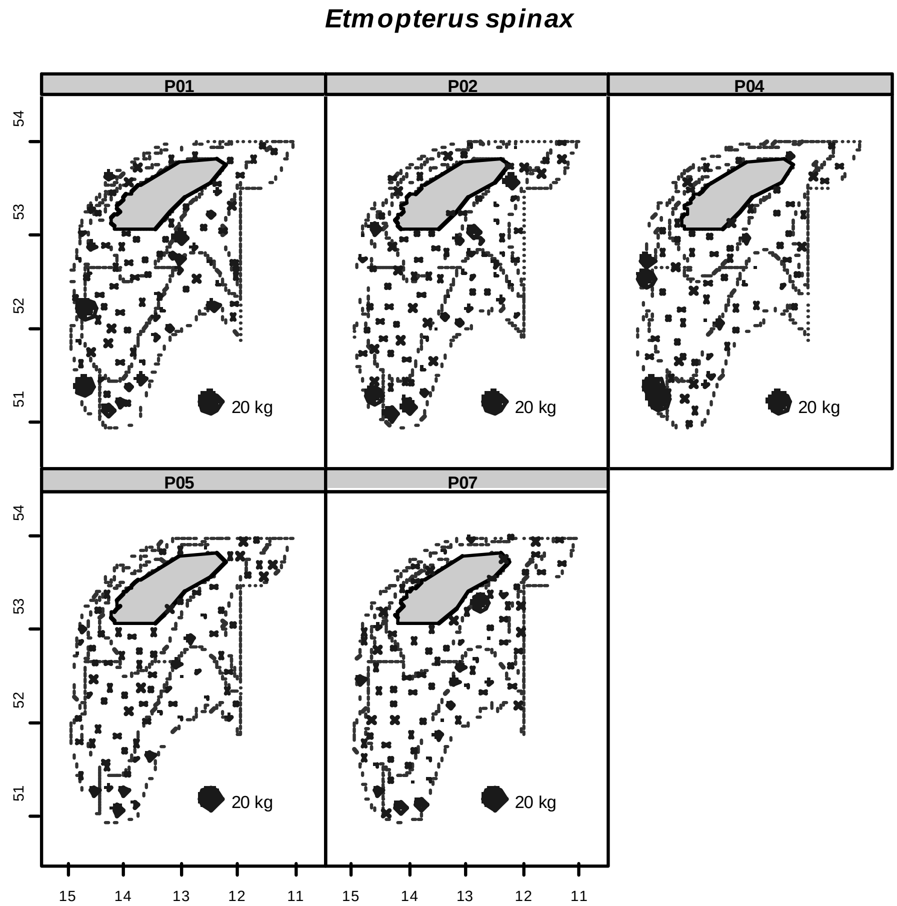

Figure 5.11 Other deep-water sharks and skates from the Northeast Atlantic Geographic distribution of velvet belly (*E. spinax*) catches (kg/30 min haul) in years with high biomass abundance in Porcupine surveys time-series (2003 and 2006; from Velasco and Blanco, 2008).

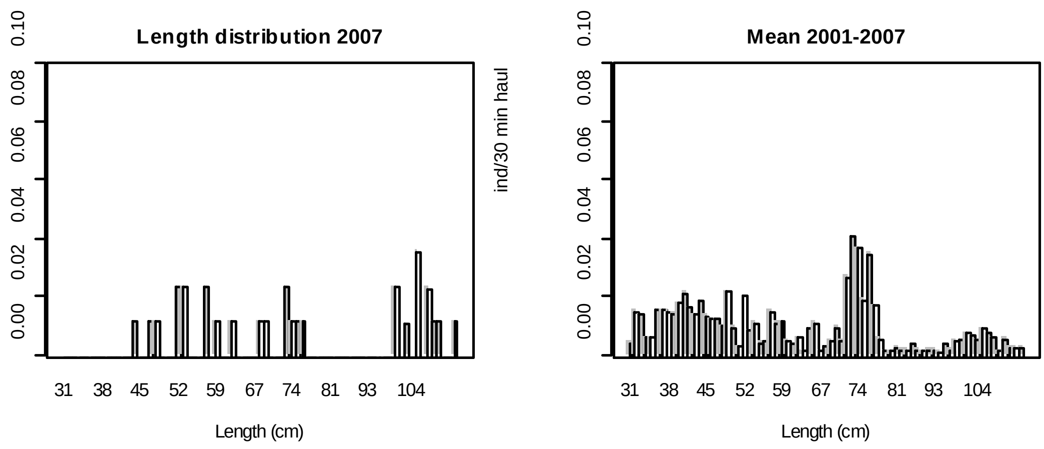

Figure 5.12 Other deep-water sharks and skates from the Northeast Atlantic Stratified length distributions of knifetooth dogfish (*S. ringens*) in 2007 in Porcupine survey, and Mean values during Porcupine Survey time-series (2001–2007; from Velasco and Blanco, 2008).

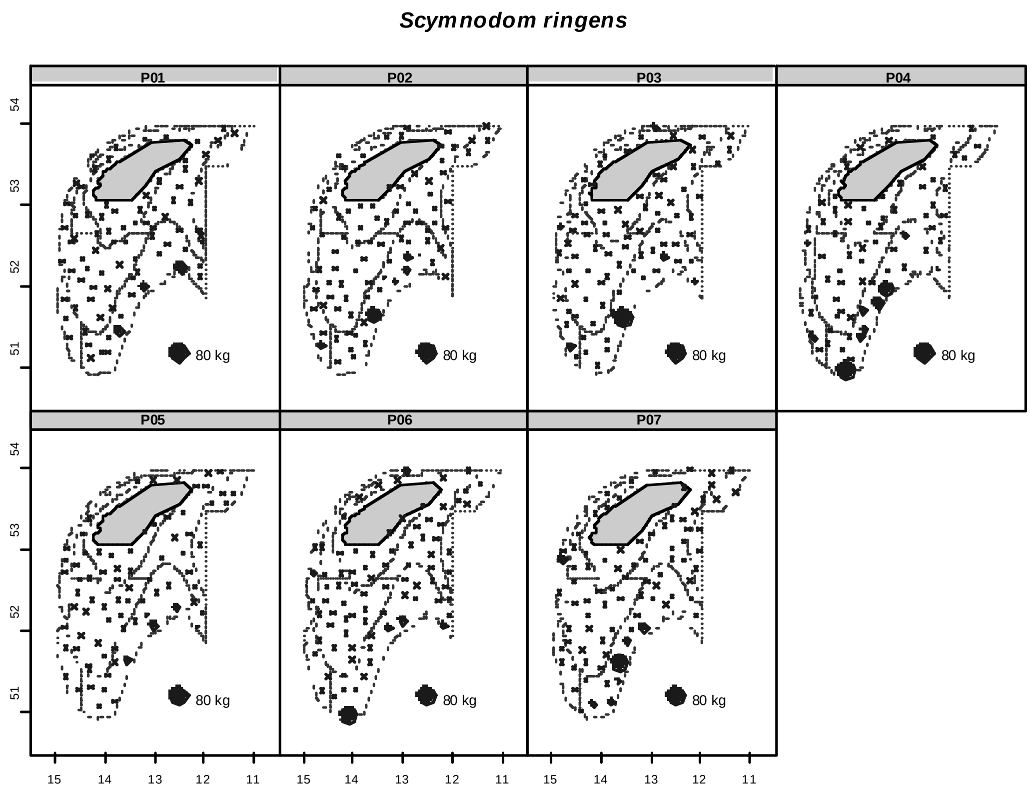

Figure 5.13 Other deep-water sharks and skates from the Northeast Atlantic Geographic distribution of knifetooth dogfish (*S. ringens*) catches (kg/30 min haul) during Porcupine surveys time-series (2001–2007; from Velasco and Blanco, 2008).

6 Porbeagle in the North East Atlantic (Subareas I–XIV)

6.1 Stock distribution

The DELASS project considered that a single-stock of porbeagle *Lamna nasus* occurred in the North East Atlantic, hence in the entire ICES area (Heessen, 2003). This stock extends from Norway, Iceland and the Barents Sea in the north to Northwest Africa.

Buencuerpo *et al.*, 1998 reported that porbeagle made up 4% of the total catches in longline and gillnet fisheries off the northwest African coast, Iberian Peninsula and Straits of Gibraltar and more information on the distribution and frequency of porbeagle in the CECAF area is needed.

The stock is considered separate from that in the NW Atlantic (Campana *et al.*, 1999, 2001, 2003). Tagging studies from Norway, the USA and Canada, resulted in 542, 1034 and 256 porbeagles being tagged respectively. A total of 197 recaptures were made (53 from Norwegian, 119 for USA and 25 from Canadian studies), and initial studies did not report transatlantic migrations (Campana *et al.*, 2003), although occasional transatlantic migrations have subsequently been reported (e.g. Green, 2007 WD; Figure 6.1). Further tagging studies are required to better examine stock structure.

Genetic evidence also suggests gene flow across the Atlantic, within the northern hemisphere, as dominant haplotypes from the NE were also present in samples from NW Atlantic population (Pade *et al.*, 2006). The same study also found marked differences in haplotype frequencies between northern and southern hemisphere populations, indicating little or no gene flow between them.

Although porbeagle also occurs in the Mediterranean, there is no evidence of mixing with the NE Atlantic stock.

6.2 The fishery

6.2.1 History of the fishery

Porbeagle is a highly migratory and schooling species. Sporadic targeted fisheries develop on these schools, and such fisheries were highly profitable (Gauld, 1989). The main countries catching porbeagle are Spain and France. However in the past, important fisheries were prosecuted by Norway, Denmark and Faroe Islands. In addition, the species is taken as a bycatch in mixed fisheries, mainly in UK, Ireland, France and Spain. Detailed descriptions of individual national fisheries were presented by WGEF in 2006 (ICES, 2006).

Porbeagle has been exploited commercially since the early 1800s, principally by Scandinavian fishers; however, the real “boom” period for this fishery in the NE Atlantic began in the 1930s. The target fishery for porbeagles before WWII was mainly a Norwegian longline fishery in the North Sea, starting in 1926 and landing around 500 t annually in the first years, peaking in 1936 with around 4000 t and declined after that. After WWII, the target fishery resumed with Norwegian, Faroese and Danish vessels involved. Norway took about 6000 t in 1947. By the 1950s this fishery had extended to the Orkney-Shetland area and the Faroes then to the waters off Ireland and offshore banks. After this, the catches began to decline to below 2000 t annually, and in 1961 a fleet of Norwegian longliners extended their fishing for porbeagle to Northwest Atlantic waters. The Norwegian fishery yielded about 8000 t in the NW Atlantic in 1964, but like the NE Atlantic, this fishery was short-lived and soon, the intensive fishery of this virgin stock lead to population crashes and ever declining catches until the fishery collapsed by 1968. Faroese effort continued in the NW Atlantic but then moved to West Africa as landings declined.

In the 1950s, average landings for the Danish porbeagle fishery were 500–600 t per year; however, this declined to under 50 t by 1984. During the 1970s several countries including The Faroes, France, England, Iceland, Germany and Sweden started to report landings of porbeagle, mainly from the Bay of Biscay and Celtic Sea. French fisheries, including a targeted fishery, landed large quantities into La Rochelle (over 1092 t in 1979), with landings declining to 300–400 t per year in the late 1990s.

Porbeagle fisheries have generally been seasonal, and many operations landed porbeagle opportunistically and sporadically rather than through directed fisheries. For instance, local fisheries in the Bristol Channel occasionally deploy longlines for porbeagle (Ellis and Shackley, 1995). The landings from Spain are thought to be taken mainly in fisheries using longlines, targeting swordfish and tuna and tend to be greater during spring and autumn, with a drop in summer, despite being erratic in nature (Mejuto, 1985; Lallemand-Lemoine, 1991). The Norwegian fishery was also mainly run between July–October in the eastern North Sea.

Porbeagle are currently landed by several European countries, principally France, Norway and Spain (although Spanish landings data are from the pelagic fleet, and further details of other captures are required).

Other countries such as the UK, Faroes and Germany land smaller quantities. Preliminary data suggest that the number of French vessels landing more than 5 t has been stable since 1990, between eight and eleven vessels (Biseau, 2006 WD).

6.2.1.1 Description of the French targeted fishery

The only regular, directed target fishery that still exists is the French fishery (although there have been occasional targeted fisheries in the UK). Fishing trips generally last 10–18 days, with an average of 14 days. The crew is composed of five to six men plus the captain, who is also the ship-owner for four of the five vessels targeting porbeagle in 2008. Porbeagle is targeted with drifting longlines set from near to the surface (e.g. in the outer Bristol Channel) or down to 220–230 m depth in deeper waters in the Bay of Biscay fishing grounds. Each longline is 1500 m long with 84 hooks ballasted with 1 kg of lead every 14th hook. Each vessel has ten such lines. The fishing activity occurs during the day, a first set in the early morning with 3–4 longlines soaking for 3.5–4 h, and a second set in the afternoon functioning for 4.5–5 h with all ten longlines deployed in the second set. The location of the second set depends on the catch rates in the first set. Frozen mackerel (*Scomber scombrus*) is used as bait, one third of a fish per hook. Most of the landings take place from March to August. The number of vessels decreased from eleven in 1994 to five in 2008. Average prices, as observed in the Sables d'Olonne and Guilvinec market auctions in 2008, have varied around 3.5 Euros per kg of dressed porbeagle. Between 2002–2007, the income realized by the porbeagle targeted fishery varies between 26–42% of the annual turnover of the boats (Jung, 2008).

6.2.2 The fishery in 2007

No new information.

Launched by the National Fisheries Committee (CNPMEM), APECS (Association Pour l'étude et la Conservation des Sélaciens), the French representative of the European Elasmobranch Association (EEA) implemented an observer programme in March 2008 aiming at gathering information on the main biological parameters of porbeagle. This programme named EPPARTIY «Etude de la Pêcherie Palangrière au Requin Taupe de l'Ile d'Yeu» received the collaboration of the fishing industry of l'Ile d'Yeu, the main French porbeagle fishery for the observers. Hence improved data should become available in future years.

6.2.3 ICES advice applicable

In 2006, ICES stated that "No targeted fishing for porbeagle should be permitted on the basis of their life history and vulnerability to fishing. In addition, measures should be taken to prevent bycatch of porbeagle in fisheries targeting other species, particularly in the depleted northern areas".

This advice was further considered by STECF in 2006 (see Section 3 of STECF, 2006), and STECF reiterated that no directed fishing for porbeagle in the NE Atlantic be permitted and that additional measures be taken to prevent bycatch of porbeagle in fisheries targeting other species.

6.2.4 Management applicable

EC Regulation 40/2008 established a TAC for porbeagle taken in EC and international waters of I, II, III, IV, V, VI, VII, VIII, IX, X, XII and XIV of 581 t (CEC, 2008).

EC Regulation 1185/2003 prohibits the removal of shark fins of this species, and subsequent discarding of the body. This regulation is binding on EC vessels in all waters and non-EC vessels in Community waters.

In 2007 Norway banned all direct fisheries for porbeagle, based on the ICES advice. Specimens taken as bycatch can be landed and sold as before.

It is forbidden to catch and land porbeagle in Sweden.

In 2006, Germany proposed that porbeagle be added to Appendix II of CITES. This proposal did not get the support of the required majority at the CITES Conference of Parties in 2007.

6.3 Catch data

6.3.1 Landings

Table 6.1 and Figures 6.2–6.3 show the historical landings of porbeagle in the Northeast Atlantic. The major landings have been made by Denmark, Faroe Islands, Norway and France. These data need to be treated as underestimates and with some caution. Many sharks have been landed as 'sharks *nei*' and thus not recorded at the species level, and species confusion can also occur (e.g. with shortfin mako).

Spanish data refer to catches from pelagic fisheries for tuna and tuna-like species, and data from other fisheries are currently lacking. Landings data from Spain (Basque Country) indicate that lamnids are taken in such fisheries (Table 6.2), and better estimates of porbeagle catches by Spanish demersal fisheries are required.

Landings data from non-ICES countries fishing in the NE Atlantic appear incomplete. Japanese landings for the NE Atlantic were reported to ICCAT in 1996 and 1997. Other non-ICES countries expected to take porbeagle as a bycatch in tuna fisheries in the NE Atlantic are Republic of Korea and Taiwan (Province of China).

Maps in Figure 6.4 show the distribution of the French catch by statistical rectangle by year and by gear type for the period 2002–2007. Catches are primarily made on the continental slope in Division VIIId (32%) and on the continental shelf in Divisions

VIIj (23%) and VIIg (20%) (Poisson and Séret, 2008). Over the last nine years, longline gears have accounted for an estimated 72% of the total French porbeagle catch, with nets taking 13% and demersal and pelagic trawls 6% and 4%, respectively (Table 6.3).

6.3.2 Discards

No information available, although as a high value species, it is likely that specimens caught as bycatch are landed and not discarded.

6.3.3 Quality of catch data

Landings data are incomplete and further studies are required to better collate catch data. For some nations, porbeagle will have been reported within "sharks *nei*", and there can be some confusion with shortfin mako *Isurus oxyrinchus.* For example, the reported landings of shortfin mako by UK-registered vessels fishing in Subareas IV and VI and Divisions VIId–e are likely to represent misidentified porbeagle.

Some diagnostic characteristics that can be used to distinguish porbeagle and shortfin mako are given in Table 6.4 (adapted from Compagno, 2001).

French targeted fishery landings are correctly documented.

Species-specific data for Spanish demersal fisheries, in which porbeagle will be an occasional bycatch, are lacking.

Further examination of national data suggests that there can be occasional confusion between catch numbers and catch weight, with some individual landings (presumably of one fish) reported as 1 kg. The extent of this problem needs to be evaluated.

6.4 Commercial catch composition

Measurement of the length of porbeagle shark catches is an important parameter that can be used to assess the population structure, composition and growth of the stock. It is therefore important that some standardization is reached to ensure accuracy. However, this is not easily achieved with larger elasmobranchs, and inaccuracies are common between datasets. Therefore, care needs to be taken when comparing length data from different sources, and where appropriate conversion factors are required.

The most commonly documented lengths are total length (L_T) and fork length (L_F), and conversion factors between the two have been calculated (see Section 6.4.1). However, even these lengths are not taken identically between samplers. A review of this can be found in Francis, 2006 and in Section 1.

The length distribution (Fork length) by sex of porbeagle measured during the EPPARTIY programme between April and July 2008 were presented by Jung, 2008. Mean average length of porbeagle landed by month and sex are presented Figure 6.5. Mean length increased from April to June for both sexes and decreased in August, especially for males caught in the Celtic Sea, south of St George's Channel (Divisions VIIg and VIIh).

The catch composition by two weight classes (<50 kg and ≥50 kg) for the targeted French fishery is demonstrated in Table 6.5. The proportion of large porbeagle in the landings has decreased since 1993.

Preliminary studies on the catches from the French targeted fishery highlight the dominance of porbeagle (94% of catch weight), with other sharks also taken including blue shark (5.2%), common thresher (0.3%) and spurdog (<0.1%), as well as occasional teleosts (e.g. *Brama brama* and *Regalus glesne*).

6.4.1 Conversion factors

Conversion factors for length-weight relationships in porbeagle sharks from different stocks are documented in Table 6.6, based on the equation:$W = (a)L^b$. New conversion factors collected from the French targeted fishery landings are also presented (Table 6.6). These data were collected from April to August 2008, and refer to fork length measured over the body.

Kohler *et al*., 1995 also calculated a conversion equation for fork length to total length, from porbeagle from the NW Atlantic.

$L_F=(a)L_T+b$: $L_F = 0.8971L_T + 1.7939$ ($r^2 = 0.99$)

6.5 Commercial catch-effort data

Preliminary analyses of data from the French fishery were undertaken in 2006 (see Section 6 of ICES, 2006). Figure 6.6 reveals cpue for the French fishery from Biseau, 2006. These data provided some indication of effort in an otherwise data poor fishery; however, the rate of kg/vessel needs to be treated with some caution, and if possible re-parameterizing to account for true effort, in terms of taking days at sea, size of vessel, changes in fishing area, etc. into account.

More detailed data were presented in 2008 (Jung, 2008). Effort from the French targeted fishery are presented in annual number of hooks (Figure 6.7) taking into account the average day of fishing activity multiplied by the average daily number of fishing operation. Effort reached a maximum of 725 760 hooks in 1994 and decreased to 323 576 hooks deployed in 2007. Cpue (kg per hook) data from the French targeted fishery is presented for 1993 to 2007 (Figure 6.8). This nominal cpue index has been calculated from the individual vessels landings of the top 12 vessels presented in Table 6.7. Annual variation ranged from 1 kg/hook (1994) to 0.54 kg/hook (2003). These data demonstrated a decline in mean cpue from 1 to 0.73 kg per hook between 1994 and 2007 (Figure 6.8), however there is much variance. Further studies to clarify this trend are required. A longer time-series of logbook data should also be reconstructed allowing a better interpretation of cpue trends.

Mean average length–frequency by sex (Figure 6.9) shows landings of higher length frequency porbeagle caught in June

Mejuto and Garcés, 1984 reported that the NW and N Spanish longline fleets had a cpue of 2.07 kg/1000 hooks for porbeagle shark. However, the cpue demonstrated a seasonal trend, with the highest catches being made in the last four months of the year, where the cpue was three to four times higher than in February or March although the effort was of a similar level.

6.6 Fishery-independent surveys

No fishery-independent survey data are available for the NE Atlantic, although records from recreational fisheries may be available.

6.7 Life-history information

The biology of porbeagle is well described for the NW Atlantic stock (e.g. Jensen *et al*., 2002; Natanson *et al*., 2002; Cassoff *et al*., 2007; Francis *et al*., 2008), although less information is available for the NE Atlantic stock.

6.7.1 Habitat

Porbeagle shark is a wide-ranging coastal and oceanic species found in temperate and cold-temperate waters worldwide (1 to 18°C, 0 to 370 m), and is more common on continental shelves (Stevens *et al*., 2006a). Campana and Joyce, 2004 found that more than half of the porbeagle caught were at temperatures of 5–10°C (at the depth of the hook). They suggest that as porbeagle are among the most cold tolerant of pelagic shark species, they could have evolved to take advantage of their thermoregulatory capability to feed on abundant cold-water prey in the absence of non-thermoregulating competitors.

In the North Atlantic, porbeagle abundance varies seasonally and spatially (Aasen, 1961; 1963; Templeman, 1963; Mejuto and Garcés, 1984; Mejuto, 1985; Gauld, 1989). In the NE Atlantic, the limited studies conducted on this population, and historical catch records indicate that porbeagle segregate by sex and size. Mejuto, 1985 found twice as many males were caught off Spain, whereas Gauld, 1989 found 30% more females were caught off Scotland, and Ellis and Shackley, 1995 found the males predominated in catches in the Bristol Channel. Their movements reveal seasonal patterns, however, this knowledge is incomplete for a large part of the year, and further studies on distribution and movements are necessary.

6.7.2 Nursery grounds

The nurseries are probably in continental waters, but there are few published data (Castro *et al*., 1999).

6.7.3 Diet

Porbeagles are opportunistic piscivores (Campana *et al*., 2003). Stomachs of 1022 porbeagles from the Canadian fishery were examined by Joyce *et al*., 2002. Teleosts made up 91% of the diet by weight, with cephalopods being the second most important prey item and were found in 12% of stomachs. Pelagic fish and cephalopods constituted the largest proportion of the diet in spring, whereas groundfish dominated in the fall. This seasonal change follows a migration from deep to shallow water. No diet differences were found between the sexes. Stomach content samples have been collected from the French targeted fishery, and data will be presented in future.

The distribution of porbeagle may be related to that of their main prey species (e.g. mackerel and herring), and the comparative spatial-temporal distribution of landings of these species could usefully be examined.

6.7.4 Life history parameters

Biological data of the NE Atlantic porbeagle sharks are very scarce; with very few published studies (e.g. Mejuto and Garcés, 1984; Gauld, 1989; Stevens, 1990; Pade *et al*., 2006; Green, 2007). The majority of other biological parameters are available from studies conducted elsewhere in the world, mainly in the NW Atlantic, but also in the Pacific to a limited extent (see Table 6.8).

During the 2008 EPPARTIY trips on the French targeted fishery, four gravid females were caught in April. These fish were 222, 215 and 205 cm long (curved fork length over the body), with the fourth released alive.

6.8 Exploratory assessment models

6.8.1 Previous studies

There have been no assessments of the NE Atlantic stock. However, assessments have been undertaken for the NW Atlantic stock (e.g. Campana *et al.*, 1999, 2001), for which there are more data.

6.8.2 Stock assessment

No assessment was undertaken.

6.9 Quality of assessments

The limitations of the available landings data and absence of fishery-independent information hampers assessments for this stock.

6.10 Reference points

No reference points have been proposed for this stock.

6.11 Management considerations

WGEF considered all available data in 2008. This included updated landings data and further analyses of cpue from the French fishery. Further analyses of these data should be undertaken in future, and would benefit from access to raw data.

In the absence of new information WGEF reiterates that this species is considered biologically sensitive, and can be considered highly susceptible to exploitation. The available information, from Norwegian and Faroese fisheries suggests that the stock is depleted. These fisheries have ceased and have not resumed. That no new fisheries have developed has been considered by WGEF to indicate that the stock has not recovered.

WGEF is not concerned about potential misidentification in the landings from the Norwegian fishery (FAO, 2007), and is satisfied that these data are a reliable record of Norwegian removals from the stock.

The time that has elapsed since the end of the northern fisheries is probably longer than the generation time of the stock, so recovery may have taken place although not detected. However in the absence of any quantitative data to demonstrate stock recovery, and in regard of this species' low reproductive capacity, WGEF considers the stock is probably still depleted.

In the southern part of the stock's distribution, the only ongoing target fishery is that of France. Cpue reached a peak in 1994 and has since declined. The decline since 1999 has been more marked, despite relatively constant number of vessels involved. Most recently cpue is the lowest since the early years of the fishery. Although more detailed information could be made available, WGEF considers it is likely that this stock has experienced a decline in this area.

WGEF considers that target fishing should not proceed without a programme to evaluate sustainable catch levels.

A maximum landing length (MLL) may constitute a useful management measure in targeted fisheries and should be evaluated. Jensen *et al.*, 2002 report 218 cm FL as L_{50} for females in the NW Atlantic. This may be considered a candidate maximum landing length. Additionally, measures should be taken to mitigate bycatch.

Experience from surface longline fishing reveals that porbeagles are usually captured alive. Therefore, a mitigation policy might be implemented by releasing porbeagle.

All fisheries dependent data should be provided by the member states having fisheries for this stock as well as other countries longlining in the ICES area.

At present, the porbeagle shark subpopulations of the NE Atlantic and Mediterranean are listed as Critically Endangered in the IUCN red list (Stevens *et al*., 2006a,b).

6.12 References

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Table 6.1. Porbeagle in the NE Atlantic. Working Group estimates of porbeagle landings data (tonnes) by country. Data derived from ICCAT, Eurostat, ICES Statlant and national data. Data are considered an underestimate.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Denmark	158	170	265	233	289	112	72	176	158	84	45	38
Faroe Is	269	.	80	307	295	121	299	425	344	259	256	126
France	105	97	292	302	554	835	1092	898	768	200	793	411
Germany	6	3	4	.	.	.	.	.	.	.	.	.
Iceland	2	2	4	3	3	.	1	1	1	1	1	1
Ireland	.	.	.	.	.	.	.	.	.	.	.	.
Netherlands	.	.	.	.	.	.	.	.	.	.	.	.
Norway	230	165	304	259	77	76	106	84	93	33	33	97
Portugal	.	.	.	.	.	.	.	.	.	.	.	.
Spain (1)	.	.	.	.	.	(2087)	.	.	.	.	.	.
Sweden	.	.	3	.	.	5	1	8	5	6	5	9
UK (E,W&Nl)	14	15	16	25	.	.	1	3	2	1	2	5
UK (Scot)	13	.	.	.	.	.	.	.	.	.	.	.
Japan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	797	452	968	1129	1218	1149	1572	1595	1371	584	1135	687
	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Denmark	72	114	56	33	33	46	85	80	91	93	86	72
Faroe Is	210	270	381	373	477	550	1189	1149	165	48	44	8
France	254	260	273	440	341	575	305	462	642	816	643	475
Germany	.	.	.	.	.	.	.	.	1	.	.	.
Iceland	1	1	1	1	1	.	.	1	3	4	5	3
Ireland	.	.	.	.	.	.	.	.	.	.	.	.
Netherlands	.	.	.	.	.	.	.	.	.	.	.	.
Norway	80	24	25	12	27	45	35	43	24	26	28	31
Portugal	.	.	3	3	2	2	1	0	1	1	1	1
Spain (1)	.	.	.	.	.	.	.	.	.	.	.	31
Sweden	10	8	5	3	3	2	2	4	3	.	2	1
UK (E,W&Nl)	12	6	3	3	15	9	.	.	.	.	0	.
UK (Scot)	.	.	.	.	.	.	.	.	.	.	.	.
Japan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3
TOTAL	639	683	747	868	899	1229	1617	1740	930	988	810	626
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	
Denmark	69	85	107	73	76	42	21	20	4	3	2	
Faroe Is	9	7	10	13	8	10	14	5	19	21	.	
France	494	419	240	318	278	394	303	287	246	194	316	
Germany	.	2	0	17	1	3	5	6	5	0		
Iceland	2	3	3	2	4	2	0	1	0	1	0	
Ireland	.	.	8	2	6	3	11	18	.	4	8	
Netherlands	.	.	.	0			0		0		0	
Norway	19	28	34	23	17	14	19	24	11	27	10	
Portugal	1	1	0	7	4	10	101.2	50	13	6	0	
Spain (1)	45	31	15	17	43	98	49	12	7	25		
Sweden	1	1	1	1	1	.	.	5	0	.	1	
UK (E,W&Nl)	.	1	6	7	10	7	25	24	24	11	26	
UK (Scot)	.	.	.	.	1	.	.	.	.	.	.	
Japan	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
TOTAL	643	578	425	480	448	584	548	453	330	292	363	

(1) Data from Spain from pelagic fisheries for tuna and tuna-like species only. Data for demersal fisheries lacking. Data for 1978 considered to refer to shortfin mako.

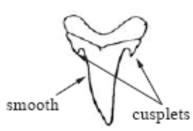
Table 6.2. Porbeagle in the NE Atlantic. Landings of Porbeagle and Shortfin mako (Lamnidae) from Spain (Basque Country).

Year	VI	VII	VIII	Total
1996			20	20
1997	0	0	12	12
1998	1	2	24	27
1999	0	8	33	41
2000	0	3	35	38
2001		7	39	45
2002	0	1	15	16
2003		1	21	22
2004		0	10	10
2005	0	1	10	11
2006			5	5
2007		0	15	16

Table 6.3. Porbeagle in the NE Atlantic. French landings (%) of porbeagle by broad categories of gear type, 1999–2007.

Gear Type	1999	2000	2001	2002	2003	2004	2005	2006	2007
Longline	77.5%	60.9%	81.0%	78.8%	82.1%	72.3%	74.9%	67.9%	89.0%
Net	12.1%	28.6%	8.1%	10.6%	10.9%	15.9%	11.4%	18.2%	5.0%
Trawl (demersal)	5.8%	6.0%	7.5%	3.5%	4.0%	6.3%	6.2%	8.2%	4.8%
Trawl (pelagic)	4.6%	4.2%	2.6%	5.6%	2.8%	4.8%	7.3%	3.8%	0.8%
Unclassified	0.1%	0.2%	0.7%	1.6%	0.2%	0.8%	0.1%	1.9%	0.4%

Table 6.4. Porbeagle in the NE Atlantic. Characteristics for the identification of porbeagle and shortfin mako.

	Porbeagle	Mako
Teeth	Lateral cusps present on teeth* 	No cusplets on teeth 
Origin of first dorsal fin	Over or anterior to posterior margins of pectoral fins	Over or behind posterior margin of the pectoral fins
Origin of second dorsal fin	Over origin of anal fin	In front of the origin of the anal fin
Caudal fin	Secondary keel present below main keel on caudal fin	No secondary keel

*** However, sometimes these cusplets appear to be absent in young porbeagle, as they may be covered by some skin, which can lead to misidentification.**

Table 6.5. Porbeagle in the NE Atlantic. Proportion of small (<50 kg) and large (≥50 kg) porbeagle taken in the French longline fishery 1992–2008.

	% Weight of in the catches of porbeagle:	
Year	< 50 kg	>50 kg
1992	26.0	74.0
1993	29.7	70.3
1994	33.1	66.9
1995	49.9	53.1
1996	31.9	68.1
1997	39.2	60.8
1998		
1999		
2000	Data not available by weight category	
2001		
2002		
2003	53.7	46.3
2004	44.0	56.0
2005	40.0	60.0
2006	44.3	55.7
2007	44.9	55.1
2008	48.1	51.9

Table 6.6. Porbeagle in the NE Atlantic. Length-weight relationships of porbeagle from scientific studies.

Stock	L-W relationship	Sex	N	Length range	Source
NW Atlantic	W = (1.4823 x 10–5) LF 2.9641	C	15	106–227 cm	Kohler *et al.*, 1995
NE Atlantic (Bristol Channel)	W = (1.292 x 10–4) LT 2.4644	C	71	114–187 cm	Ellis and Shackley, 1995
NE Atlantic (N/NW Spain)	W = (2.77 x 10–4) LF 2.3958	M	39		Mejuto and Garcés, 1984
	W = (3.90 x 10–6) LF 3.2070	F	26		
NE Atlantic (SW England)	W = (1.07 x 10–5) LT 2.99	C	17		Stevens, 1990
NE Atlantic (Biscay / SW England/W Ireland)	W = (5 x 10–5) LF 2.729	M	283	100–238 cm	Jung, 2008
	W = (3 x 10–5) LF 2.8164	F	245	100–230 cm	

Table 6.7. Porbeagle in the NE Atlantic. Number of fishing trip per year for vessels involved in the targeted porbeagle fishery 1993 to 2008 (Jung, 2008).

Vessel	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	9	10	9	5	5	6	2	3	2	9	9	9	7	8	7
2	4	12	6	9	5	7	4	4	6	4	5	7	2	3	3
3	1	5	6	1	5	5	3	6	5	5	7	6			
4	10	7	6	5	8	3	3	3	1	6	2				
5	6	9	6	4	4	5	4	3	6	2					
6	3	9	9	10	8	7	8	8	5						
7	4	2	4	4	2										
8									5	6	5	7	3		5
9				1	1	2	3	2	2						
10											5	2			3
11					5								5	3	5
12	7	6	7	5											
13					3	3	2	3							
14			6	5	6										
15	11	12													
16				3											
17	4														
18	10														

Table 6.8. Porbeagle in the NE Atlantic. Life-history parameters for porbeagle from the scientific literature.

PARAMETER	VALUES	SAMPLE SIZE	AREA	REFERENCE
Reproduction	Ovoviviparous with oophagy			Campana *et al.*, 2003
Gestation period	8–9 months			Aasen, 1963; Francis and Stevens, 2000; Jensen *et al.*, 2002
Litter size	4 (3.7–4 per year)		Scotland and NW Atlantic	Gauld, 1989; Francis and Stevens, 2000; Jensen *et al.*, 2002
Size at birth	60–75 cm		NW Atlantic	Aasen, 1963; Compagno, 1984
	58–67 (LF)		SW Pacific	Francis and Stevens, 2000
Sex Ratio (males : females)	1:1.3	1368 (1954–1987-year-round samples)	Scotland	Gauld, 1989 (data from 1954–1987)
	1:1	1228 (year-round samples)	NW Atlantic	Kohler *et al.*, 2002
	1:0.25	65 (year-round samples)	NE Atlantic	Kohler *et al.*, 2002
	1:0.5		NE Atlantic (Spain and Azores)	Mejuto, 1985
	1:0.6		N and NW Spain	Mejuto and Garcés, 1984
Embryonic sex ratio	1:1			Francis and Stevens, 2000; Jensen *et al.*, 2002
Male age at 50% maturity (years)	~ 8		NW Atlantic	Natanson *et al.*, 2002
Female age at 50% maturity (years)	~ 13		NW Atlantic	Natanson *et al.*, 2002
Male length at maturity (LF)	150–200 cm 166–184 cm (L50 ~ 174 cm)			Aasen 1961 Jensen *et al.*, 2002
Male mean length (LF)	116 cm		NW Atlantic	Kohler *et al.*, 2002
	147 cm		NE Atlantic	Kohler *et al.*, 2002
Female length at maturity (LF)	210–230 cm (L50 ~ 218 cm) 200–250			Jensen *et al.*, 2002 Aasen, 1961

Parameter	Values	Sample Size	Area	Reference
Female mean length (LF)	108 cm		NW Atlantic	Kohler *et al.*, 2002
	154 cm		NE Atlantic	Kohler *et al.*, 2002
Maximum length (LF)	250 cm (male) 302 cm (female)		NW Atlantic	Campana (unpublished data*)
	253 cm (male) 278 cm (female)		NE Atlantic	Gauld, 1989
Average growth rate	25.2 cm y–1	3	NE Atlantic	Stevens 1990
Life span (years) Maximum age	29–45		NW Atlantic	Campana *et al.*, 1999
	40+ (unfished popn. based on natural mortality estimates) 25 (fished, maximum observed)			Campana *et al.*, 2001
	males: 25 females: 24 (vertebral counts) Longevity calcs. indicate 45–46 in unfished popn.			Natanson *et al.*, 2002
Length-weight relationship	W = (1.4823 x 10–5) LF 2.9641			Kohler *et al.*, 1995
Fork length-total length relationship	LF = 0.8971LT + 1.7939			Kohler *et al.*, 1995
Male growth parameters	l_∞ = 257.7 k = 0.080 t0 = -5.78		NW Atlantic	Harley, 2002
Female growth parameters	l_∞ = 309.8 k = 0.061 t0 = -5.90		NW Atlantic	Harley, 2002
Combined sex growth parameters	l_∞ = 289.4 k = 0.066 t0 = -6.06		NW Atlantic	Harley, 2002; Natanson *et al.*, 2002
	l_∞ = 267.6 ± 9.3 k = 0.084 ± 0.009 t0 = -5.39 ± 0.47	577	NW Atlantic	Cassoff *et al.*, 2007 (1993–2004 data)
Population growth rate	~ 2.5% per year max ~ 5% per year in unfished popn.			Campana *et al.*, 2003
Generation time (years)	~ 18 ~ 11		NW Atlantic Atlantic	Campana *et al.*, 2003 Cortés, 2000
Intrinsic rate of increase	0.05–0.07		NW Atlantic	Campana *et al.*, 2001
Potential rate of increase per year	0.8%		Atlantic	Cortés, 2000

Parameter	Values	Sample Size	Area	Reference
Trophic level	4.2	115 (stomachs)	various (4 studies)	Cortes, 1999
Total mortality coefficient	0.18		NW Atlantic	Aasen, 1963

*** Cited in Francis *et al*. 2008**

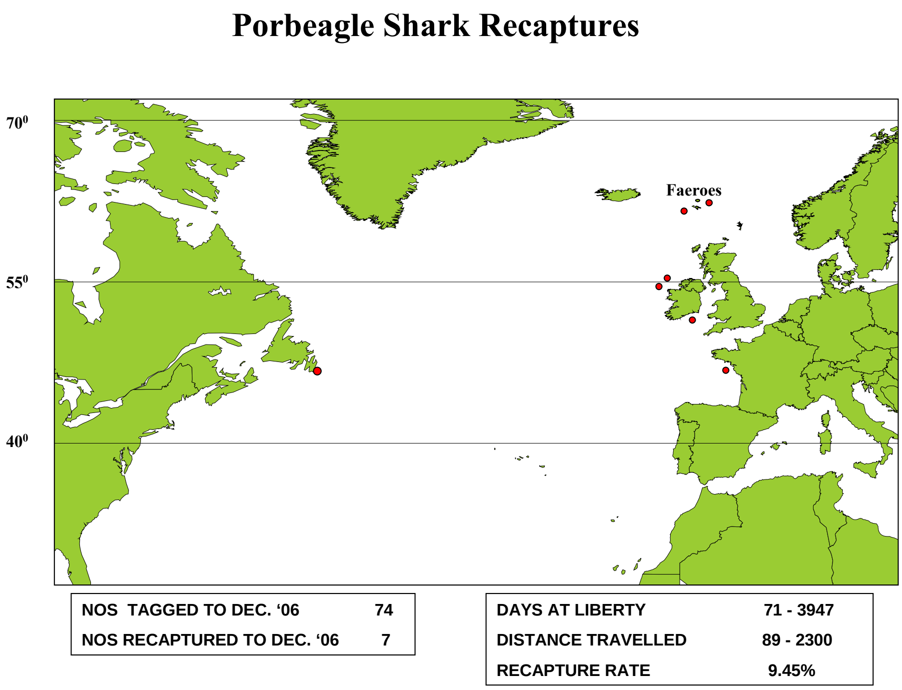
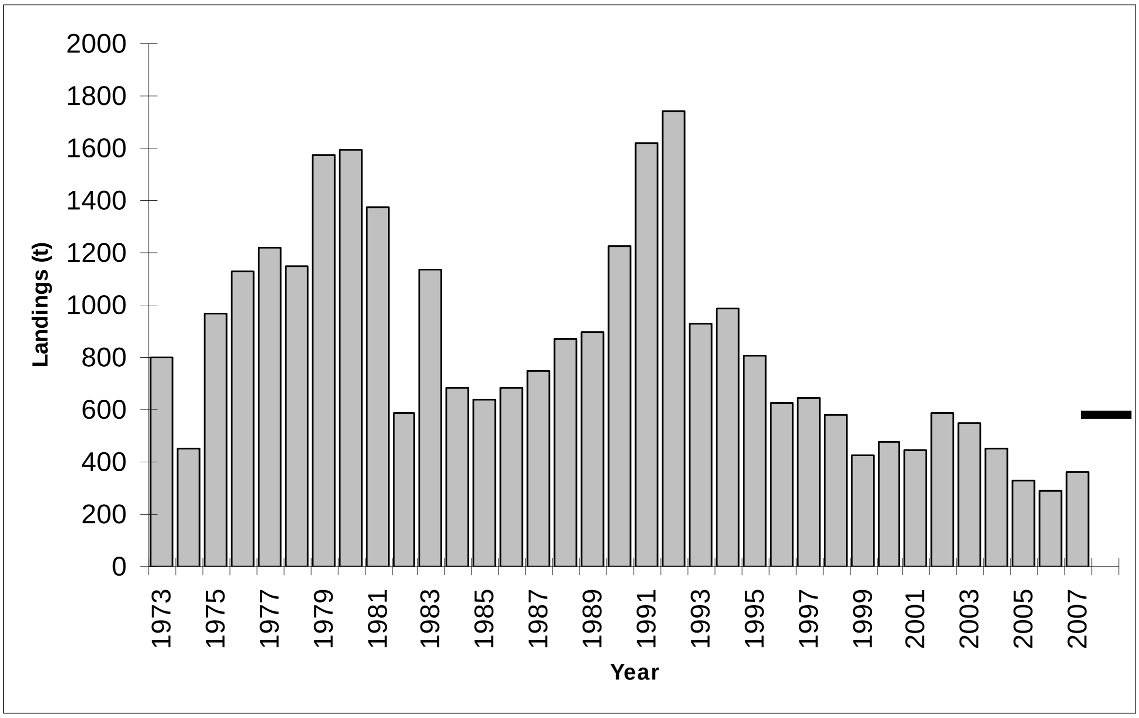


Figure 6.1. Porbeagle in the NE Atlantic. Recapture locations of porbeagle sharks, from Irish Central Fisheries Board tagging programme (Green, 2007 WD).



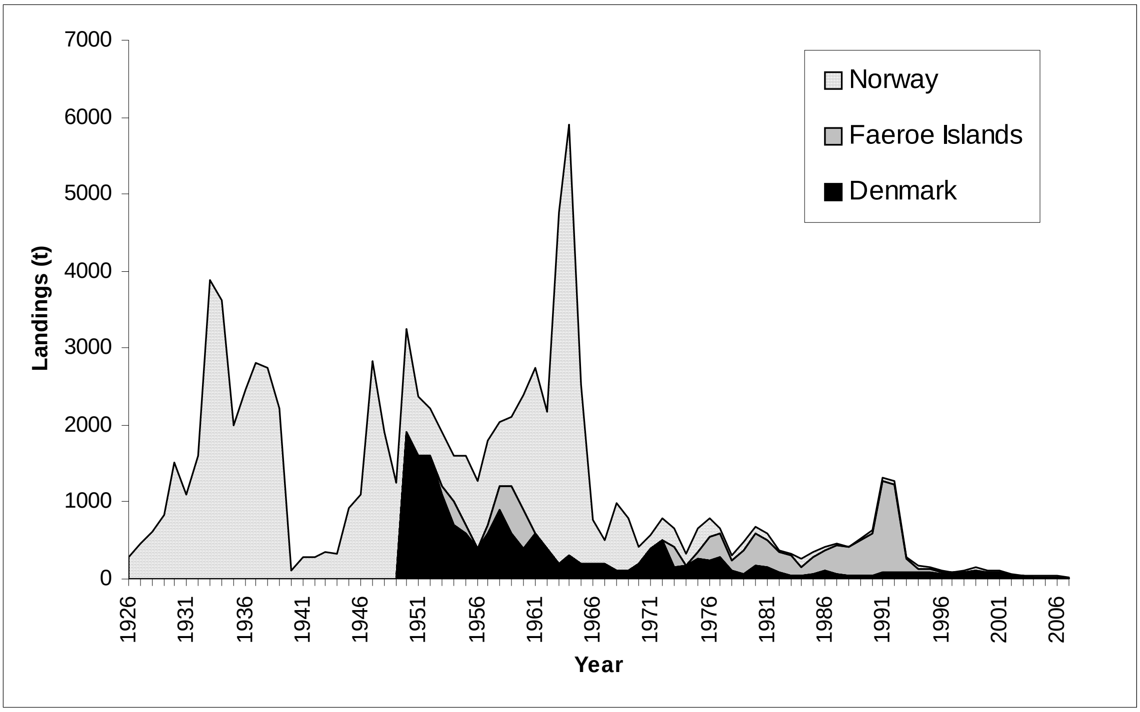


Figure 6.2. Porbeagle in the NE Atlantic. Working Group estimates of landings of porbeagle in the NE Atlantic for 1973–2007 (top, black line indicates 2008 TAC) and landings from the northern part of the ICES area (bottom) illustrating reported landings from Norway (1926–2007) and Denmark and Faroe Islands (1950–2007).

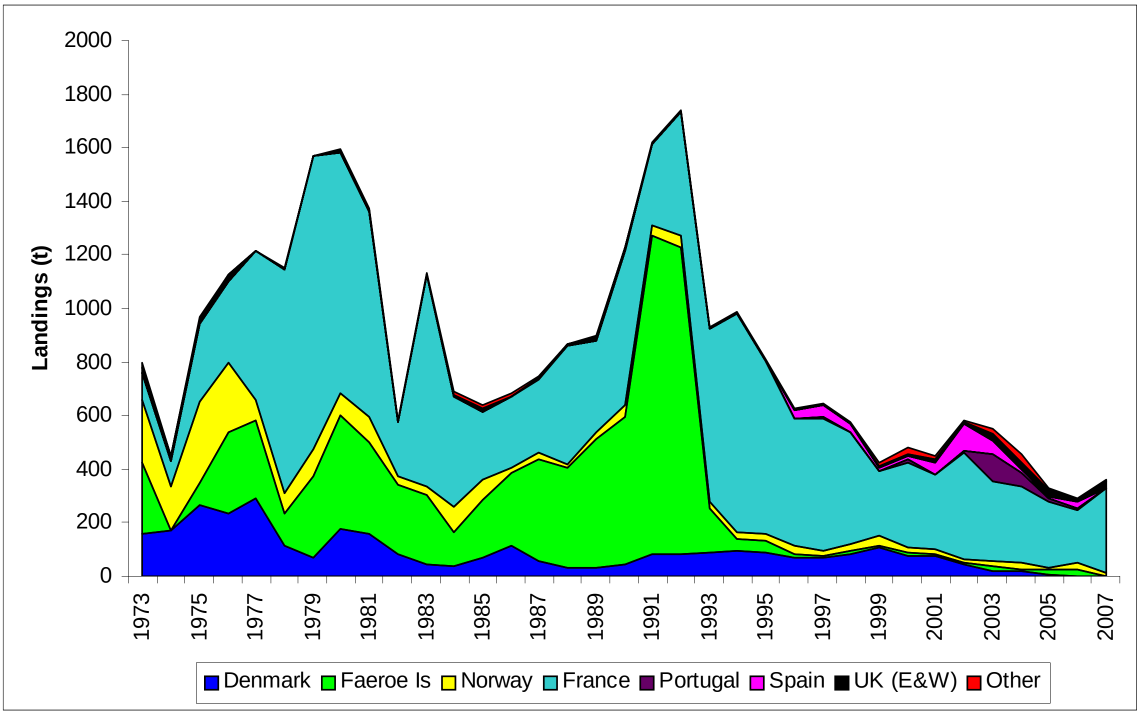
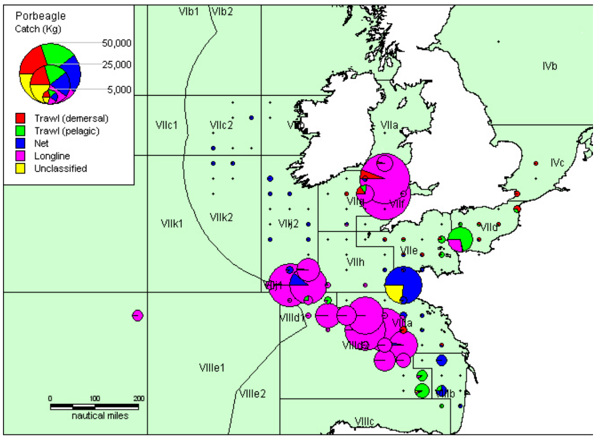
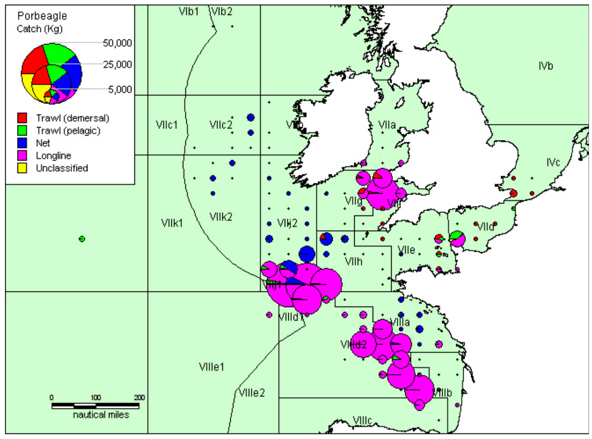


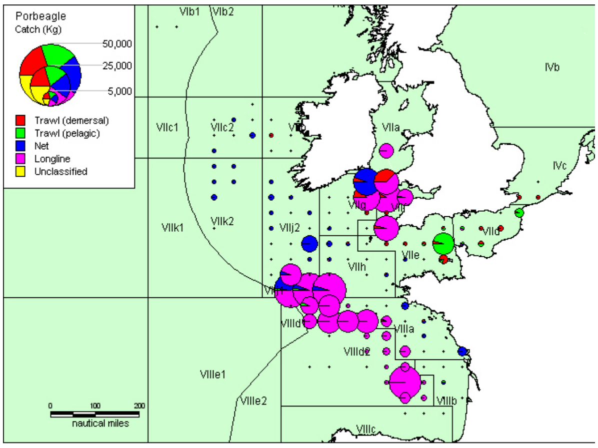
Figure 6.3. Porbeagle in the NE Atlantic. Working Group estimates of landings of porbeagle in the NE Atlantic for 1973–2007 by country.



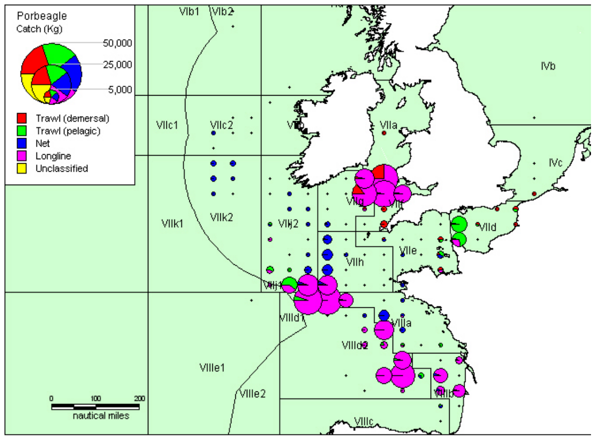
2002



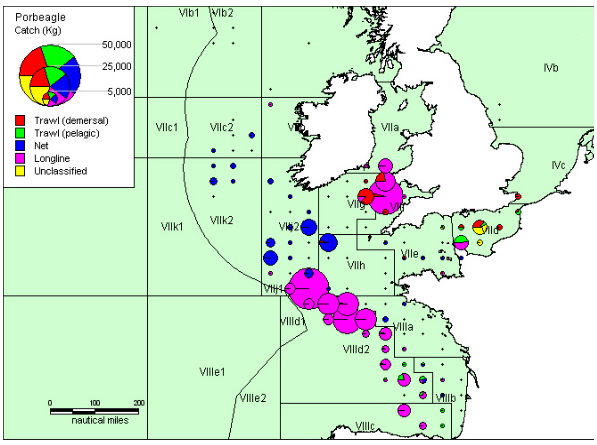
2003



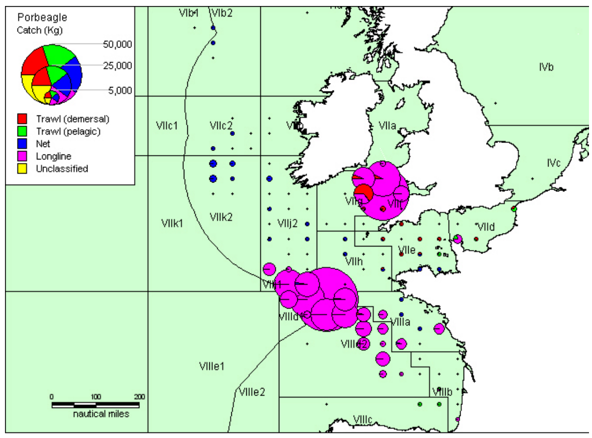
2004



2005



2006



2007

Figure 6.4. Porbeagle in the NE Atlantic. Distribution of Porbeagle (*Lamna nasus*) catch by gear by ICES statistical rectangles, 2002–2007.

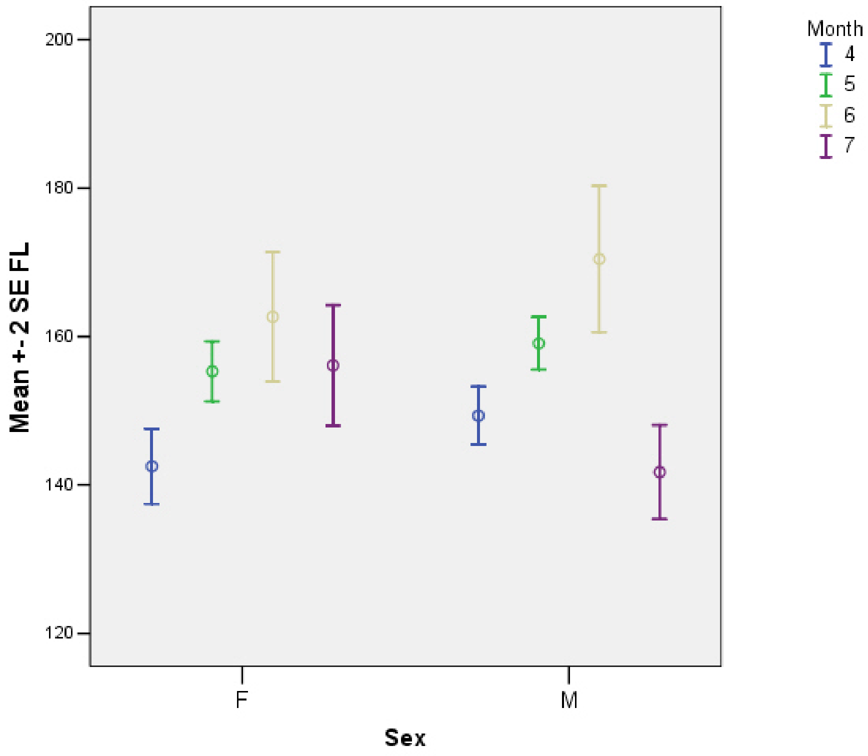


Figure 6.5. Porbeagle in the NE Atlantic. Mean average length of the porbeagle landed in the French targeted fishery by sex for April (blue), May (green), June (yellow) and July (purple). Source: Jung (2008).

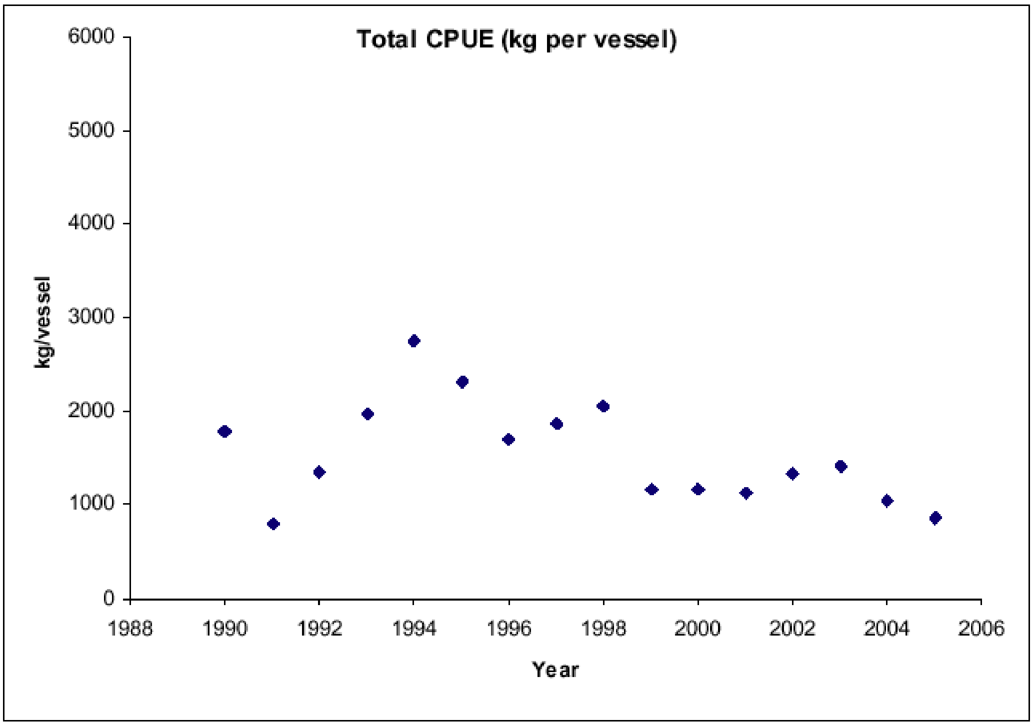


Figure 6.6. Porbeagle in the NE Atlantic. Preliminary analyses of nominal cpue (kg/vessel) for porbeagle taken in the French fishery (1989 to 2005). From Biseau (2006, WD).

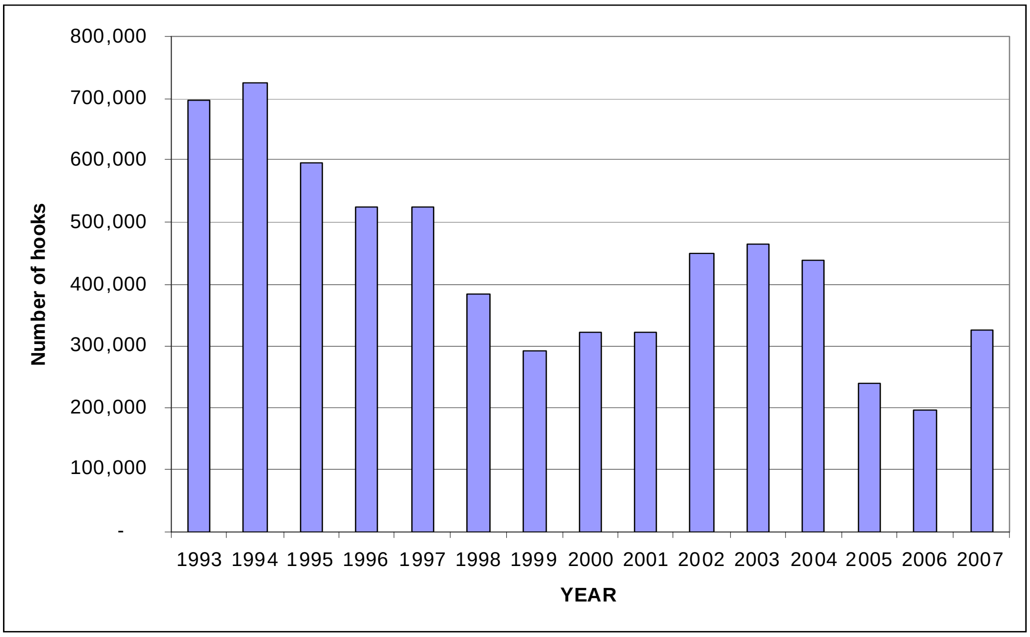


Figure 6.7. Porbeagle in the NE Atlantic. Temporal trend in estimated effort (number of hooks per year) in the French porbeagle fishery, 1993–2007.

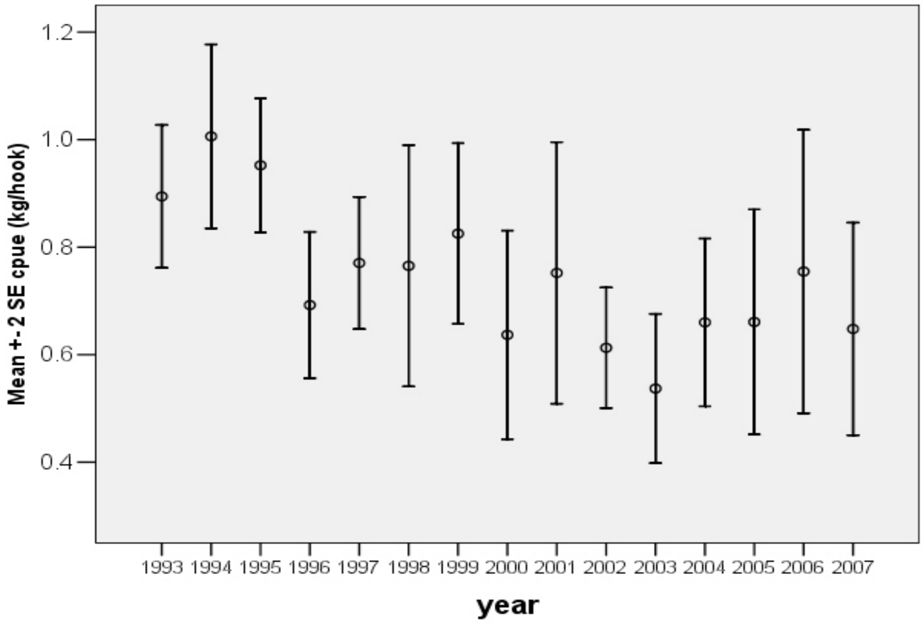


Figure 6.8. Porbeagle in the NE Atlantic. Temporal trends in cpue (kg/hook) of the French longline fishery for porbeagle targeted fishery 1993–2007 (based on twelve vessels).

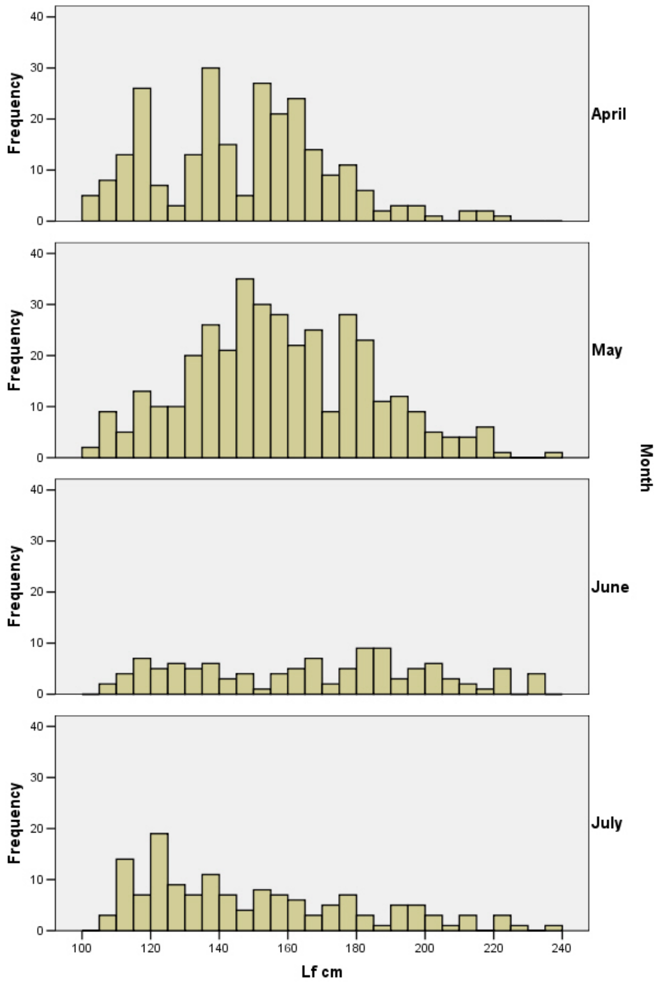


Figure 6.9. Porbeagle in the NE Atlantic. Length frequency distribution of the landings of the Yeu porbeagle targeted fishery by month in 2008 (April, n = 164; May, n = 350; June, n = 113; July, n = 142) 2008. Source: Jung (2008).

7 Basking Shark in the Northeast Atlantic (ICES Areas I–XIV)

7.1 Stock distribution

WGEF considers that a single-stock of basking sharks *Cetorhinus maximus* exists in the ICES area. There is no information on transatlantic migrations. A genetics study underway in the UK aims to differentiate distinct stocks globally (Sims *et al.*, 2005; Noble *et al.*, 2006).

7.2 The fishery

7.2.1 History of the fishery

Norwegian fishers have always been the major catchers of basking sharks in the Northeast Atlantic. The fishery started off Namdalen and Hitra in 1760 (Moltu, 1932) and spread south to Møre and Romsdal. Strøm, 1762 also describes this fishery and he claims that it started before 1750 in north Norway and spread southerly to Møre (Western Norway). The fishery started close to shore but after a while the landings decreased and the fishery moved farther from shore. According to Moltu, 1932 the fishery peaked in 1808 and the best fishing areas were between Romsdal and Storegga. After some years the fishery ceased, and in 1860 it ended. The fishery generally started around April and May, occasionally as early as March, peaking in June and finishing by in August or, less commonly, September (Myklevoll, 1968). Basking sharks were caught using hand-held harpoons from open boats. The fleet was composed of small wooden vessels 15–25 feet in length, which were sometimes used for hunting small whales as well as basking sharks (Kunzlik, 1988).

In 1920 the fishery resumed and the fishery employed more modern fishing gear and vessels. Basking sharks were harpooned by cannons mounted on steam vessels or smacks (Rabben, 1982–83). This technology was developed for whaling and remained in use for basking sharks until the fishery was closed in 2006.

The Norwegian fleet conducted local fisheries from the Barents Sea to the Kattegat, as well as more distant fisheries ranging across the North Sea and south and west of Ireland, Iceland and Faroes. Norwegian fishers were fishing for porbeagle off the Scottish coast as early as 1934, and they started fishing for basking sharks in the immediate post-war years following the establishment of several native Scottish fisheries. Similarly, Norwegian vessels took basking sharks in Irish waters after the Second World War. The landings increased during the 1930s as the fishery gradually expanded to offshore waters. The main reason was that new markets were developed and thereby the demand for basking shark oil increased. During 1959–1980, catches ranged between 1266 and 4266 sharks per year, but have since declined (Kunzlik, 1988). The geographical and temporal distribution of the Norwegian domestic basking shark fishery changed markedly from year to year, possibly as a consequence of the unpredictable nature of the shark's inshore migration (Stott, 1982).

McNally, 1976 and Parker and Stott, 1965 described two basking shark fisheries off the Irish west coast. Large numbers of basking sharks were taken by small boats on the 'Sunfish Bank' for several decades between 1770 and 1830. The season only lasted for a few weeks in April and May, but at least 1000 individuals may have been taken each year at the height of the fishery. In the early 1830s, sharks became very scarce. Despite continued high prices for 'sunfish' (basking shark) oil, the fishery collapsed in the second half of the 19th century. Basking sharks were next recorded in abundance around Achill Island in 1941 and a new fishery started in 1947. Between 1000 and 1800 sharks were taken each year from 1951 to 1955 (an average of 1475/year), but a significant decline in catch records occurred from 1956, the last year in which shark catchers were employed. From 1957 onwards, continued declining sightings and catches made the fishery less profitable for the free-lance fishers who took over from them. Average annual catches were 489 individuals from 1956–1960, 107 individuals from 1961–65, then about 50–60 individuals *per annum* for the remaining years of the fishery.

Fairfax, 1998 summarizes the limited information available on the earlier 18th and 19th century fisheries in Scotland. These appear, like the Irish fishery, to have ceased by the mid 1830s with large numbers of sharks not being reported again until the 1930s. Fairfax, 1998 and Kunzlik, 1988 describe the 20th century Scottish basking shark fisheries, which concentrated on the Firth of Clyde and West coast. Several small fisheries started up in the 1940s, some targeted full time at the basking shark during summer and others more opportunistic. These took in all ~970 sharks between 1946 and 1953 (during a period when Norwegian vessels were also catching basking sharks in these waters).

Oil prices rose again in the mid-1970s. About 500 sharks were taken off eastern Ireland in 1974–75, Norwegian catchers took several hundred sharks in 1975, some Clyde basking shark bycatch was processed in the late 1970s, and a small target harpoon fishery started again in the Clyde in 1982. Initial yields from the latter were good, but these were extremely short-lived and the fishery ceased at the end of 1994 after several years of poor catches and taking in all 333 sharks (Fairfax, 1998).

From 1977–2007, an estimated total of 12 347 basking sharks were caught by Norway and Scotland, and of these Norway landed 12 014 individuals with an annual maximum of 1748 individuals landed in 1979 (Figure 7.2).

More recent data on the price changes for basking shark fins are from the Norwegian Directorate of Fisheries, and covers the period 1979–2007. This demonstrates that the nominal value of fins increased dramatically from 12 NOK per kg in 1979 to 165 NOK per kg in 1992, varied between 108 NOK and 203 NOK per kg during 1993–2005, and has decreased since 2005 (Figure 7.5). The inflation adjusted value of fins varied from 74 NOK per kg to 253 NOK per kg during 1990–2007, but decreased considerably from 2006 to 2007.

7.2.2 The fishery in 2007

There was no directed fishery for basking sharks in Norway, UK or Ireland in 2007.

In 2007 the Norwegian bycatch of basking sharks was 26.1 t, which was higher than in 2006 (6.4 t). In both years the landed basking sharks were taken as bycatch in gillnets, and around 80% of the total catch in 2007 was taken in the Lofoten archipelago.

7.2.3 ICES advice applicable

ICES advice in 2006 was for a zero TAC in 2007.

7.2.4 Management applicable

Since 2007, the EU has prohibited fishing for, retaining on board, transhipping or landing basking sharks by any vessel in EU waters or EU vessels fishing anywhere (Council regulation (EC) No 41/2006).

Based on ICES advice, Norway banned all directed fisheries and landing of basking shark in 2006 in the Norwegian Economical Zone and in ICES-Areas I–XIV, and the ban has continued in 2007 and 2008. Live specimens caught as bycatch have to be released immediately, although dead or dying specimens have to be landed.

The basking shark has been protected from killing, taking, disturbance, possession and sale in UK territorial (12 nautical miles) waters since 1998. They are also protected in two UK Crown Dependencies: Isle of Man and Guernsey (Anon., 2002).

In Sweden it is forbidden to fish for or to land basking shark.

Basking shark was listed on Appendix II of the Convention on International Trade in Endangered Species (CITES) in 2002. Norway and Iceland have made a reservation on this listing and are therefore treated as 'States not Party to the Convention' with respect to trade in the species. For other States, this listing only affects international trade in basking shark products (including scientific samples). Export, re-export or introduction from the high seas requires a CITES permit from the relevant national authorities. Such a permit can only be granted if the exporting State's Scientific Authority has advised that this export will not be detrimental to the survival of the species (for example, because it comes from a sustainable managed stock), and the Management Authority is satisfied that it was not captured illegally. Imports require that an appropriate export or re-export permit be presented and approved by the importing State's CITES Management Authority. Trade inside the EU is controlled under the provisions of EC Regulations Nos. 338/97 and 1808/2001.

Basking shark was listed in 2005 on Appendices I and II of the Convention on the Conservation of Migratory Species (CMS). CMS Parties should strive toward strictly protecting the endangered species on Appendix I, conserving or restoring their habitat, mitigating obstacles to migration and controlling other factors that might endanger them. The Convention encourages the Range States of Appendix II species (migratory species with an unfavourable conservation status that need or would significantly benefit from international cooperation) to conclude global or regional Agreements for their conservation and management. These Agreements are open to accession by all Range States, not just to the CMS Parties. Some Parties, from the ICES area and elsewhere, intimated that they might take out reservations on this listing, in some cases until they had the necessary legislation in place to implement strict protection measures. Reservations are not yet published.

The basking shark is listed on Annex I, Highly Migratory Species, of the UN Convention on the Law of the Sea (UNCLOS).

The basking shark was listed on the OSPAR (Convention on the protection of the marine environment of the North-East Atlantic) list of threatened and/or declining species in 2004.

7.3 Catch data

7.3.1 Landings

Landings data within ICES Areas I–XIV from 1977–2007 are presented in Table 7.1, and Figure 7.1. These data were extracted from FishStat Plus database for 1977–2007. The table and figure include landings from Portugal (1991–2005), France (2005–2006) and landings data from Norway (1977–2007). Most catches are from Subareas I, II and IV and are taken by Norway. For Portugal and France the reported landings were between 0.3 and 1.5 t.

Table 7.2 demonstrates the Norwegian landings of liver and fins, official landings in live weight, revised landings in live weight (ICES WGEF 2008), and estimated numbers of landed individuals based on landings of liver and fins using an average weight per individual of 648.5 kg for liver and 71.5 kg for fins of basking shark from

1977–2007.

Table 7.4 demonstrates the proportions (%) of basking sharks caught by various gears as reported to the Directorate of Fisheries in Norway from 1990–2007. Harpoon was the major gear during most of the 1990s, but remained at a relatively low level from 2000, except for 2005, which was the last year with directed fishery. After the ban of directed fishery was introduced in 2006, bycatch has been taken in gillnets only.

7.3.2 Discards

Limited quantitative information exists on basking shark discarding in non-directed fisheries. However, anecdotal information is available indicating that this species is caught in gillnet and trawl fisheries in most parts of the ICES area. Most of this bycatch takes place in summer as the species moves inshore. The total extent of these catches is unknown. Berrow, 1994 extrapolated from very limited observer data to suggest that 77–120 sharks may be taken annually in the bottom-set gillnet fishery in the Celtic Sea (south of Ireland), though the reliability of this estimate has been questioned. Berrow and Heardman, 1994 received 28 records from fishers of sharks entangled in fishing gear (mostly surface gillnets) around the Irish coast during 1993, representing nearly 20% of all records of the species that year. At least 22% of basking shark bycatch in fishing nets died.

Bycatch in the Isle of Man herring fishery has amounted to 10–15 sharks annually, and a further bycatch source here is entanglement in pot fishers' ropes, amounting to some 4–5 sharks annually. Fairfax, 1998 reported that basking sharks are sometimes brought up from deep-water trawls near the Scottish coast during winter. Valeiras *et al.*, 2001 reported that of 12 reported basking sharks that were incidentally caught in fixed entanglement nets in Spanish waters between 1988 and 1998, three sharks were sold on at landing markets, three live sharks were released, and three dead sharks were discarded at sea. In contrast to the coastal bycatches, extrapolation of observer data from oceanic gillnet fleets suggests that bycatch in these fisheries is very small; only about 50 basking sharks were among the several million sharks taken annually offshore in the Pacific Ocean (Bonfil, 1994).

The requirement for EU fleets to discard all basking sharks caught as bycatch means that information cannot be obtained on these catches. A better protocol for recording and obtaining scientific data from bycatches is necessary for assessing the status of the stock.

7.3.3 Quality of the catch data

The official Norwegian conversion factors used to convert from liver weight and fin weight to live fish weight were 10.0 for liver and 100.0 for fins, respectively up to 2007. These conversion factors were too high, and in 2008 the Norwegian conversion factors were revised by the Norwegian Directorate of Fisheries, and they are now 4.64 for liver and 40.0 for fins. Hence, the official Norwegian live weights reported from 1977 to 2007 were overestimated. Landed liver weights constituted the basis for the official catch statistics from 1977 to 1995, and from 1996 landings of fins have constituted the basis for the official catch statistics. A revised Norwegian catch statistics for basking shark is given based on landings of liver from 1977 to 1992 and landings of fins from 1993 to 2007, applying the revised conversion factors 4.64 for liver and 40.0 for fins (Table 7.2). Official Norwegian catch statistics will not be changed between 1977 and 1999, but from 2000-2007 the revised catch figures will be applied.

7.4 Commercial catch composition

The median weights of liver and fins of 56 probable individual basking sharks caught in Norway during 1992–1997 were 648.5 kg and 71.5 kg, respectively (Figure 7.3). Minimum and maximum weights for liver and fins were 45.0 kg and 974.0 kg and 6.0 kg and 110.0 kg, respectively.

The median estimated live weights of the same individuals were 3009 kg and 2860 kg from liver and fins weights, respectively (Figure 7.4). Minimum and maximum estimated weights were 209 kg and 4519 kg based on liver weights, respectively, and 240 kg and 4400 kg based on fin weights, respectively. This indicates that individuals >2500 kg dominated the catches taken by Norwegian fishers during 1992–1997.

7.5 Commercial catch-effort data

There are no effort or cpue data available for the latest years. However in Hareide, 2006, WD, the numbers of Norwegian vessels involved in this fishery and the landings for 13 of the years between 1965 and 1985 were used to calculate a simple estimate of effort. The largest number of vessels participating in this fishery was 70 vessels in 1978. Based on total landings and number of vessels participating in the fishery an estimate of cpue was generated for the years 1965–1985 (Table 7.3). For this period there was a significant decrease in cpue. This cpue series can be considered an underestimation of the decline in the abundance because the area fished expanded during this period.

7.6 Fishery-independent surveys

In 1993 a sighting scheme was established to determine distribution and abundance of basking shark in Irish coastal areas. The concentrations given by Berrow and Heardman, 1994 are based mainly on sightings made in 1993 correspond to historical accounts from the same area.

Since 2003, the French Association Pour l'Etude et la Conservation des Sélaciens (APECS), has surveyed the migrating basking sharks off the Atlantic coast of France, by recording sightings and using satellite tags.

Doyle *et al.*, 2005 presented the results of a public sightings record scheme for basking sharks, primarily in UK waters. The lack of effort information for the great majority of these records limited the application of these data. Other fishery-independent information currently being collected includes the photo-identification of individual sharks and the use of archival tags to track basking shark movements (e.g. Sims *et al.*, 2005; Southall *et al.*, 2005).

In addition there are a number of possible sources of data that may be utilized better. Several countries, e.g. Norway and Denmark, conduct scientific whale counting surveys. During these surveys observations of basking sharks should also be noted. A number of Norwegian commercial vessels also regularly report observations of whales. A request for reporting the sightings of basking sharks might yield useful effort-related data.

7.7 Life-history information

Available, reliable published and unpublished data on lengths and weights of 25 individual basking sharks have been compiled, and are demonstrated together with a regression equation in Figure 7.6. More historical data on lengths and weights of basking shark and other biological data should be collated by WGEF.

7.8 Exploratory assessment models

No assessments have been undertaken.

7.9 Quality of assessments

No assessments have been undertaken.

7.10 Reference points

No reference points have been proposed for this stock.

7.11 Management considerations

At present there is no directed fishery for this species. The WGEF considers that no directed fishery should be permitted unless a reliable estimate of a sustainable exploitation rate is available.

The species may be found in all ICES-areas, and thus the TAC-area should correspond to the entire ICES-area.

Proper quantification of bycatch and discarding both in weight and numbers of this species in the entire ICES-area is required.

Where national legislation prohibits landing of bycaught basking sharks, measures should be put in place to ensure that incidental catches are recorded in weight and numbers, and carcasses or biological material made available for research.

7.12 References

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Table 7.1 Basking sharks in the Northeast Atlantic. Total landings (t) of basking sharks in ICES Areas I–XIV from 1977–2007.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
I & II	3680	3349	5120	3642	1772	1970	967	873	1465	1144	164
III & IV							734	1188			
Va											
Vb		14		83	28						
VI											
VII		278	139			186	60	1			
VIII			7								
IX											
X											
XII											
XIV											
TOTAL	3680	3641	5266	3725	1800	2156	1761	2062	1465	1144	164
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
I & II	96	593	781	533	1613	1374	920	604	792	425	55
III & IV	10		116	220	84		157	23		43	
Va											
Vb											
VI											
VII											
VIII			1	0	0	0	0	1	0	2	1
IX									1	1	
X											
XII											
XIV											
TOTAL	106	593	897	753	1697	1374	1077	628	793	471	56
	1999	2000	2001	2002	2003	2004	2005	2006	2007		
I & II	31	117	80	54	128	72	87	6	26		
III & IV					0						
Va											
Vb											
VI											
VII							1	0	0		
VIII	1	1	0	0	0	0	0	0	0		
IX					1	+	2	0	0		
X			1								
XII											
XIV											
TOTAL	32	118	81	54	129	72	90	6	26		

Table 7.2 Norwegian landings of liver (kg) and fins (kg) of basking shark (*Cetorhinus maximus*) during 1977–2007, calculated official landings in live weight applying conversion factors of 10.0 for liver (1977–1995) and 100.0 for fins (1996–2007), revised landings in live weight (ICES WGEF 2008) applying conversion factors of 4.64 for liver (1977–1992) and 40.0 for fins (1993–2007), and estimated numbers of landed individuals based on landings of liver and fins using an average weight per individual of 648.5 kg for liver and 71.5 kg for fins. Landed catches and numbers in bold are the estimates that were recommended used by the ICES WGEF. In 1995 and 1997, landings of whole individuals measuring 3760 kg (1 individual) and 7132 kg (2 individuals), respectively, were reported. These weights are included in the official and revised landings and in the estimation of landed numbers. Weights given in parentheses for official landings will be the revised official Norwegian landings when the revised conversion factor of 40.0 for fins is applied from 2000-2007.

Year	Liver (kg)	Fins (kg)	Official landed catch (tonnes)	Landed catch - liver (tonnes)	Landed catch - fins (tonnes)	Landed numbers (livers – fins)
1977	793 153	0	7931.5	**3680.2**	0.0	**1223**
1978	784 687	0	7846.9	**3640.9**	0.0	**1210**
1979	1 133 477	95 070	11 334.8	**5259.3**	3802.8	**1748**–1330
1980	802 756	60 851	8027.6	**3724.8**	2434.0	**1238**–851
1981	387 997	27 191	3880.0	**1800.3**	1087.6	**598**–380
1982	464 606	31 987	4646.1	**2155.8**	1279.5	**716**–447
1983	379 428	24 847	3794.3	**1760.5**	993.5	**585**–348
1984	444 171	23 505	4441.7	**2061.0**	940.2	**685**–329
1985	315 629	16 699	3156.3	**1464.5**	668.0	**487**–234
1986	246 474	12 138	2464.7	**1143.6**	485.5	**380**–170
1987	35 244	3148	352.4	**163.5**	125.9	**54**–44
1988	22 761	1927	227.6	**105.6**	77.1	**35**–27
1989	127 775	10 367	1277.8	**592.9**	414.7	**197**–145
1990	193 179	18 110	1931.8	**896.4**	724.4	**298**–253
1991	162 323	18 337	1623.2	**753.2**	733.5	**250**–256
1992	365 761	37 145	3657.6	**1697.1**	1485.8	**564**–520
1993	291 042	34 360	2910.4	1350.4	**1374.4**	449–**481**
1994	176 220	26 922	1762.2	817.7	**1076.9**	272–**377**
1995	10 450	15 571	108.3	52.2	**626.6**	17–**219**
1996	41 283	19 789	1978.9	191.6	**791.6**	64–**277**
1997	57 184	11 520	1159.1	272.5	**467.9**	90–**163**
1998	3	1366	136.6	0.0	**54.6**	**19**
1999	20	770	77.0	0.1	**30.8**	**11**
2000	51	2926	292.6 (117.0)	0.2	**117.0**	**41**
2001	0	1997.5	199.8 (79.9)	0.0	**79.9**	**28**
2002	0	1351.5	135.2 (54.1)	0.0	**54.1**	**19**
2003	0	3191.5	319.2 (127.7)	0.0	**127.7**	**45**
2004	0	1808.3	180.8 (72.3)	0.0	**72.3**	**25**
2005	0	2180.5	218.1 (87.2)	0.0	**87.2**	**30**
2006	0	160	16.0 (6.4)	0.0	**6.4**	**2**
2007	0	653	65.3 (26.1)	0.0	**26.1**	**9**

Table7.3 Basking sharks in the Northeast Atlantic. Norwegian landings of liver (t), number of vessels participating in the fishery and estimate of cpue.

Year	Tonnes liver	Number of vessels	cpue
1965	652	31	210
1966	911	30	304
1967	2090	53	394
1968	1580	70	226
1970	1887	57	331
1976	751	26	289
1977	793	32	248
1979	1133	30	378
1981	388	28	139
1982	465	25	186
1983	379	24	158
1984	444	26	171
1985	315	23	137

Table 7.4 Basking sharks in the Northeast Atlantic. Proportions (%) of basking sharks caught in different gears as reported to the Norwegian Directorate of Fisheries from 1990–2007.

Year	Area IIa							Area IVa		Total
	Harpoon	Gillnets	Driftnets*	Undefined nets	Bottom trawl	Danish seine	Hooks and line	Harpoon	Gillnets	%
1990	84,0	0,0	3,1	0,0	0,0	0,0	0,0	12,9	0,0	100
1991	69,7	0,0	1,0	0,0	0,0	0,0	0,0	29,3	0,0	100
1992	83,1	0,0	6,0	0,0	5,6	0,0	0,4	4,9	0,0	100
1993	99,1	0,8	0,0	0,0	0,1	0,0	0,0	0,0	0,0	100
1994	85,4	0,0	0,0	0,0	0,0	0,0	0,0	14,6	0,0	100
1995	89,8	6,5	0,0	0,0	0,0	0,0	0,0	0,0	3,7	100
1996	89,1	10,3	0,0	0,2	0,0	0,4	0,1	0,0	0,0	100
1997	66,7	23,7	0,0	0,0	0,0	0,0	0,5	9,1	0,0	100
1998	67,2	28,5	0,0	0,0	0,0	0,0	4,4	0,0	0,0	100
1999	9,1	81,8	0,0	7,8	1,3	0,0	0,0	0,0	0,0	100
2000	33,4	58,7	0,0	0,0	7,8	0,0	0,0	0,0	0,0	100
2001	0,0	96,0	0,0	0,0	4,0	0,0	0,0	0,0	0,0	100
2002	16,3	78,5	0,0	0,0	5,2	0,0	0,0	0,0	0,0	100
2003	3,4	89,7	0,0	0,0	7,2	0,0	0,0	0,0	0,0	100
2004	0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	100
2005	54,1	44,5	0,0	0,5	1,4	0,0	0,0	0,0	0,0	100
2006	0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	100
2007	0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	100

*** These driftnets for salmon were banned after 1992**

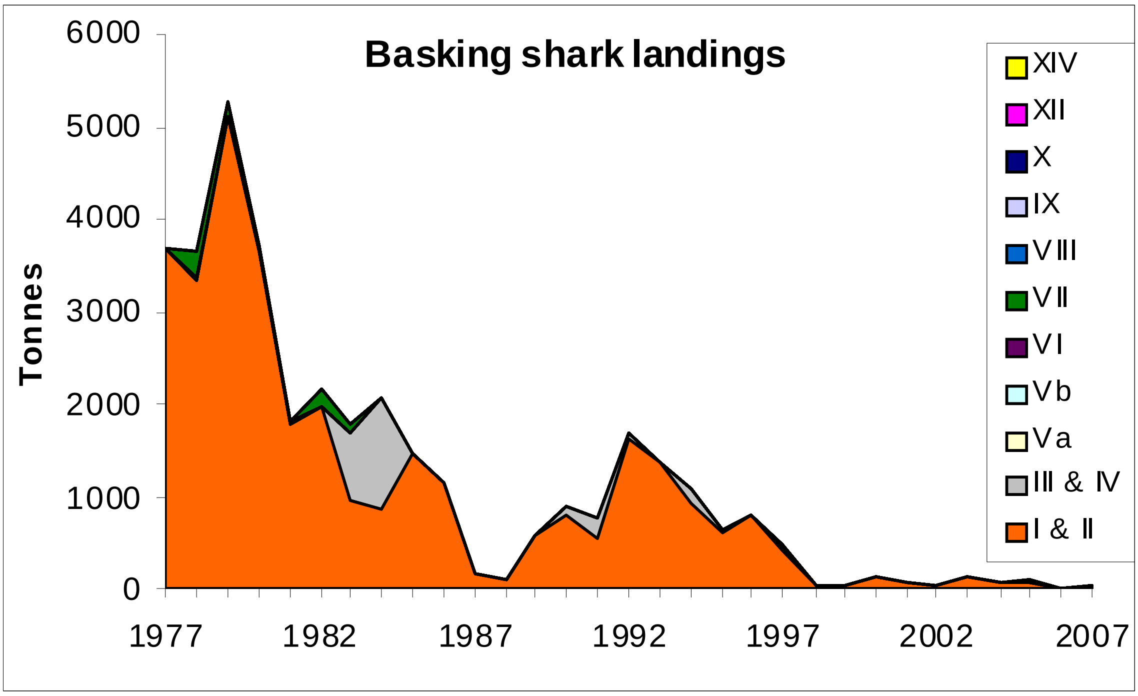


Figure 7.1 Basking sharks in the Northeast Atlantic. Total landings (t) of basking sharks in ICES Areas I–XIV from 1977–2007.

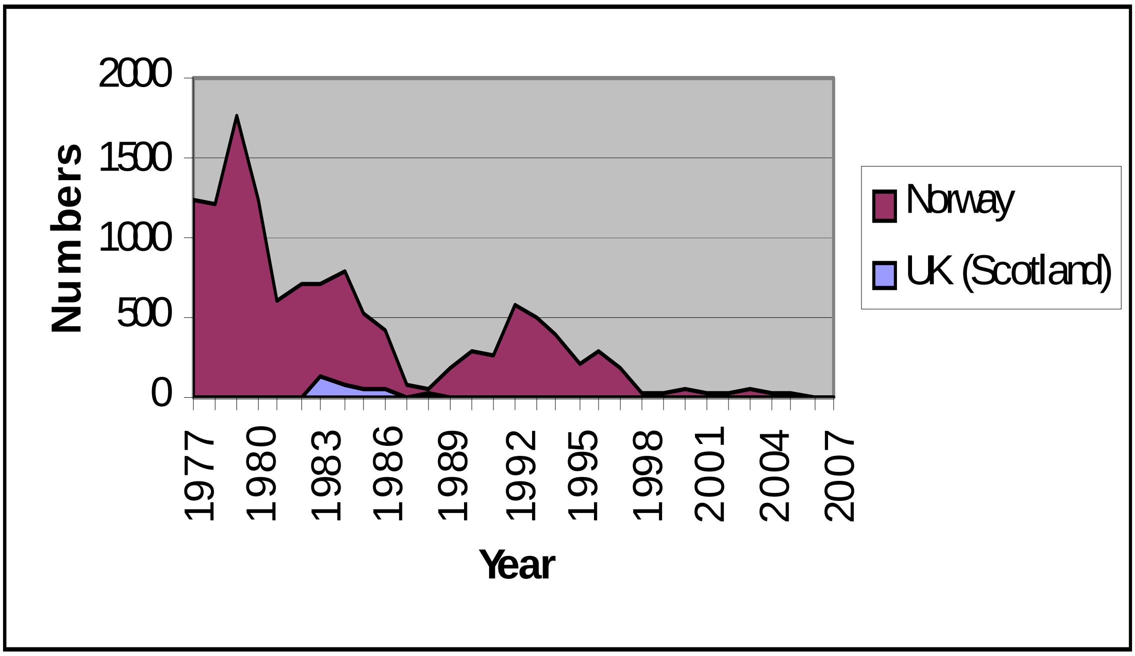
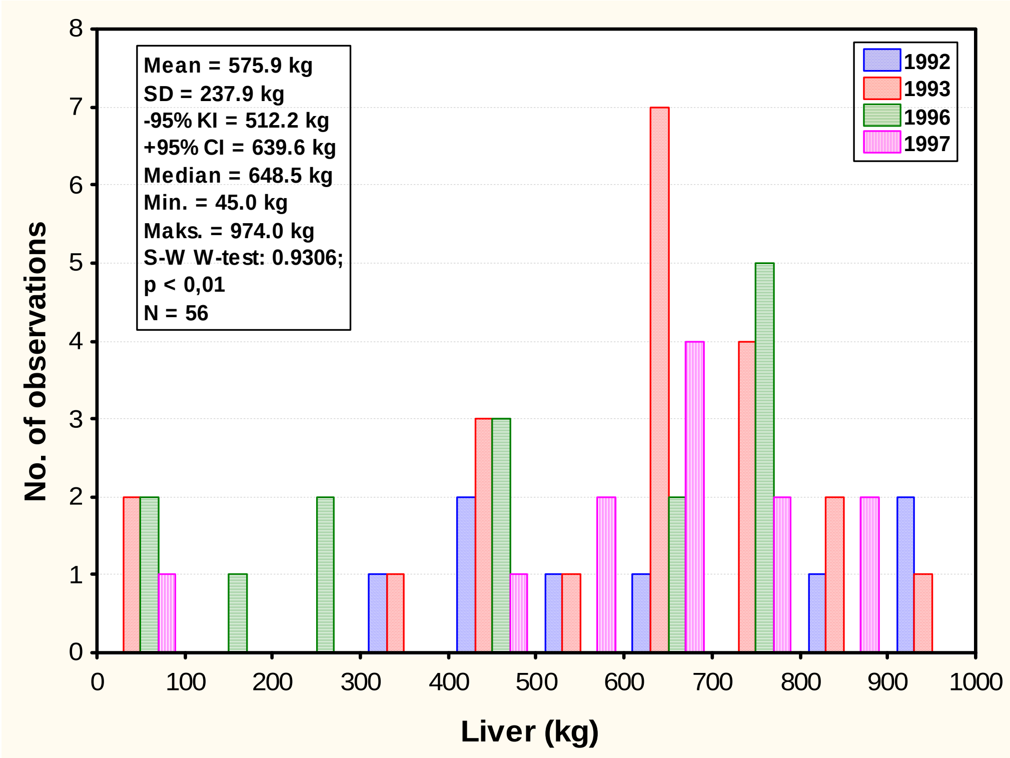


Figure 7.2 Basking sharks in the Northeast Atlantic. Numbers of basking sharks caught by Norway and Scotland from 1977–2007 in ICES Areas I–XIV from 1977–2007.



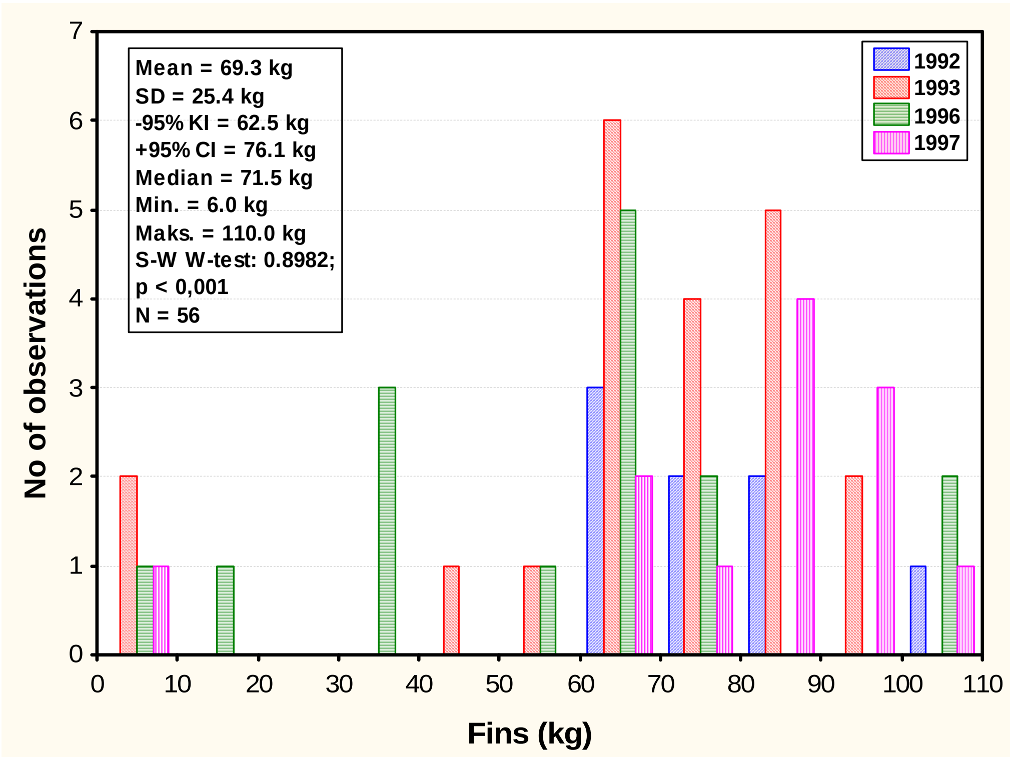


Figure 7.3 Liver (A) and fin weights (B) (kg) of 56 probable individual basking sharks landed in 1992, 1993, 1996 and 1997. The distributions of liver and fin weights were different from a normal distribution (Shapiro-Wilk's W-test; p < 0.004).

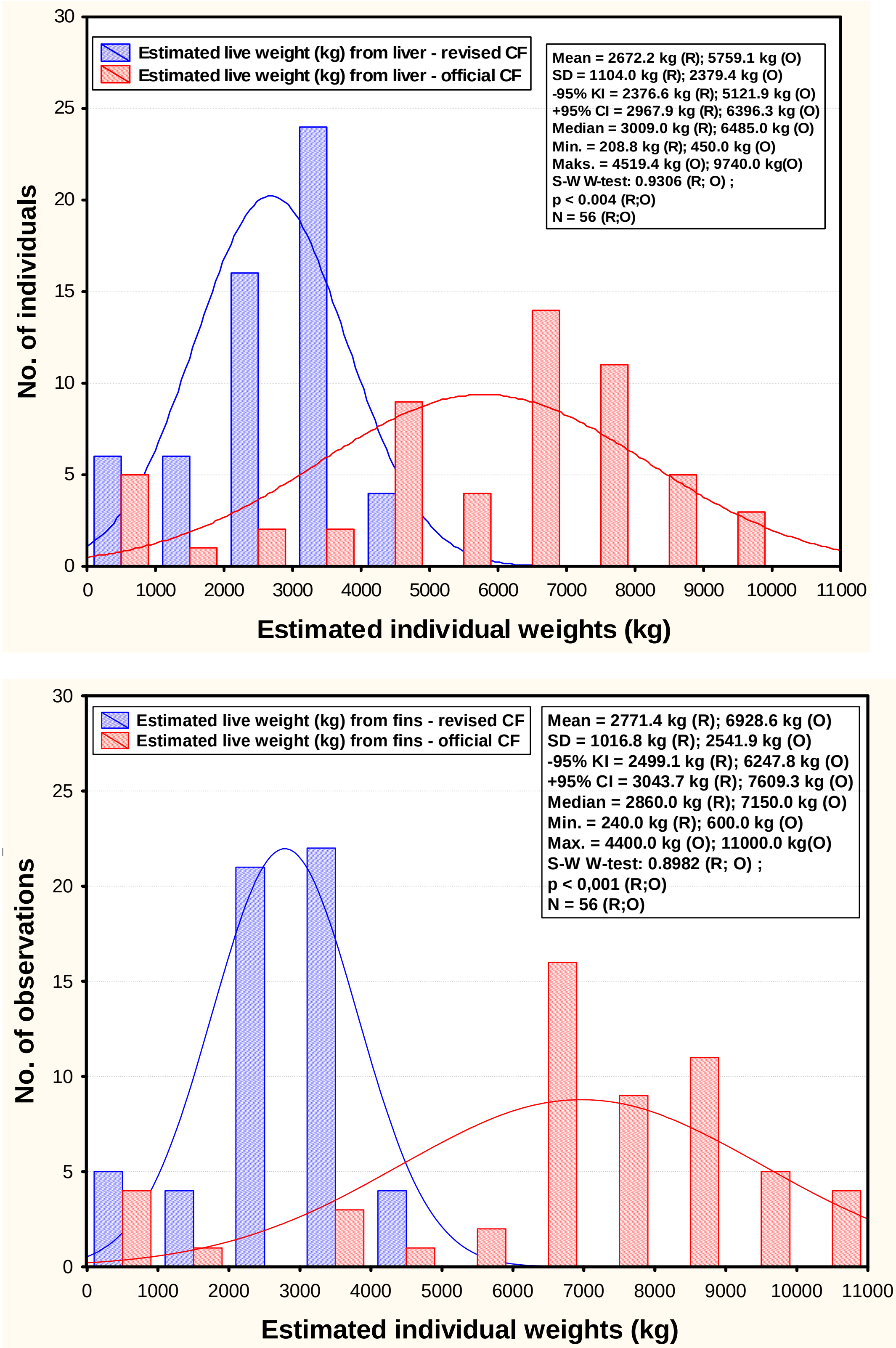


Figure 7.4 Comparison of estimated weight (kg) of 56 probable individual basking sharks landed in Norway in 1992, 1993, 1996 and 1997 applying A. the revised (4.64) and old (10.0) conversion factors for liver, and B. revised (40.0) and old (100.0) conversion factors for fins. The distributions of weights differed from a normal distribution (Shapiro-Wilk's W-test; p < 0.004).

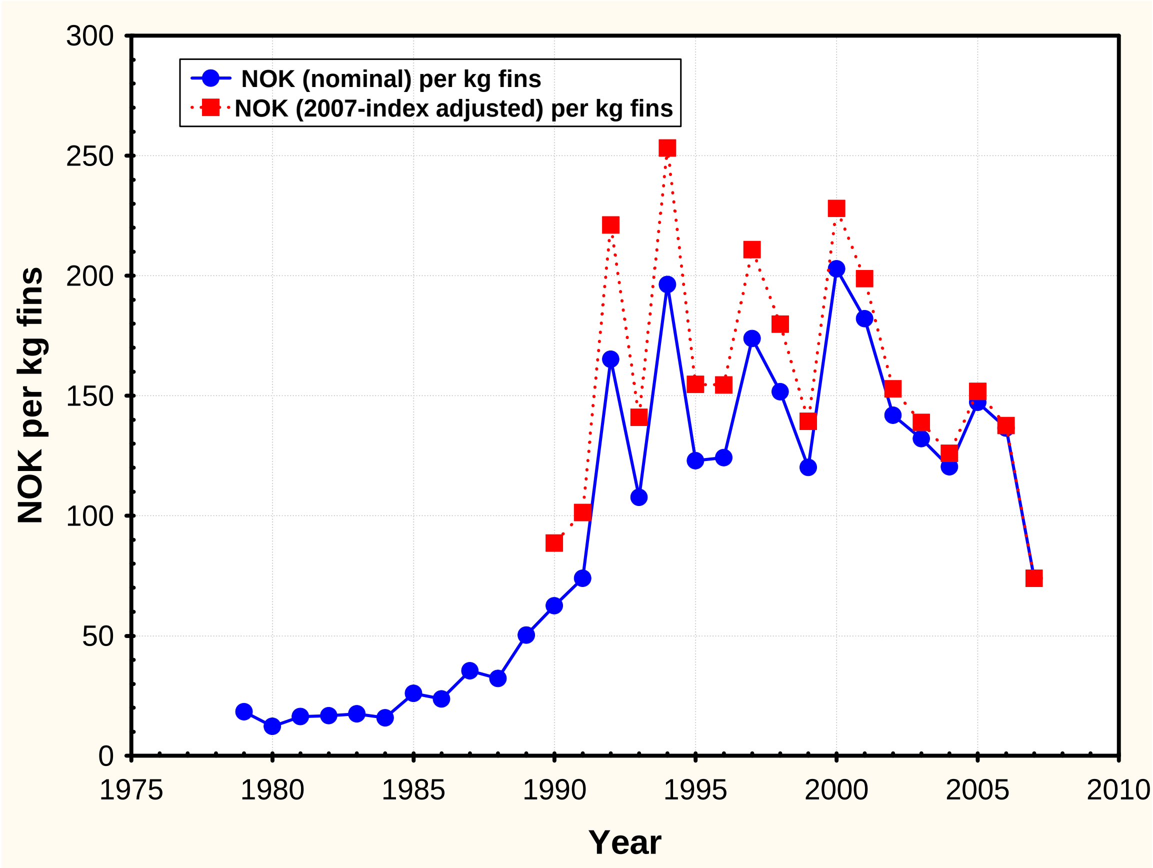


Figure 7.5 Development in nominal and inflation adjusted prices (NOK per kg) paid to fishers for fins of basking shark during 1979–2007. The data were provided by the Norwegian Directorate of Fisheries.

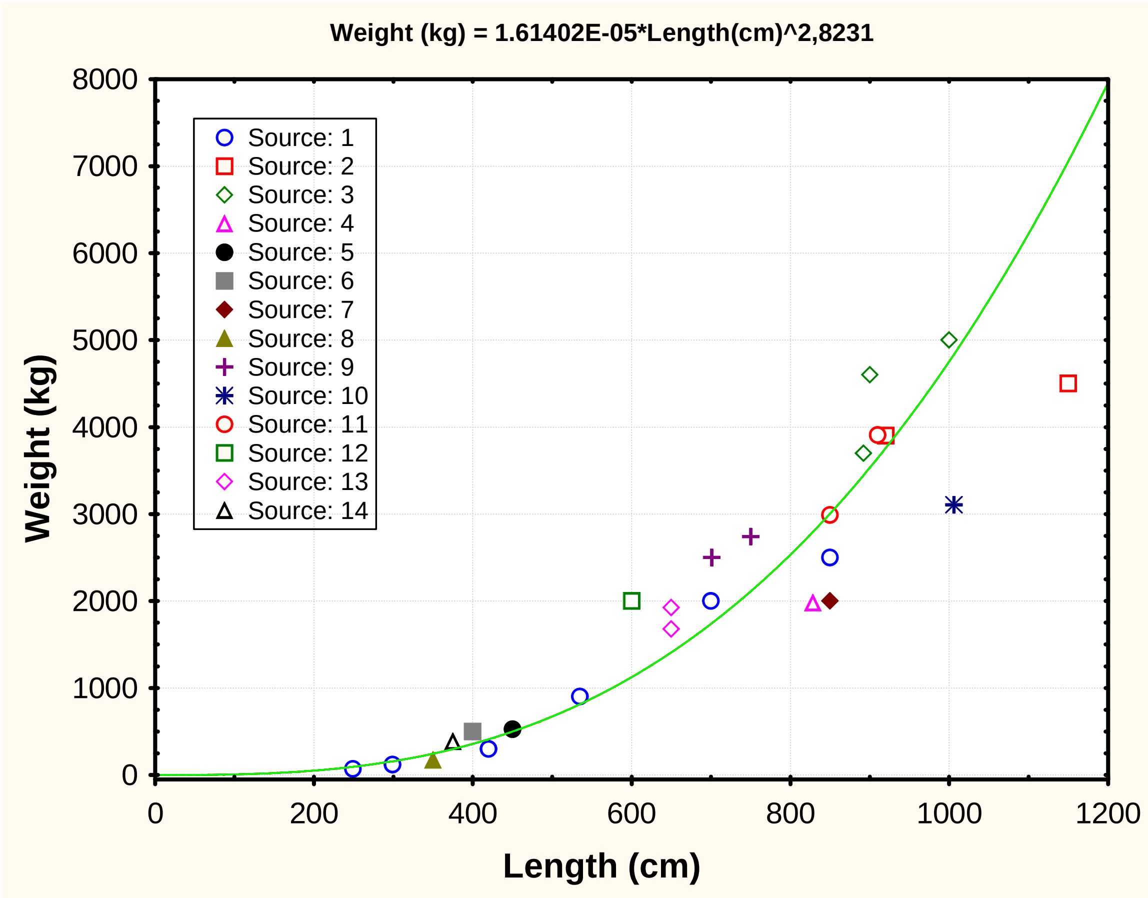


Figure 7.6 Length-weight regression of basking shark based on various published and unpublished (websites on basking shark and information from newspapers) data on measured lengths and weights. The original log length-log weight regression equation was given as: log Weight = - 11.0342 + 2.8231*log Length; R^2 = 0.943; N = 25.

8 Blue shark in the North Atlantic (North of 5°N)

8.1 Stock distribution

The DELASS project and the ICCAT Shark Assessment Working Group consider there to be one stock of blue shark *Prionace glauca* in the North Atlantic (Heessen 2003; Fitzmaurice *et al.*, 2005; ICCAT, 2008). Thus the ICES area is only part of the stock. ICCAT, 2008 considered that the 5°N parallel was the most appropriate division between North and South Atlantic stocks of blue shark. This decision was based on the oceanographic features of the region and to facilitate comparison with fisheries statistics from tuna-like species for which North Atlantic stocks are also assumed to have 5°N as a southern stock boundary.

Assessment of this stock is considered to be the responsibility of ICCAT. WGEF presents a section on blue shark here, to help summarize available data and aid the process of assessment in ICCAT.

8.2 The fishery

8.2.1 History of the fishery

In recent years, more information has become available about fisheries taking blue shark in the North Atlantic. Although the available data are limited, it offers some information on the situation in fisheries and trends. Although there are no large-scale directed fisheries for this species, it is a major bycatch in many fisheries for tunas and billfish, where it can comprise up to 70% of the total catches (ICCAT, 2005).

Observer data indicated that substantially more sharks are caught as bycatch than reported in catch statistics. Blue sharks are also caught in considerable numbers in recreational fisheries, including in the ICES area (Campana *et al*., 2005).

8.2.2 The fishery in 2007

Due to difficulties in obtaining reliable data it is difficult to summarize fishing activity in 2007. ICCAT, 2008 does not provide an update of fishing activity.

8.2.3 Advice applicable

ACFM has never provided advice for blue shark in the ICES area. ICCAT is the responsible agency for assessment of this species. No specific management advice has been provided by ICCAT for this stock, to date.

8.2.4 Management applicable

There are no measures regulating the catches of blue shark in the North Atlantic.

EC Regulation No. 1185/2003 prohibits the removal of shark fins of this species, and subsequent discarding of the body. This regulation is binding on EC vessels in all waters and non-EC vessels in Community waters.

8.3 Catch data

8.3.1 Landings

It is difficult to quantify landings of blue shark in the North Atlantic. This is because reporting of data is incomplete. Furthermore it is difficult to identify landings and discards separately. Because blue shark is a low value species, landings data underestimate removals. Several attempts have been made to estimate landings. Data reported to ICCAT are not considered a reliable estimate of landings, and are not presented in ICCAT, 2008. In addition, it is thought that landings data for blue shark are unreliable as a result of the amount of pelagic sharks that are or have been reported under the generic "sharks nei" category (Johnston *et al.,* 2005). Two other estimates of landings for this stock were prepared (Figure 8.1). The tuna ratio estimates are considered conservative by ICCAT because they do not consider all fisheries (ICCAT, 2008).

Available landings data from FAO Fishstat are presented in Table 8.1. These values are underestimates, as a consequence of the inconsistent or generic reporting of shark catches. Estimated catches of blue shark from the ICCAT shark subgroup are given in Table 8.2. These data include reported landings of blue shark and estimated landings from (a) the ratio of shark catches to tuna and tuna-like species, and (b) from fin trade data. Reported landings of blue shark are underestimated more so in the early part of the time-series (prior to 1997), with official landings and estimates of a comparable magnitude in more recent years, with annual landings in the region of 20 000–43 000 t.

In the ICES area, blue shark is reported predominantly from French, Portuguese and Spanish fisheries in Subareas VII–XII, with smaller quantities taken in Subareas II–VI.

Because catch data are unreliable, several methods have been used to estimate removals. Figure 8.2 summarizes previous approaches to estimate total catches. Revised catch estimates were available from estimates derived from analyses of the shark fin trade (ICCAT, 2008). Three different methods were used to apply Hong Kong derived shark fin trade estimates to the Atlantic, viz. Atlantic as a proportion of total sea area, Atlantic catch of tuna and billfish to total catch thereof, Atlantic longline effort to total longline effort. The effort–scaled series was the preferred option because it does not consider a constant relationship between tuna and shark catches, and can be used to segregate catches between the North and South Atlantic. These effort scaled estimates are shown in Figure 8.1. These estimates, and the tuna ratio estimates vary widely, especially since the mid 1990s. Recent catches are variously estimated as about 27 000 t or 60 000 t, depending on the method used. The fin ratio estimates, based on effort scaling are different from those previously presented to ICCAT (Clarke *et al*., 2006; Figure 8.2).

8.3.2 Discards

The low value of blue shark means that it is not always retained for market. The most valuable part of the blue shark is its fins. In some fisheries the fins of blue sharks are retained and the carcasses discarded, although various national and EC measures have been brought in to prevent this practice. Accurate estimates of discarding are required in order to quantify total removals from the stock. Currently no such estimates are available. Differences between estimated and reported catch in various fisheries (ICCAT, 2008 and references cited therein) suggest that discarding is very widespread in fisheries taking blue shark.

Discard estimates are available only for fisheries from USA, Canada and UK (Bermuda). Numbers for the latter country are negligible. USA reported discards in quantities of 63–1 136 $t.year^{-1}$, averaging at around 390 $t.year^{-1}$ over time (ICCAT, 2006). Discards from Canadian fisheries have been estimated at about 1000 t annually in recent years (ICCAT, 2008) compared with estimated annual landings of about 2000 t.

The full extent of bycatch of blue shark cannot be interpreted from present data, but available evidence suggests that longline operations can catch more blue shark bycatch than target fish. There is considerable bycatch of blue sharks in Japanese and

Taiwanese tuna longliners operating in the Atlantic. However it is not possible, from the information available, to estimate discard rates from these fleets. Data are available for one observed fishing trip on a Japanese bluefin longliner in 1997. On this trip, 186 blue sharks were caught compared with 166 bluefin tuna (Boyd, 2007).

Discards can be presumed to be far higher than reported (Campana *et al*., 2005), especially in high seas fisheries. It is thought that most discards of whole sharks would be alive on return to the sea. It is noted that discard survival is about 60% in longline fisheries and 80% in rod and reel fisheries (Campana *et al*., 2005).

8.3.3 Quality of catch data

Catch data are incomplete, and the extent of finning in high seas fisheries is unclear. The historical use of generic shark categories is problematic, although many European countries have begun to report more species-specific data.

Discrepancies have been identified between data reported to ICCAT and reported to other agencies (ICCAT, 2008). Further work needs to be done to harmonize reporting of catch data. However, landings data are not sufficient to quantify total catch, because discarding is so widespread.

8.4 Commercial catch composition

Incomplete information is available on blue shark composition in commercial catches. Japanese catches (landings and discards) from tuna longliners in the North Atlantic are estimated to have fluctuated between 2000–4500 t in recent years. These are higher than reported landings of the target species (bluefin tuna) from Japanese longliners in this period (ICCAT, 2008). Another study of Japanese bluefin tuna longline fishing demonstrated that the ratio of blue shark to the target species was about 1:1 (Boyd, 2007). Data from observed fishing for bluefin tuna by a Chinese Taipei (Taiwanese) vessel in the southern North Atlantic found that blue shark accounted for 76% of shark bycatch, though no information was presented on the percentage of blue shark in the total catch (Dai and Jang, 2008). Blue shark and shortfin mako shark are estimated together to account for between 69% and 72% of catches from Spanish and Portuguese surface longliners in the North Atlantic (Oceana, 2008). Blue shark have been revealed to be an insignificant bycatch in Mexican tuna and shark directed fisheries in the Gulf of Mexico.

8.4.1 Conversion factors

Information on the length-weight relationship is available form several scientific studies (Table 8.3) and information on length-length relationships is summarized in Table 8.4. Campana *et al*., 2005 calculated the conversion relationships between dressed weight (W_D) and round weight (W_R) for NW Atlantic blue shark (n=17) to be:

$$W_R = 0.4 + 1.22\ W_D$$
$$W_D = 0.2 + 0.81\ W_R$$

For gutted fish from French fisheries the DW/RW is 75.19%. There is also a factor for landed round weight to live weight (96.15%), meaning that there is a 4% reduction in weight because of lost moisture (Hareide *et al*., 2007). There have been various estimates of fin weight to body weight (see: Mejuto and García-Cortés, 2004; Santos and Garcia, 2004; Hareide *et al*., 2007).

8.5 Commercial catch-effort data

In 2008, the following cpue series were available to and used for stock assessments by

ICCAT:

- US longlines 1986–2007;
- Japanese longlines 1971–2006;
- Irish recreational fisheries 1989–2005;
- US longlines 1957–1986;
- Venezuelan longlines 1994–2007;
- Spanish swordfish longlines 1997–2007.

Details of these series are available in ICCAT, 2008 and are presented in Figure 8.3.

The longer time-series demonstrated steady trends until the mid 1990s. The only exception to that is the US logbook series that demonstrates a large decline from very high levels in 1985. Downward trends since the mid 1990s are apparent from Irish coastal recreational fisheries, Venezuelan longliners, US mid-east coast recreational fisheries, and the US commercial longliners, though not from Canadian bluefin tuna and bigeye tuna/swordfish fisheries. However the Canadian data were not used for assessment purposes by ICCAT. Data from the Japanese tuna longline fishery demonstrated a similar peak to the Irish data from the mid 1990s. There is no obvious abundance signal in the Spanish longline cpue, though this series only began after the declines in the other series were already demonstrating marked declines.

Most time-series declined to lowest observed levels in 2004 and 2005, with slight increases afterward. The US Spanish and Japanese commercial indices displayed lower decline in recent years than the other series. These cpue series were assigned weightings before they were included in the stock assessments conducted by ICCAT. These weightings were based on the spatial area of the North Atlantic. Series from fisheries with broader spatial extents received greater weightings than those with more restricted spatial coverage.

8.6 Fishery independent surveys

No fishery-independent information from research vessel surveys is available, and although such data exist for parts of the NW Atlantic, there are no scientific fishery-independent data from the NE Atlantic.

8.7 Life-history information

Various studies have compiled data on biological information on this species in the North Atlantic and other areas. Some of these data are summarized in Table 8.5 (Growth parameters), and Table 8.3 (Length-weight relationship) and Table 8.6 (other life-history parameters). The US National Marine Fisheries Service also conducts a Cooperative Shark Tagging Programme (CSTP) (Kohlet *et* al., 1998; NMFS, 2006), with tagging in the NE Atlantic also being undertaken under the auspices of the Irish Central Fishing Board Tagging Programme (Green, 2007 WD) and UK Shark Tagging Programme, and there have been other earlier European tagging studies (e.g. Stevens, 1976). Based on life-history information, blue shark is considered to be among the most productive shark species (ICCAT, 2008).

8.8 Exploratory assessment models

8.8.1 Previous assessments

In 2004, ICCAT completed a preliminary stock assessment (ICCAT, 2005). Although the North Atlantic Stock appeared to be above biomass in support of MSY, the assessment remained highly conditional on the assumptions made. These assumptions included (i) estimates of historical shark catch, (ii) the relationship between catch rates and abundance, (iii) the initial state of the stock in 1971, and (iv) various life-history parameters. It was pointed out that the data used for the assessment did not meet the requirements for proper assessment (ICCAT, 2006), and further research and better-resolved data collection for this species was highly recommended.

In 2008, three models were used in assessments by ICCAT (ICCAT, 2008 and references cited therein): a Bayesian surplus production model, an age structured model that did not require catch data, and an age-structured production model.

Preliminary modelling with the Bayesian surplus production model produced estimates of stock size well above MSY levels (1.5 -2* B_{MSY}), and estimated F to very low (at F_{MSY} or well below it). The carrying capacity of the stock was estimated so high that the increasing estimated catches (25–62 000 t over the time-series) generated very low F estimates. Sensitivity analyses found that the stock size estimate was sensitive to the weighting of the Irish cpue series. Equal weighting of this and the other series produced a stock size at around B_{MSY}. All other sensitivity analyses found similar results to the base case run, with the stock well above MSY levels.

The age structured biomass model displayed varying results with either a strong decrease in biomass throughout the series to about 30% of virgin levels, or a less pronounced decline. The prior for the virgin biomass assigned high values to a very small number of biomass values but also indicated that the range of plausible values of this parameter is very wide (long tail). This is probably because there is not enough information in the data to allow the model to provide a more narrow range of plausible values than the one started with and thus, provide a more precise estimate of the biomass of the stock.

Preliminary runs of an age structured model not requiring catch information estimated F > F_{MSY}, but still low. These runs demonstrated little depletion, with current SSB estimated at around 83% of virgin levels.

8.8.2 Stock status

In 2008, ICCAT tentatively concluded that biomass was estimated to be above the level that would support MSY (ICCAT, 2008). These results agreed with earlier work (ICCAT, 2005). Stock status appeared to be close to unfished biomass levels and fishing mortality rates well below those corresponding to the level at which MSY is reached. However, ICCAT, 2008 pointed out that the results are heavily dependent on the underlying assumptions. In particular the choice of catch data to be used, the weighting of cpue series and various life-history parameters can be expected to be of great importance. ICCAT did not have time to conduct a sensitivity analysis of the input data and assumptions (ICCAT, 2008).

Owing to these underlying weaknesses, no firm conclusions could be drawn from the preliminary assessments conducted by ICCAT. ICCAT, 2008 stated that most models used predicted this stock was not overfished, and that overfishing was not occurring. However, ICCAT did not use these assessments to make conclusions about stock status and has not provided management advice based on these analyses.

8.9 Quality of assessments

A full evaluation of the sensitivity of results to the results of the 2008 ICCAT assessment was not conducted (ICCAT, 2008). The main difficulties are with regard to the input data, rather than the models used. In particular, further analyses could be conducted into the weighting procedures used and the sensitivity to catch data. The models do not always follow the trends in the cpue series available, especially the longer time-series. Even the best estimates of catch data available only generated very low estimates of fishing mortality. This is because the stock size was estimated to be so high. Clearly, further analyses are required before any firm conclusions can be drawn about stock status.

8.10 Reference points

ICCAT uses F/F_{MSY} and B/B_{MSY} as reference points for stock status of this stock. These reference points are relative metrics rather than absolute values. The absolute values of B_{MSY} and F_{MSY} are dependent on model assumptions and results and are not presented by ICCAT for advisory purposes.

8.11 Management considerations

The stock status of blue shark in the North Atlantic remains unclear. Catch data are very unreliable. Some cpue series are available, and where data are available, mainly reveal declines since the mid 1990s. Further work is required to explain the downward trends, and to quantify removals from the stock.

Clearly, the catch data are incomplete. Besides unaccounted discards and the occurrence of finning it becomes obvious that countries supply data to ICCAT that is not available to ICES. For accurate stock assessments of pelagic sharks, better data are required. In addition, reporting procedures must be strengthened so that all landings are reported, and that landings are reported to species level, rather than generic "shark nei" categories. In the absence of reliable landings and catch data, catch ratios and market information derived from observers can provide useful information for understanding blue shark fishery dynamics.

Blue shark is considered to be one of the most productive sharks in the North Atlantic. As such, it can be expected to be more resilient to fishing pressure than other pelagic sharks. However the poor quality of the information available to assess the status of this stock is a cause for concern. Given that this species is a significant bycatch, especially in tuna and billfish fisheries, better data should be made available by the countries whose fleets catch it.

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Table 8.1. Blue shark in the North Atlantic. Reported landings (t) by country (Source FAO Fishstat). These data are considered underestimates.

Fishing area	Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Atlantic, Eastern Central	Benin	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	China	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Liberia	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Panama	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Portugal	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Russia	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Spain	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Channel Is	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Denmark	4	3	3	4	2	2	1	2	2	1	1	<0.5	1
Atlantic, Northeast	France	9	8	14	39	50	67	91	79	130	187	276	322	350
Atlantic, Northeast	Ireland	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Portugal	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Spain	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	UK	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northwest	Canada	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northwest	Portugal	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northwest	Spain	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Western Central	Portugal	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Western Central	Spain	.	.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Western Central	Trin & Tobago	.	.	.	.	.	.	.	.	.	.	.	.	.
	TOTAL	13	11	17	43	52	69	92	81	132	188	277	322	351

Table 8.1. cont.

Fishing area	Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Atlantic, Eastern Central	Benin	.	.	6	4	27	.	.	.	9	7	6	6
Atlantic, Eastern Central	China	.	.	.	.	.	.	750	420	600	.	.	.
Atlantic, Eastern Central	Liberia	.	.	.	.	76	70	.	.	.	25	.	.
Atlantic, Eastern Central	Panama	.	.	.	.	177	22	.	.	.	.	.	254
Atlantic, Eastern Central	Portugal	.	.	.	.	.	351	557	668	1292	661	1440	1754
Atlantic, Eastern Central	Russia	.	.	.	.	.	.	.	.	.	.	17	.
Atlantic, Eastern Central	Spain	.	.	12 183	9541	9225	7820	7958	7159	10 080	9955	8448	8008
Atlantic, Northeast	Channel Is	.	.	.	1	<0.5	.	.	.	.	1	.	.
Atlantic, Northeast	Denmark	2	3	1	1	1	2	1	13	6	1	<0.5	1
Atlantic, Northeast	France	266	278	213	163	230	395	205	112	134	103	120	134
Atlantic, Northeast	Ireland	.	.	.	.	67	23	66	11	2	<0.5	<0.5	.
Atlantic, Northeast	Portugal	.	.	.	.	887	1133	1006	1209	2169	1514	1990	2627
Atlantic, Northeast	Spain	.	.	.	.	.	.	.	.	.	4828	1942	1399
Atlantic, Northeast	UK	.	.	.	.	.	12	9	6	4	6	5	3
Atlantic, Northwest	Canada	.	12	11	21	54	18	<0.5	5	6	<0.5	11	4
Atlantic, Northwest	Portugal	.	.	.	.	.	169	.	.	48	.	.	11
Atlantic, Northwest	Spain	.	.	.	.	.	.	.	.	.	.	1150	1387
Atlantic, Western Central	Portugal	.	.	.	17	.	.	.	8	.	.	3	1
Atlantic, Western Central	Spain	.	.	1700	418	.	.	.	.	1015	.	1310	1972
Atlantic, Western Central	Trin & Tobago	.	.	.	.	.	.	.	6	3	2	1	1
	TOTAL	268	293	14 114	10 166	10 744	10 015	10 552	9617	15 368	17 103	16 443	17 562

Table 8.2. Blue shark in the North Atlantic. Estimated landings (t) of blue shark 1971–2006 based on reported landings, and as estimated from the ratio of sharks to tuna and tuna-like species, and as estimated by fin trade data (Source: ICCAT Shark subgroup).

Year	Estimated catch (tuna ratio)	Estimated catch (fin trade data)	ICCAT landings	Fin trade estimates as a proportion of estimated landings	ICCAT landings as a proportion of estimated landings
1971	25 332	-	-	-	-
1972	25 274	-	-	-	-
1973	30 163	-	-	-	-
1974	27 593	-	-	-	-
1975	37 993	-	-	-	-
1976	31 411	-	-	-	-
1977	35 396	-	-	-	-
1978	27 506	-	4	-	0.00
1979	20 108	-	12	-	0.00
1980	27 202	11 392	-	-	-
1981	29 968	12 528	204	0.42	0.01
1982	33 318	13 972	9	0.42	0.00
1983	42 717	13 923	613	0.33	0.01
1984	39 644	15 982	121	0.40	0.00
1985	43 572	14 720	380	0.34	0.01
1986	55 374	18 265	1162	0.33	0.02
1987	58 923	14 906	1467	0.25	0.02
1988	50 284	13 312	867	0.26	0.02
1989	33 242	14 268	832	0.43	0.03
1990	36 129	14 543	2348	0.40	0.06
1991	38 966	21 847	3533	0.56	0.09
1992	38 307	27 604	2343	0.72	0.06
1993	45 057	20 497	7879	0.45	0.17
1994	41 925	27 341	15 407	0.65	0.37
1995	43 885	31 977	13 298	0.73	0.30
1996	42 760	40 539	15 781	0.95	0.37
1997	37 813	42 765	43 028	1.13	1.14
1998	34 617	43 228	39 450	1.25	1.14
1999	33 105	49 068	38 529	1.48	1.16
2000	31 021	51 183	42 721	1.65	1.38
2001	27 713	56 859	37 223	2.05	1.34
2002	25 983	46 826	34 040	1.80	1.31
2003	26 493	47 695	40 059	1.80	1.51
2004	25 510	46 509	39 207	1.82	1.54
2005	25 707	52 759	23 149	2.05	0.90
2006	26 795	61 845	19 796	2.31	0.74

Table 8.3. Blue shark in the North Atlantic. Length-weight relationships for *Prionace glauca* from different populations. Lengths in cm, and weights in kg unless specified in equation. W_R = round weight; W_D = dressed weight.

Stock	L (cm) W (kg) relationship	Sex	n	Length range (cm)	Source
NE Atlantic	WD = (8.04021 x 10-7) LF 3.23189	C	354	75–250 (LF)	García-Cortés and Mejuto, 2002
NW Atlantic	WR = (3.1841 x 10-6) LF 3.1313	C	4529		Castro, 1983
Atlantic	WR = (3.92 x 10-6) LT 3.41	Male	17		Stevens, 1975
Atlantic	WR = (3.184 x 10-7) LT 3.20	Female	450		Stevens, 1975
NW Atlantic	WR = (3.2 x 10-6) LF 3.128	C	720		Campana *et al.*, 2005
NW Atlantic	WD = (1.7 x 10-6) LF 3.205	C	382		Campana *et al.*, 2005

Table 8.4(a). Blue shark in the North Atlantic. Length-length relationships for male, female and both sexes combined of *Prionace glauca* from the NE Atlantic and Straits of Gibraltar (Buencuerpo *et al.*, 1998).

Females	Males	Combined
LF = 1.076 LS + 1.862 (n=1043)	LF = 1.080 LS + 1.552 (n=1276)	LF = 1.079 LS + 1.668 (n=2319)
LT = 1.249 LS + 7.476 (n=1043)	LT = 1.272 LS + 4.466 (n=1272)	LT = 1.262 LS + 5.746 (n=2315)
LUC = 0.219 LS + 4.861 (n=1038)	LUC = 0.316 LS + 2.191 (n=1264)	LUC = 0.306 LS + 3.288 (n=2302)
LT = 1.158 LF + 5.678 (n=1043)	LT = 1.117 LF + 2.958 (n=1272)	LT = 1.167 LF + 4.133 (n=2315)

L_S = standard length; L_F = fork length; L_T = total length; L_{UC} = upper caudal lobe length.

Table 8.4 (b). Blue shark in the North Atlantic. Length-length relationships for both sexes combined of *Prionace glauca* from various populations and sources.

Stock	Relationship	n	Source
NW Atlantic	LF = (0.8313) LT + 1.3908	572	Kohler *et al.*, 1995
NE Atlantic	LF = 0.8203 LT -1.061		Castro and Mejuto, 1995
NW Atlantic	LF = -1.2 +0.842 LT	792	Campana *et al.*, 2005
NW Atlantic	LT = 3.8 + 1.17 LF	792	Campana *et al.*, 2005
NW Atlantic	LCF = 2.1 + 1.0 LSF	782	Campana *et al.*, 2005
NW Atlantic	LSF = -0.8 + 0.98 LCF	782	Campana *et al.*, 2005
NW Atlantic	LF = 23.4 + 3.50 LID	894	Campana *et al.*, 2005
NW Atlantic	LID = -4.3 + 0.273 LF	894	Campana *et al.*, 2005

Table 8.5. Blue shark in the North Atlantic. Von Bertalanffy growth parameters from various studies. (L_∞ in cm (TL), k in years-1, t_0 in years).

Area	L∞	k	t0	Sex	Study
North Atlantic	394	0.133	-0.801	Combined	Aasen, 1966
North Atlantic	423	0,11	-1.035	Combined	Stevens, 1975
NW Atlantic	343	0.16	-0.89	Males	Skomal, 1990
NW Atlantic	375	0.15	-0.87	Females	Skomal, 1990
NE Atlantic	377	0.12	-1.33	Combined	Henderson *et al*., 2001
North Atlantic	282	0.18	-1.35	Males	Skomal and Natanson, 2002
North Atlantic	310	0.13	-177	Females	Skomal and Natanson, 2002
North Atlantic	287	0.17	-1.43	Combined	Skomal and Natanson, 2003
NW Atlantic	300	0.68	-0.25	Combined	MacNeil and Campana, 2002 (whole ages)
NW Atlantic	302	0.58	-0.24	Combined	MacNeil and Campana, 2002 (section ages)

Table 8.6. Blue shark in the North Atlantic. Biological parameters for blue shark.

Parameter	Values	Sample Size	Area	Reference
Reproduction	Placental viviparity			various
Litter size	25–50 (30 average)			various
Size-at-birth (LT)	30–50 cm			various
Sex ratio (males: females)	1.5:1		NE Atlantic	García-Cortés and Mejuto, 2002
	1:1.44		NE Atlantic	Henderson *et al.*, 2001
	1.33:1		NW Atlantic	Kohler *et al.*, 2002
	1:2.13		NE Atlantic	Kohler *et al.*, 2002
	1:1.07	801	NE Atlantic (N. coast Spain)	Mejuto and García-Cortés, 2005
	1:0.9	158	NE Atlantic (S. coast Spain)	
	1:0.38	2187	N central Atlantic	
	1:0.53	4550	NW Atlantic	
Gestation period	9–12 months			Campana *et al.*, 2002
% of females revealing fecundation signs	0.74	415	NE Atlantic (N. coast Spain)	Mejuto and García-Cortés, 2005
	0	76	NE Atlantic (S. coast Spain)	
	36.27	601	N central Atlantic	
	18.15	1573	NW Atlantic	
% of pregnant females	0	415	NE Atlantic (N. coast Spain)	Mejuto and García-Cortés, 2005
	0	76	NE Atlantic (S. coast Spain)	
	14.6	601	N central Atlantic	
	9.8	1573	NW Atlantic	
Male age-at-maturity (years)	4–6			various
Female age-at-maturity (years)	5–7			various
Male length-at-maturity	180–280 cm (LF)		NW Atlantic	Campana *et al.*, 2002
	190–195 cm (LF)			Francis and Duffy, 2005
	201 cm (LF) (50% maturity)		NW Atlantic	Campana *et al.*, 2005

Parameter	Values	Sample Size	Area	Reference
Female length-at-maturity	220–320 cm (LF)			Campana *et al.*, 2002
	170–190 cm (LF)			Francis and Duffy, 2005
	> 185 cm (LF)			Pratt, 1979
Longevity (years)	16–20			Skomal and Natanson, 2003
Natural mortality (M)	0.23		Worldwide	Campana *et al.*, 2005 (mean of various studies)
Productivity (R2m) estimate: intrinsic rebound	0.061 (assuming no fecundity increase)		Pacific	Smith *et al.*, 1998
Potential rate of increase per year	43% (unfished)		NW Atlantic	Campana *et al.*, 2005
Population doubling time TD (years)	11.4 (assuming no fecundity increase)		Pacific	Smith *et al.*, 1998
Trophic level	4.1	14		Cortés, 1999

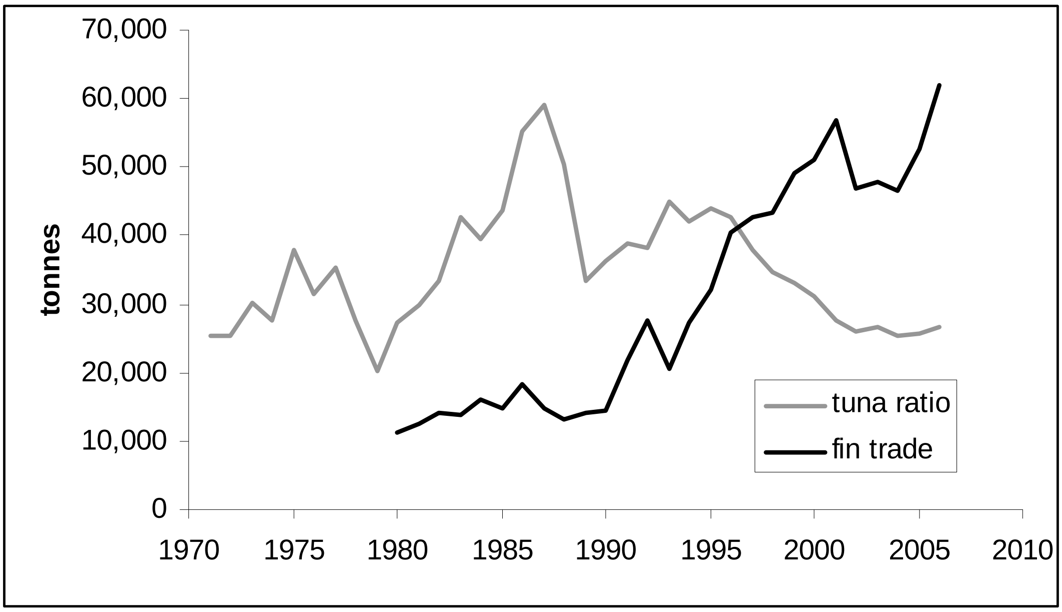

Figure 8.1. Blue Shark in the North Atlantic. Two estimates of catch, as presented by ICCAT (2008). Tuna ratio: resulting from application of the method of estimating catches using the ICCAT reported data and the ratio of tunas to shark catch; fin trade: based on the medians scaled to effort partitioned into north and south management units based on effort in the ICCAT database.

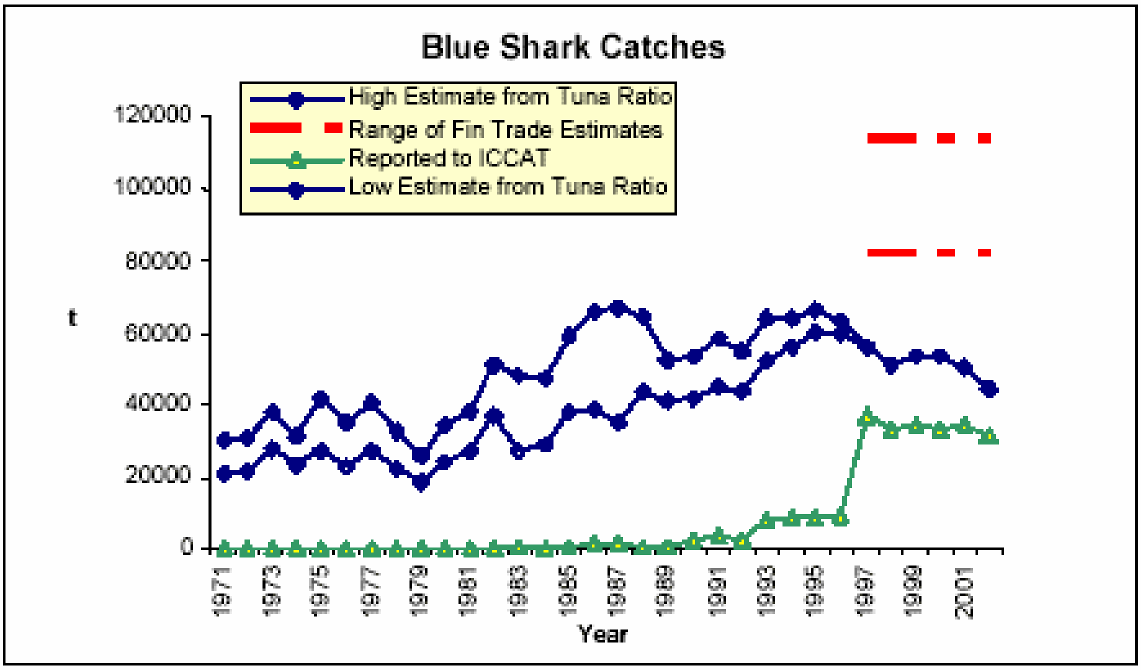

Figure 8.2. Blue shark in the Atlantic. Comparison of shark catch reported to ICCAT with estimates resulting from tuna to shark ratios and from fin trade data for blue sharks in the Atlantic. Source: ICCAT.

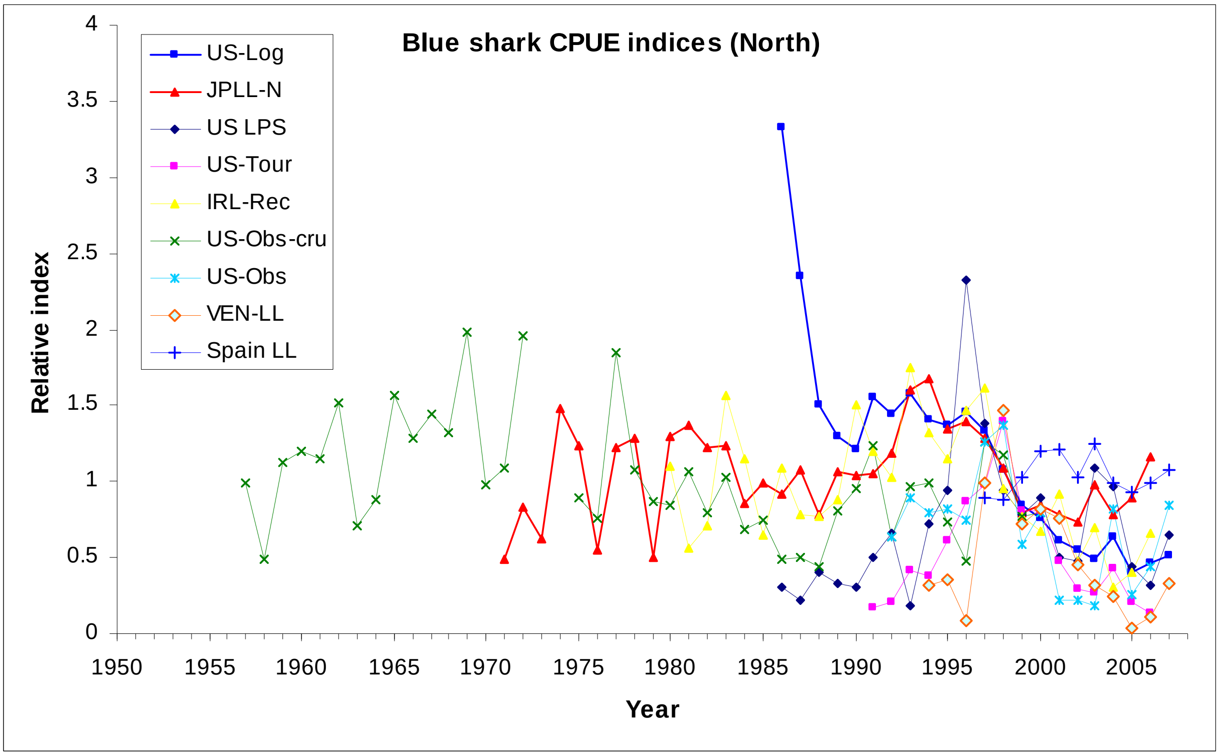

Figure 8.3. Blue Shark in the North Atlantic. Cpue indices used in ICCAT assessment in 2008. Indices presented on a relative scale.

9 Shortfin mako in the North Atlantic

9.1 Stock distribution

There is considered to be a single-stock of shortfin mako *Isurus oxyrinchus* in the North Atlantic. This conclusion is based on genetic analyses and tagging studies (e.g. Kohler *et al*., 2002). Tagging studies conducted by NMFS (1962–2003), tagged 6309 shortfin mako from the NW Atlantic. A total of 730 (11.6%) recaptures were made, of which transatlantic movements were recorded. Genetic studies (Heist *et al*., 1996; Schrey and Heist, 2003) have found no evidence to suggest separate east and west populations in the Atlantic, however the North Atlantic population appears to be isolated from those of other oceans. Therefore, the ICES area is only part of the North Atlantic stock.

Based on the oceanography of equatorial waters, and that other large pelagic species (e.g. swordfish) have a southern stock boundary of 5ºN, this is also suggested to be the southern limit of the North Atlantic shortfin mako stock. Hence, the stock area broadly equates with FAO Areas 27, 21, 31 and 34 (in part). The relationship between shortfin mako in the North Atlantic and Mediterranean Sea is unclear.

9.2 The fishery

9.2.1 A history of the fishery

Shortfin mako is a highly migratory pelagic species that is caught frequently as a bycatch, mostly in surface longline fisheries that traditionally target tuna and billfish, and in other high seas tuna fisheries. Like porbeagle shark, it is a relatively high-value species (cf blue shark, which is of lower commercial value), and thus is normally retained (Campana *et al*., 2005). Recreational fisheries on both sides of the North Atlantic also catch this species, although in relatively small quantities and some of these fish are released.

They are also taken in Mediterranean fisheries (STECF, 2003). Tudela *et al*., 2005 observed 542 shortfin mako taken as a bycatch in 4140 km of driftnets set in the Alboran Sea between December 2002 and September 2003.

9.2.2 The fishery in 2007

No new information.

9.2.3 Advice applicable

ICES does not provide advice for this stock. Assessment of this stock is considered to be the responsibility of ICCAT.

9.2.4 Management applicable

EC Regulation No. 1185/2003 prohibits the removal of fins and subsequent discarding of the body of this species. This regulation is binding on EC vessels in all waters and non-EC vessels in Community waters.

9.3 Catch data

9.3.1 Landings

Available landings data from FAO Fishstat are presented in Table 9.1. These values are considered underestimates, because of the inconsistent or generic reporting of shark catches. Estimated catches of shortfin mako from the ICCAT shark subgroup are given in Table 9.2. These data include reported landings of shortfin mako and unspecified mako, and estimated landings from (a) the ratio of shark catches to tuna and tuna-like species, and (b) from fin trade data. Reported landings of shortfin mako and unspecified mako sharks are thought to be underestimated in the early part of the time-series (prior to 1997), with official landings and estimates of a comparable magnitude in more recent years, with annual landings in the region of 4500 t.

In the ICES area, shortfin mako is reported predominantly from Portuguese and Spanish fisheries in Subareas, VIII, IX, and X, although there are records from as far north as Hatton Bank (northwest of Ireland) from Japanese tuna longliners (Boyd, 2007). Given that there can be confusion between shortfin mako and porbeagle; further studies to clarify the northern range of shortfin mako are required.

9.3.2 Discards

Estimates of shortfin mako bycatch are difficult, as available data are limited and documentation is incomplete. A report of the US pelagic longline observer programme stated that of the sharks caught alive, 23% were released alive and 61% retained (ICCAT 2005).

Shortfin mako is a high value species, and many European fisheries land shortfin mako gutted (usually with the head on). Although in some fisheries shortfin mako sharks are landed for their meat, finning (i.e. the practice of removing a fin or fins of a shark and returning the remainder of the shark's carcass to the sea) may occur for this species as well, which may result in undocumented catches and mortality in some fleets. Observations on fin trade markets in Asia and the numbers of fins traded there leads to estimated annual landings of 4000–6000 t of North Atlantic shortfin mako. The effect of finning bans in the US and Canada (since 1994) and the EU (since 2003) need to be evaluated.

9.3.3 Quality of catch data

Catch data are incomplete, and the extent of finning in high seas fisheries is unclear. The historical use of generic shark categories is problematic, although many European countries have begun to report more species-specific data in recent years.

9.4 Commercial catch composition

No new information.

9.4.1 Conversion factors

Scientific estimates for the length-weight relationship for shortfin mako are summarized in Table 9.3, conversion factors for different length measurements in Table 9.4. Shortfin mako can be landed in various forms, whole, dressed, with or without heads, fins only etc. It is therefore important that appropriate conversion factors for these landings are used. FAO (based on Norwegian data) use conversion factors for fresh, gutted, and gutted and headed sharks of 87% and 77%, respectively (Hareide *et al*., 2007).

9.5 Commercial catch-effort data

Cpue data were compiled at the ICCAT assessment in 2004 (ICCAT, 2005) and in 2008, and these indicated a declining trend for this species in the North Atlantic for the years 1975–2004. Further analyses and interpretation of these data are required. These datasets include commercial data from Japanese, Spanish, Chinese (Taiwan), Canadian and US longline fisheries. Some of these indices have revealed a rapid increase in recent years, with such an increase incompatible with the known population productivity of shortfin mako. Hence, these data may be affected by changes in catchability (e.g. changes in the spatial distribution, target species, fishing depths, or fishing gear used by the fleets and/or a contraction in the range of the population), changes in reporting or regulations, or that there has been immigration from adjacent areas.

Matsunaga and Nakano, 2000 analysed observer data of bycatch from Japanese tuna longline fisheries in the Atlantic. The catch of shortfin mako was low in the central Atlantic (eight specimens recorded) but quite high in the Northwest Atlantic (710 specimens recorded), with a cpue of >0.8 (number of catches per 1000 hooks).

Buencuerpo *et al.*, 1998 investigated shortfin mako landings made by the Spanish longline and gillnet fisheries, fishing in waters from the NW African coast northwards to the Iberian Peninsula and the Straits of Gibraltar. In total, 5947 *Isurus* were landed into Algeciras fish market from 175 landings between July 1991 and July 1992, and they comprised 11.6% of the total catches.

Although the relationship between Atlantic and Mediterranean shortfin mako is unclear, Tudela *et al.*, 2005, estimated cpue based on driftnetters from Al Hoceima and Nador fishing in the Alboran Sea. Di Natale and Pelusi, 2000 reported on data from the Italian large pelagic longline fishery in the Tyrrhenian Sea (1998–1999), and calculated a cpue of 1.1 kg per 1000 hooks.

9.6 Fishery-independent surveys

Few sources of fishery-independent information are available, mainly from the NW Atlantic (e.g. Simpfendorfer *et al.*, 2002). No fishery-independent data from the NE Atlantic are available.

9.7 Life-history information

Only a few studies have compiled data on biological information on this species. Data available for the North Atlantic stock is given in Table 9.3 (Length-weight relationships), Tables 9.5 (growth parameters), and 9.6 (other life-history parameters). The NMFS also conducts a Cooperative Shark Tagging Programme (CSTP), which collaborates with the Shark Tagging Programme of the Irish Central Fisheries Board (Green, 2007 WD; NMFS, 2006).

9.7.1 Habitat

Shortfin mako is a common, extremely active, offshore littoral and epipelagic species found in tropical and warm-temperate seas from the surface down to at least 500 m (Compagno, 2001). They are seldom found in waters below 16°C, and in the western North Atlantic they only move onto the continental shelf when surface temperatures exceed 17°C. Observations from South Africa indicate that this species prefers clear water (Compagno, 2001).

9.7.2 Nursery grounds

Published records of potential nursery grounds are lacking. However, Stevens, 2008 suggested that nursery areas would likely be situated close to the coast, based on the basis of the majority of reports, with possible nursery grounds off West Africa in the North Atlantic.

9.7.3 Diet

Shortfin mako feed primarily on fish, with a wide variety of both pelagic and demersal species observed in stomach contents (Compagno, 2001). In the NW Atlantic, bluefish is the most important prey species and comprises about 78% of the diet (Stillwell and Kohler, 1982). Stillwell and Kohler, 1982 estimated that a 68 kg shortfin mako might consume about 2 kg of prey per day, and could eat about 8–11 times its body weight per year. Stillwell, 1990 subsequently suggested that shortfin mako may consume up to 15 times their weight per year.

Shortfin mako sampled off southwest Portugal had teleosts as the principal component of their diet (occurring in 87% of the stomachs and accounting for over 90% of the contents by weight), whereas crustaceans and cephalopods were also relatively important in their diet; other elasmobranchs were only present occasionally (Maia *et al*., 2006). The diets of shortfin mako in South African waters indicated that elasmobranchs could be important prey, and marine mammals can also make up a small proportion of the diet (Compagno, 2001).

9.7.4 Life history parameters

The life-history parameters of the shortfin mako from studies to-date are summarized in Table 9.6.

9.8 Exploratory assessment models

9.8.1 Previous assessments

In 2004, ICCAT has held an assessment meeting to assess stock status of shortfin mako (ICCAT, 2005). Overall data quantity and quality was considered limited and results were considered provisional. Based on cpue data, it was likely that the North Atlantic stock of shortfin mako has been depleted to about 50% of previous levels. Stock capacity may likely be below MSY and a high to full level of exploitation for this stock was inferred from available data. Further studies are needed of the assumptions underlying the model need to be completed before stronger conclusions can be drawn (ICCAT 2005, 2006).

9.8.2 Stock assessment

Assessments were undertaken in 2008, using a Bayesian surplus production (BSP) model, an age structured production model (ASPM) and a catch-free age structured production model. For details of these models and model outputs see ICCAT (2008).

9.9 Quality of assessment

Preliminary assessments undertaken by ICCAT are conditional on several assumptions, including the estimates of historical shark catch, the relationship between catch rates and abundance, the initial state of the stock, as well as uncertainty in some life-history parameters.

ICCAT (2008) noted that "Although both the quantity and quality of the data available to conduct stock assessments has increased with respect to that available in 2004, they are still quite uninformative and do not provide a consistent signal to inform the model. Unless these and other issues can be resolved, the assessments of stock status for this and other species will continue to be very uncertain."

9.10 Reference points

No reference points have been proposed for this stock.

9.11 Management considerations

Catch data of pelagic sharks are considered unreliable, as many sharks are not reported on a species-specific basis, and some fisheries may have only landed fins. It is clear that the landings data presented in this report are underestimates. Reporting procedures must be strengthened so that all landings are reported, and that landings are reported to species level, rather than generic "nei" categories.

ICCAT, 2005 used three sources of data when assessing pelagic shark stocks; reported data (i.e. the declared landings made by each member state to ICCAT and the FAO), tuna ratios (estimated catches in relation to declared landings of tuna and tuna-like species) and market data (based on the amount of sharks or fins traded in the large Asian market).

The 2006 Report of the Standing Committee on Research and Statistics (SCRS) suggested that, if the status of this stock was to be improved, then reductions in effective fishing effort would be most beneficial to shortfin mako, given that the basis for recommending catch limits was hampered by the uncertainty of catches (ICCAT, 2006). Technical measures (e.g. modifications to fishing gear, restrictions on fishing areas and times, minimum or maximum sizes for allowable retained catch) were also suggested as having potential benefits to the stock (ICCAT, 2006).

In 2006, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the Atlantic population of the shortfin mako as threatened and is considering its addition to Schedule 1 under the Species at Risk Act (SARA) (DFO, 2006). A catch limit of 100 t annually for the Canadian pelagic longline fishery as well as release of live catch is advised. The US National Marine and Fisheries Service NMFS is currently assessing the Atlantic shortfin mako stock to determine possible threat level (NMFS, 2006).

At present, the shortfin mako is listed as Lower Risk Near Threatened in the IUCN Red List (Stevens, 2000).

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Table 9.1. Shortfin mako in the North Atlantic. Available landings (t) of shortfin mako by country. Landings of 'Mako sharks' assumed to be shortfin mako (Source FAO Fishstat). These data are considered underestimates.

Fishing area	Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Atlantic, Eastern Central	Benin	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	China	-	-	-	-	-	-	34	45	23	27
Atlantic, Eastern Central	Côte d'Ivoire	-	-	-	-	9	13	7	17	12	15
Atlantic, Eastern Central	Liberia	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Panama	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Philippines	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Portugal	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Spain	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Vanuatu	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	Portugal	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Spain	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	UK	-	-	-	-	-	-	-	-	-	-
Atlantic, Northwest	Canada	-	-	-	-	-	-	-	-	-	67
Atlantic, Northwest	Portugal	.	.	.	.	.	.	.	.	.	.
Atlantic, Northwest	Spain	-	-	-	-	-	-	-	-	-	-
Atlantic, Northwest	USA	6	2	7	20	64	59	71	115	5	-
Atlantic, Western Central	Portugal	-	-	-	-	-	-	-	-	-	-
Atlantic, Western Central	Spain	-	-	-	-	-	-	-	-	-	-
Atlantic, Western Central	Trin & Tob	.	.	.	.	.	.	.	.	.	.
Atlantic, Western Central	USA	-	-	-	-	-	-	-	-	-	-
	TOTAL	6	2	7	20	73	72	112	177	40	109
Mediterranean Sea	Portugal	-	-	-	-	-	-	-	-	-	-
Mediterranean Sea	Spain	-	-	-	-	-	-	-	-	-	-

Table 9.1. Cont.

Fishing area	Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Atlantic, Eastern Central	Benin	.	.	.	3	1	.	.	.	1	.
Atlantic, Eastern Central	China	19	74	126	191	22	208	260	.	.	.
Atlantic, Eastern Central	Côte d'Ivoire	92	38	10	9	15	15	30	15	14	22
Atlantic, Eastern Central	Liberia	.	.	.	116	.	.	.	.	.	.
Atlantic, Eastern Central	Panama	-	-	25	1	-	-	-	-	-	-
Atlantic, Eastern Central	Philippines	-	-	3	-	-	-	-	-	.	-
Atlantic, Eastern Central	Portugal	.	.	.	42	42	68	151	42	216	225
Atlantic, Eastern Central	Spain	-	-	-	-	-	-	-	468	523	604
Atlantic, Eastern Central	Vanuatu	-	-	-	-	-	-	-	52	12	13
Atlantic, Northeast	Portugal	.	.	160	183	186	107	541	328	603	729
Atlantic, Northeast	Spain	-	-	-	-	-	-	-	254	93	91
Atlantic, Northeast	UK	-	<0.5	2	3	2	1	1	1	<0.5	<0.5
Atlantic, Northwest	Canada	110	69	70	78	69	78	73	80	91	71
Atlantic, Northwest	Portugal	.	.	.	10	-	-	9	-	1	<0.5
Atlantic, Northwest	Spain	-	-	-	-	-	-	-	-	212	214
Atlantic, Northwest	USA	-	-	-	19	66	57	37	66	45	50
Atlantic, Western Central	Portugal	-	<0.5	-	-	-	-	-	-	-	-
Atlantic, Western Central	Spain	73	33	.	.	.	134	63	-	94	105
Atlantic, Western Central	Trin & Tob	.	.	1	.	1	2	3	1	2	1
Atlantic, Western Central	USA	-	-	-	5	5	-	-	5	-	-
	TOTAL	294	214	397	660	409	670	1168	1312	1907	2125
Mediterranean Sea	Portugal	-	-	-	1	6	-	<0.5	31	15	5
Mediterranean Sea	Spain	6	7	5	3	2	2	2	2	2	5

Table 9.2. Shortfin mako in the North Atlantic. Estimated landings (t) of shortfin mako 1971–2006 based on reported landings of shortfin mako and mako (unspecified), and as estimated from the ratio of sharks to tuna and tuna-like species, and as estimated by fin trade data (Source: ICCAT Shark subgroup).

Year	Estimated catch (tuna ratio)	Estimated catch (fin trade data)	ICCAT landings (shortfin mako & mako unspecified)	Fin trade estimates as a proportion of estimated landings	ICCAT landings as a proportion of estimated landings
1971	3717	-	200	-	0.05
1972	3014	-	168	-	0.06
1973	3322	-	263	-	0.08
1974	3345	-	346	-	0.10
1975	4280	-	389	-	0.09
1976	3038	-	92	-	0.03
1977	3642	-	465	-	0.13
1978	3241	-	299	-	0.09
1979	2402	-	313	-	0.13

1980	3253	1105	474	0.34	0.15
1981	3079	1216	999	0.39	0.32
1982	3614	1356	1723	0.38	0.48
1983	4209	1352	941	0.32	0.22
1984	4480	1551	1776	0.35	0.40
1985	6900	1429	3801	0.21	0.55
1986	6589	1773	1957	0.27	0.30
1987	6336	1447	1039	0.23	0.16
1988	5985	1292	1563	0.22	0.26
1989	4098	1385	1647	0.34	0.40
1990	3852	1411	1348	0.37	0.35
1991	4114	2128	1326	0.52	0.32
1992	3871	2689	1441	0.69	0.37
1993	5364	1996	2967	0.37	0.55
1994	4510	2663	2025	0.59	0.45
1995	6202	3114	2988	0.50	0.48
1996	4790	3956	1714	0.83	0.36
1997	3792	4173	5212	1.10	1.37
1998	4255	4218	4560	0.99	1.07
1999	3311	4788	3982	1.45	1.20
2000	2955	4994	4779	1.69	1.62
2001	2855	5512	4648	1.93	1.63
2002	3521	4539	4959	1.29	1.41
2003	4206	4624	7254	1.10	1.72
2004	3689	4509	6981	1.22	1.89
2005	3807	5114	4269	1.34	1.12
2006	3564	5996	3839	1.68	1.08

Table 9.3: Shortfin mako in the North Atlantic. Length-weight relationships for *Isurus oxyrinchus* from different populations.

Stock	L (cm) W (kg) relationship	Sex	n	Length range (cm)	Source
Central Pacific	log W (lb) = –4.608 + 2.925 x log LT				Strasburg, 1958
Cuba	W = 1.193 x 10–6 x LT 3.46	C	23	160–260 (LT)	Guitart, 1975
Australia	W = 4.832 x 10–6 x LT 3.10	C	80	58–343 (LT)	Stevens, 1983
South Africa	W = 1.47 x 10–5 x LPC 2.98	C	143	84–260 (LPC)	Cliff, Dudley and Davis, 1990
NW Atlantic	WR = (5.2432 x 10–6) LF 3.1407	C	2081	65–338 (LF)	Kohler *et al.*, 1995.
NW Atlantic	W = 7.2999 x LT (m) 3.224	C	63	2.0–3.7 m (LT)	Mollet *et al.*, 2000
southern hemisphere	W = 6.824 x LT (m) 3.137	C	64	2.0–3.4 m (LT)	Mollet *et al.*, 2000
NE Atlantic	WD = (2.80834 x 10–6) LF 3.20182	C	17	70–175 (LF)	García-Cortés and Mejuto, 2002

Tropical east Atlantic	WD = (1.22182 x 10–5) LF 2.89535	C	166	95–250	García-Cortés and Mejuto, 2002
Tropical central Atlantic	WD = (2.52098 x 10–5) LF 2.76078	C	161	120–185	García-Cortés and Mejuto, 2002
Southwest Atlantic	WD = (3.1142 x 10–5) LF 2.7243	C	97	95–240	García-Cortés and Mejuto, 2002

Lengths in cm, and weights in kg unless specified in equation.

W_R = round weight; W_D = dressed weight

Table 9.4: Shortfin mako in the North Atlantic. Length-length relationships for male, female and both sexes combined from the NE Atlantic and Straits of Gibraltar (Source: Buencuerpo *et al.* 1998). L_S = standard length; L_F = fork length; L_T = total length; L_{UC} = upper caudal lobe length.

FEMALES	MALES	COMBINED
LF = 1.086 LS + 1.630 (n=852)	LF = 1.086 LS + 1.409 (n=911)	LF = 1.086 LS + 1.515 (n=1763)
LT = 0.817 LS + 0.400 (n=852)	LT = 1.209 LS + 0.435 (n=681)	LT = 1.207 LS + 0.971 (n=1533)
LUC = 3.693 LS + 13.094 (n=507)	LUC = 3.795 LS + 10.452 (n=477)	LUC = 3.758 LS + 11.640 (n=1054)
LT = 1.106 LF + 0.052 (n=853)	LT = 1.111 LF – 0.870 (n=911)	LT = 1.108 LF – 0.480 (n=1746)

Table 9.5: Shortfin mako in the North Atlantic. Growth parameters from 2 studies.

Formation of 2 vertebral bands annually assumed and von Bertalanffy growth function used t_0 in years.

**** Gompertz growth function used, t_0 in cm. L_∞ in cm (Fork Length), k in years–1.**

AREA	L∞	K	T0	SEX	STUDY
Northwest Atlantic	302	0.266	–1	Male	Pratt and Casey, 1983)
Northwest Atlantic	345	0.203	–1	Female	Pratt and Casey, 1983*
Atlantic	373.4	–0.203	1.0	Female	Cortés, 2000*
Northwest Atlantic	253	0.125	71.6	Male	Natanson *et al.*, 2006**
Northwest Atlantic	366	0.087	88.4	Female	Natanson *et al.*, 2006**

Table 9.6: Shortfin mako in the North Atlantic. Life history information available from the scientific literature.

PARAMETER	VALUES	SAMPLE SIZE	AREA	REFERENCE
Reproduction	Ovoviviparous with oophagy			Campana *et al.*, 2004
Litter size	4–25	35	Worldwide	Mollet *et al.*, 2000
	12–20			Castro *et al.*, 1999
Size at birth (LT)	70 cm	188+	Worldwide	Mollet *et al.*, 2000
Sex ratio (males: females)	1:1	2188	NW Atlantic	Casey and Kohler, 1992
	1:0.4		NE Atlantic (Spain, Azores)	Mejuto and Garces, 1984
	1:0.9		NE, N central Atlantic and Med	Buencuerpo *et al.*, 1998

Parameter	Values	Sample Size	Area	Reference
	1.0:1.4	17	NE Atlantic	García-Cortés and Mejuto, 2002
Gestation period	15–18	26	Worldwide	Mollet *et al*., 2000
Male age at first maturity (years)*	2.5			Pratt and Casey, 1983
	9			Cailliet *et al*., 1983
Male age at median maturity (years)	7	145	New Zealand	Bishop *et al*., 2006
Female age at first maturity (years)*	5			Pratt and Casey, 1983
Female age maturity (years)	19	111	New Zealand	Bishop *et al*., 2006
	7			Pratt and Casey, (1983)
Male length at first maturity (TL)	195 cm			Stevens, 1983
Male length at maturity (TL)	197–202 cm (median)	215	New Zealand	Francis and Duffy, 2005
	180 cm (LF)		NE Atlantic (Portugal)	Maia *et al*., 2007
	200–220		Worldwide	Pratt and Casey, 1983; Mollet *et al*., 2000
Female length at first maturity (TL)	265–280 cm			Cliff *et al*., 1990
Female length at maturity (TL)	301–312 (median)	88	New Zealand	Francis and Duffy, 2005
	270–300 cm (LT)		Worldwide	Pratt and Casey, 1983; Mollet *et al*., 2000
Age at recruitment (year)	0–1			Stevens and Wayte, 1999
Male maximum length (TL)	296 cm			Compagno, 2001
Female maximum length (TL)	396 cm 408 cm (estimated)			Compagno, 2001
Life span (years)	11.5–17 (oldest aged)			Pratt and Casey, 1983
	45 (estimated longevity)			Cailliet *et al*., 1983
Natural mortality (M)	0.16		Pacific	Smith *et al*., 1998

Parameter	Values	Sample Size	Area	Reference
Annual survival estimate	0.79 (95% C.I. 0.71–0.87)			
Growth parameters	61.1 cm year–1 first year 40.6 cm year–1 second year 5.0 cm month–1 in summer 2.1 cm month–1 in winter	262	NE Atlantic (Portugal)	Maia *et al*., 2007
Maximum age (estimated from von Bertalanffy growth eqn.)	28			Smith *et al*., 1998
Productivity (R2m) estimate : intrinsic rebound	0.051 (assuming no fecundity increase)		Pacific	Smith *et al*., 1998
Potential rate of increase per year	8.5%		Atlantic	Cortés, 2000
Population doubling time TD (years)	13.6 (assuming no fecundity increase)		Pacific	Smith *et al*., 1998
Generation time (years)	~ 9		Atlantic	Cortés, 2000
Trophic level	4.3	7		Cortés, 1999

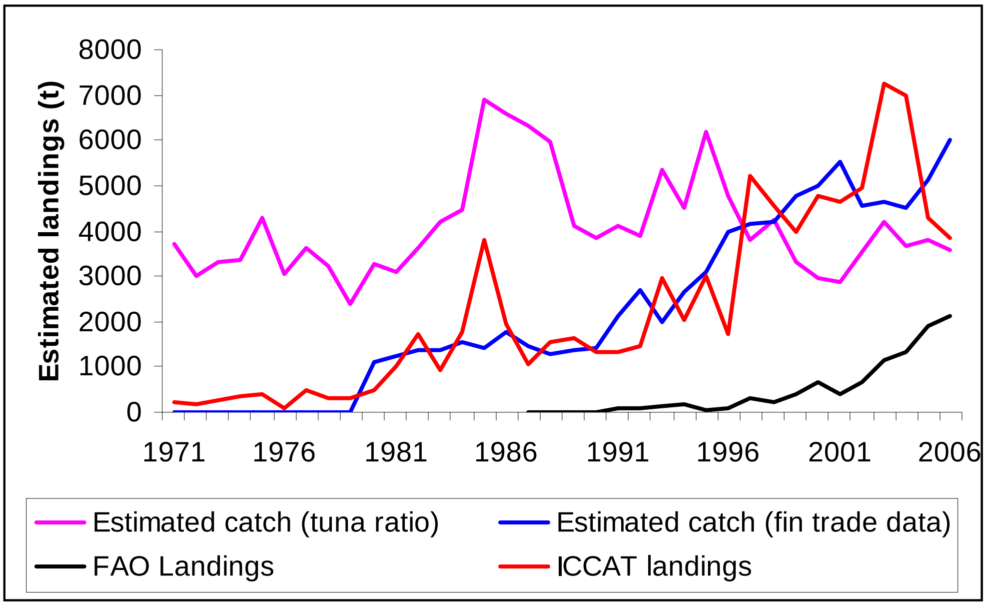

Figure 9.1. Shortfin mako (*Isurus oxyrinchus*) in the North Atlantic. Available landings (tonnes) from North Atlantic by FAO Areas 27, 21 and 34. Reporting has been minimal or the years 2005 and 2006.

10 Tope in the North East Atlantic and Mediterranean

10.1 Stock distribution

WGEF considers that there is a single-stock of tope (or school shark, *Galeorhinus galeus*) in the ICES area, with the distribution ranging from Scotland and southern Norway southwards to the coast of north-western Africa and Mediterranean Sea. The stock area therefore, covers ICES Subareas II–X (where Subareas IV and VI–X are important parts of the stock range, and Subareas II, III and V areas where tope tend to be an occasional vagrant).

This stock also extends beyond the ICES area, as tope tagged in the ICES area have been recaptured as far south as the Canary Islands. The distribution of tope along the western seaboard of Africa is poorly known, and the degree of mixing (if any) between NE and SE Atlantic tope stocks is unclear. Tope do not occur in the NW Atlantic.

WGEF consider the NE Atlantic tope stock covers the ICES Area (II–X), Mediterranean Sea (Subareas I–III) and northern part of the CECAF area, and any future assessment of the NE Atlantic tope stock may need to be undertaken in conjunction with the General Fisheries Commission for the Mediterranean (GFCM) and Fishery Committee for the Eastern Central Atlantic (CECAF).

The stock unit identified by WGEF was based on published tagging studies (e.g. Holden and Horrod, 1979; Stevens, 1976, 1990; Irish Central Fisheries Board, unpublished data), which clearly indicate that tagged fish move widely throughout the NE Atlantic (Figure 10.1). There are several ongoing tagging programmes, which may provide further information on the stock in future.

10.2 The fishery

10.2.1 History of the fishery

Currently there are no targeted commercial fisheries for tope in the north-eastern Atlantic, though they are taken as a bycatch in trawl, gillnet and longline fisheries, including demersal and pelagic set gears. Though tope are discarded in some fisheries, because of their low market value, other fisheries land this bycatch.

Tope is also an important target species in recreational sea angling and charter boat fishing in several areas, with most anglers and angling clubs following catch and release protocols.

Landings data on this species are limited, as they are often included as “dogfish and hounds” (DGH). Nevertheless, England and France have some species-specific landings data, and there are also limited data from Denmark, Ireland, Portugal and Spain (Basque Country) in recent years.

Many of the reported landings are from the English Channel, Celtic Sea and northern Bay of Biscay (Bonfil, 1994). Tope is also caught in Spanish fisheries in the western Cantabrian Sea (Galicia), where about 80% of the landings are from longline vessels, with the remainder from trawl and small gillnets (Anon., 2003). Tope also feature in the catches off mainland Portugal, and are an important component of Azorean bottom longline fisheries (Heessen, 2003; Morato *et al*., 2003). Tope are also caught in offshore longline fisheries is this area (Pinho, 2005) and are an occasional bycatch in surface longline fisheries (e.g. Megalofonou *et al*., 2005).

10.2.2 The fishery in 2007

There were no major changes to the fishery noted in 2007. It was suggested that there might have been a greater retention of tope in some inshore fisheries operating in ICES Division IVc, as a result of bycatch limits on skates and rays (see Section 15), although no data are currently available to examine this.

10.2.3 ICES Advice applicable

ICES has never provided advice for this stock.

10.2.4 Management applicable

Some Sea Fisheries Committees in the UK are considering local bylaws to deter targeted fisheries establishing in UK coastal waters.

In terms of UK fisheries, and following a stakeholder consultation in 2006, Defra has prohibited fishing for tope other than by rod and line (with rod and line anglers fishing from boats not allowed to land their catch) and established a tope bycatch limit of 45 kg per day for commercial fisheries targeting other species.

10.3 Catch data

10.3.1 Landings

No accurate estimates of catch are available, as many nations that land tope will report an unknown proportion of landings in aggregated landings categories (e.g. dogfish and hounds). Reported species-specific landings, which commenced in 1978 for French fisheries, are given in Table 10.1. Landings indicate that France is one of the main nations landing tope (though data for 1980 and 1981 were not available). The UK also land tope, although species-specific data are lacking for the earlier years. Since 2001, Ireland, Portugal and Spain have also declared species-specific landings, although recent data were not available for Spanish fisheries, other than for the Basque fleet.

Landings data for 2007 were incomplete and also contained some provisional landings data. These data (Table 10.1) will be updated next year.

No species-specific catch data for those parts of the stock in the Mediterranean Sea and off North-west Africa are available. The degree of possible misreporting or underreporting is not known. Overall available landings appear relatively stable in recent years, at about 500 $t.y^{-1}$ (Figure 10.2). However, the absence of some recent national data restricts the interpretation of these data.

10.3.2 Discards

Though some discards information is available from various nations, data are limited for most nations and fisheries. The length–frequency of tope observed in UK (England and Wales) discard sampling for demersal trawl fisheries and drift and fixed net fisheries are illustrated in Figure 10.3. These are raw data that, because of the small sample size of fish involved, have been aggregated across years (2001–2006) and ICES Divisions (IV b–c, VII a, d–k) and have not been raised to fleet level. It indicates that juvenile tope tend to be discarded in demersal trawl fisheries and larger individuals are usually retained. Tope caught in drift and fixed net fisheries are usually retained. Smaller individuals (<60 cm total length) were not recorded during observer trips in the fixed and driftnet fisheries, which could be because of gear selectivity or that these fisheries do not overlap with juvenile tope in space/time.

10.3.3 Quality of catch data

Catch data are of poor quality, and biological data are not collected under the Data Collection Regulations. Some generic biological data are available (see Section 10.7).

10.4 Commercial catch composition

No new data available.

10.5 Commercial catch-effort data

No data available.

10.6 Fishery-independent information

10.6.1 Availability of survey data

Although several fishery-independent surveys operate in the stock area, data are limited for most of these. This species is not sampled appropriately in beam trawl surveys (because of low gear selectivity). They are only caught occasionally in GOV trawl and other otter trawl surveys, and future studies could examine the catches of tope in the southern and western IBTS surveys (ICES, 2008).

10.6.2 Cpue

Analyses of catch data would need to be undertaken with care, as tope is a relatively large-bodied species (up to 200 cm length in the NE Atlantic), and adults are strong swimmers that forage both in pelagic and demersal waters. Hence, they are probably not sampled effectively in IBTS surveys, and survey data generally include a large number of zero hauls. The tendency for many surveys to now have short trawl durations (e.g. of less than one hour) may also affect the likelihood of catching tope. Nevertheless, survey data may provide useful indications of areas where juvenile tope are caught.

10.6.3 Length distributions

The size distributions of fish caught in surveys around the British Isles are illustrated in Figure 10.4. These data are aggregated across years for the various surveys, and all surveys are described in Ellis *et al.*, 2005a, b. Survey data from 4-m beam trawl surveys operating in the English Channel (July, 1990–2005), and Bristol Channel and Irish Sea (September, 1990–2005) only catch tope very infrequently. Surveys in the North Sea (Granton trawl and GOV trawl, August, 1977–2005) sample a large part of the overall size range, including pups 31–45 cm long, and other juveniles. Surveys in the Celtic Sea (Portuguese high headline trawl, March, 1982–2003) sampled mostly larger individuals and comparatively few juveniles were recorded during this survey, although this survey has now ceased.

More recently, Q4 IBTS surveys in the Celtic Seas ecoregion also sample small numbers of tope (with some nations tagging and releasing specimens wherever possible). Irish IBTS surveys also record small numbers of tope, although one haul (40E2, VIa) in 2006 yielded 59 specimens. Southern and western IBTS surveys may cover a large part of the stock range, and more detailed analyses of these data are required.

10.7 Life-history information

Tope tend to most commonly reported in continental shelf waters, though tag returns suggest that they occasionally move further offshore. Tope are primarily piscivorous

(Ellis *et al*., 1996; Morato *et al*., 2003; Domi *et al*., 2005; Lucifora *et al*., 2006), feeding on a variety of pelagic and demersal fish and cephalopods.

There have been few studies describing the age and growth and reproduction of tope in the NE Atlantic (e.g. Capapé and Mellinger, 1988; Capapé *et al*., 2005), and there is no routine monitoring of length, weight and maturity-at-age for either survey or commercial catches. Due to the importance of tope in Australian and South American fisheries, there have been several biological studies of these stocks (e.g. Peres and Vooren, 1991; Ward and Gardner, 1997; Hurst *et al*., 1999; West and Stevens, 2001; Lucifora *et al*., 2004).

Tope is an aplacentally viviparous shark, with gestation lasting approximately one year, although they are thought to only reproduce every other year (Capapé *et al*., 2005). Studies on the South West Atlantic tope stock indicate that it has a triennial reproductive cycle (Peres and Vooren, 1991). Tope is a long-lived species, with longevity of at least 36 years, based on tag returns and age and growth studies (e.g. Moulton *et al*., 1989; Peres and Vooren, 1991). A tope recaptured off Cadiz during 2008 was released by recreational fisheries in the English Channel during the early 1970s (Cefas, unpublished data); and although accurate release information have been lost, it suggests a time at liberty of >30 years.

Fecundity has been estimated as 8–41 for specimens in the Mediterranean Sea (Capapé and Mellinger, 1988; Capapé *et al*., 2005), and litter size increases with maternal length. Pups are born at a length of about 24–32 cm (Compagno, 1984; Capapé *et al*., 2005).

Males and females are mature at lengths of about 122–158 cm and 140–190 cm respectively (Capapé and Mellinger, 1988; Capapé *et al*., 2005), with first spawning occurring at a length of about 150 cm. Though no age at maturity data are available for the NE Atlantic stock, 50% maturity in males and females in the South West Atlantic occurs at about 11 years (111 cm) and 15 years (123 cm) (Peres and Vooren, 1991).

Though there are no published age and growth studies of the NE Atlantic tope stock, tope from other areas have been aged successfully using vertebrae (e.g. Ferreira and Vooren, 1991; Francis and Mulligan, 1998) and tag returns (Grant *et al*., 1979).

Recruitment: Pups (24–45 cm length) are occasionally taken in groundfish surveys, and such data might be able to assist in the preliminary identification of general pupping and/or nursery areas (Figure 10.5). Most of the records for pups recorded in UK surveys are from the southern North Sea (IVc), though they have also been recorded in the northern Bristol Channel (VIIf), and fishers in this area have reported catching large numbers of juvenile tope in this area. Given the low catch rates and high variability of pups and juveniles in surveys, these data are unlikely to be sufficiently robust to estimate annual recruitment. Other sources of information regarding pupping grounds may be available from the commercial and recreational fishing sectors.

Pupping and nursery grounds: There is limited information on the distribution of tope pups, though they have been reported to occur in certain inshore areas (e.g. southern North Sea, Bristol Channel). The lack of more precise data on the location of pupping and nursery grounds, and their importance to the stock, precludes spatial management for this species at the present time. Nevertheless, protecting pupping and nursery habitats has been considered an important tool for the Australian stock, where seasonal closures and gear restrictions to protect pregnant females migrating to pupping grounds have been used (Walker, 1999).

10.8 Exploratory assessment models

10.8.1 Previous studies

No previous assessments of NE Atlantic tope have been made. Several assessment methods have been applied to the South Australian stock (e.g. Punt and Walker, 1998; Punt *et al.*, 2000; Xiao and Walker, 2000).

10.8.2 Data exploration and preliminary modelling

Landings data (see Section 10.3) and survey data (see Section 10.6) are insufficient to allow for an assessment of this species.

10.8.3 Stock assessment

No assessment was undertaken, as a consequence of insufficient data.

10.9 Quality of the assessment

No assessment was undertaken, as a consequence of insufficient data.

10.10 Reference points

No reference points have been proposed for this stock.

10.11 Management considerations

Tope is considered highly vulnerable to overexploitation, as they have a low population productivity, relatively low fecundity and protracted reproductive cycle. Furthermore, unmanaged, targeted fisheries elsewhere in the world have resulted in stock collapse (e.g. off California and in South America).

Tope are currently a non-target species in commercial fisheries, though some of the bycatch is discarded, because of the low market value in many areas. There was the suggestion of developing a targeted commercial fishery in the southern North Sea (e.g. *Fishing News*, 17 and 24 June 2005), although this has not proceeded at the present time.

Tope are also an important target species in recreational fisheries; though there are insufficient data to examine the relative economic importance of tope in the recreational angling sector, this may be high in some regions.

Tope is, or has been, a targeted species elsewhere in the world, including Australia/New Zealand, South America and off California (Ripley, 1946; Walker, 1999; Paul and Sanders, 2001). Evidence from these fisheries suggest that targeted fisheries would need to be managed quite conservatively, as targeted fisheries off California collapsed, the Australian fishery's long history of management has only very recently allowed some stock recovery to begin (Olsen, 1954, 1959, 1984; Walker, 1999), and there is concern over the seriously depleted status of the south-western Atlantic stock (Eilia *et al.*, 2005). Australian fisheries managers have used a combination of a legal minimum length, a legal maximum length, legal minimum and maximum gillnet mesh-sizes, closed seasons and closed nursery areas. However as the species are mainly taken in mixed fisheries in the ICES area, many of these measures are of less utility.

10.12 References

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Table 10.1. Tope in the North East Atlantic and Mediterranean. Reported species-specific landings (Tonnes) for the period 1978–2007. These data are considered an underestimates as some tope are landed under generic landings categories, and species-specific landings data are not available for the Mediterranean Sea and are limited for North-west African waters.

ICES Division IIIa-IV	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
France	32	22	na	na	26	26	13	31	13	14	18	12	17	16	10	11
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK	na	na	na	na	8	10	31	36	94	28	22	18	14	21	15	15
UK (Scotland													-	-	-	-
Total (IIIa–IV)	32	22	0	0	34	36	44	67	107	42	40	30	31	37	25	26
ICES Division V–VII																
France	522	2076	na	na	988	1580	346	339	1141	491	621	407	357	391	235	240
Ireland	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Spain	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Spain (Basque country)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK	na	na	na	na	63	51	28	23	21	21	21	55	45	47	53	48
Total (VI–VII)	522	2076	0	0	1051	1631	374	362	1162	512	642	462	402	438	288	288
ICES Division VIII																
France	na	237	na	na	na	63	119	52	103	97	66	39	34	38	34	40
Spain	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Spain (Basque country)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK	+	+	+	+	+	+	+	+	1							
Total (VIII)	0	237	0	0	0	63	119	52	104	97	66	39	34	38	34	40
ICES Division IX																
Spain	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Total (IX)																
ICES Division X																
Portugal	24	15	51	77	42	24	29	24	24	24	34	23	56	81	80	115
Total (X)	24	15	51	77	42	24	29	24	24	24	34	23	56	81	80	115
Other																
France	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CECAF area																
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL LANDINGS	578	2350	51	77	1127	1754	567	505	1397	675	782	554	523	593	427	469

Table 10.1. (continued). Tope in the North East Atlantic and Mediterranean. Reported species-specific landings (Tonnes) for the period 1978–2007. These data are considered an underestimate as some tope are landed under generic landings categories, and species-specific landings data are not available for the Mediterranean Sea and limited for North-west African waters.

ICES Division IIIa-IV	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Denmark	-	-	-	-	-	3	8	4	5	5	5	8	6	3
France	12	8	11	5	11		11	11	6	6	3	3	6	6
Sweden	-	-	-	-	-	-	-	-	-	-	-	+	0	0
UK	19	25	14	22	12	14	13	10	13	11	8	10	13	5
UK (Scotland	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Total (IIIa–IV)	31	33	25	27	23	17	32	25	24	22	16	21	25	14
ICES Division V–VII														
France	235	265	314	409	312		368	394	324	284	209	181	293	155
Ireland	na	na	na	na	na	na	na	4	1	6	4	na	7	3
Spain	na	na	na	na	na	na	na	+	242	3	na	na	na	na
Spain (Basque country)	-	-	-	-	-	-	-	+	+	3	15	10	.	.
UK	49	38	39	34	41	62	98	72	60	55	65	65	74	44
Total (VI–VII)	284	303	353	443	353	62	466	470	627	351	293	256	374	202
ICES Division VIII														
France	54	44	78	40	46	+	71	58	49	60	16	29	40	28
Spain	na	na	na	na	na	na	na	9	13	10	na	na	na	na
Spain (Basque country)	-	-	-	-	-	-	-	9	6	10	10	14	12	1
UK		0	0	0	0	0		1		3	8	6	5	0
Total (VIII)	54	44	78	40	46	0	71	77	68	83	34	49	57	29
ICES Division IX														
Spain	na	na	na	na	na	na	na	na	na	na	76	na	na	na
Total (IX)														
ICES Division X														
Portugal	116	124	80	104	128	129	142	82	77	69	51	45	45	na
Total (X)	116	124	80	104	128	129	142	82	77	69	51	45	45	0
Other														
France	-	-	-	-	-	386	-	2	-	-	-	-	-	-
UK	+	+	-	-	-	-	-	-	-	-	-	-	-	-
CECAF area														
Portugal	-	-	-	-	-	-	2	1	2	98	na	na	na	na
TOTAL LANDINGS	485	504	536	615	551	593	713	656	798	622	394	371	502	245

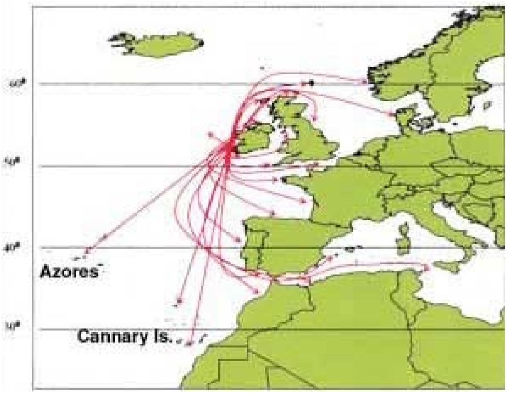

Figure 10.1. Tope in the North East Atlantic and Mediterranean. Location of tag returns from the tope tagging programme coordinated by the Central Fisheries Board (Ireland). Source: http://www.cfb.ie/fisheries_research/tagging/tope.htm.

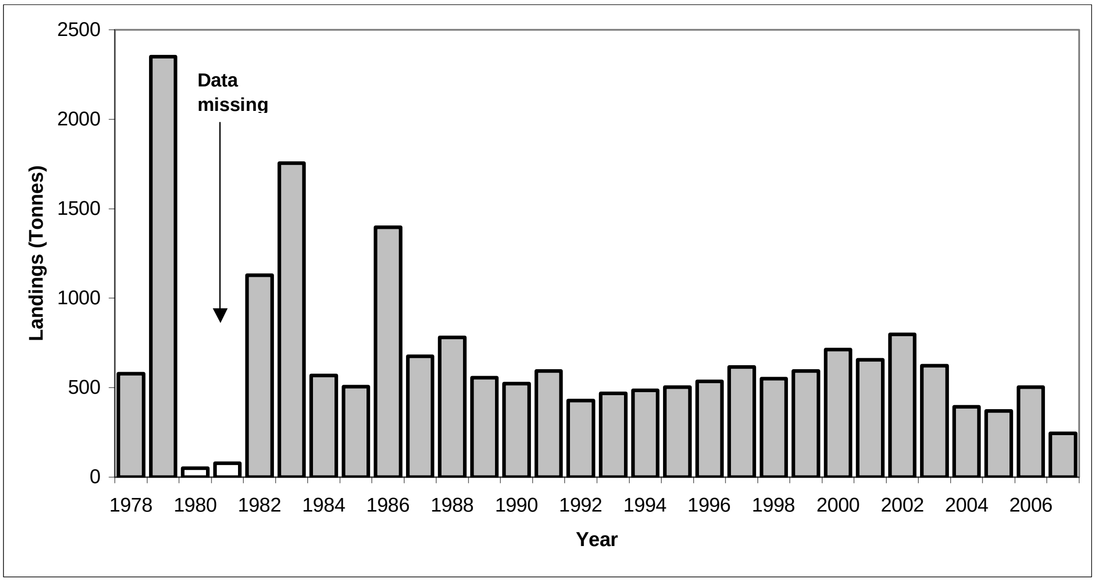

Figure 10.2. Tope in the North East Atlantic and Mediterranean. Annual landings of tope. These data are considered an underestimate as some tope are landed under generic landings categories, and no species-specific landings data are available for the Mediterranean Sea and North-west African waters. Not all data are available for recent years.

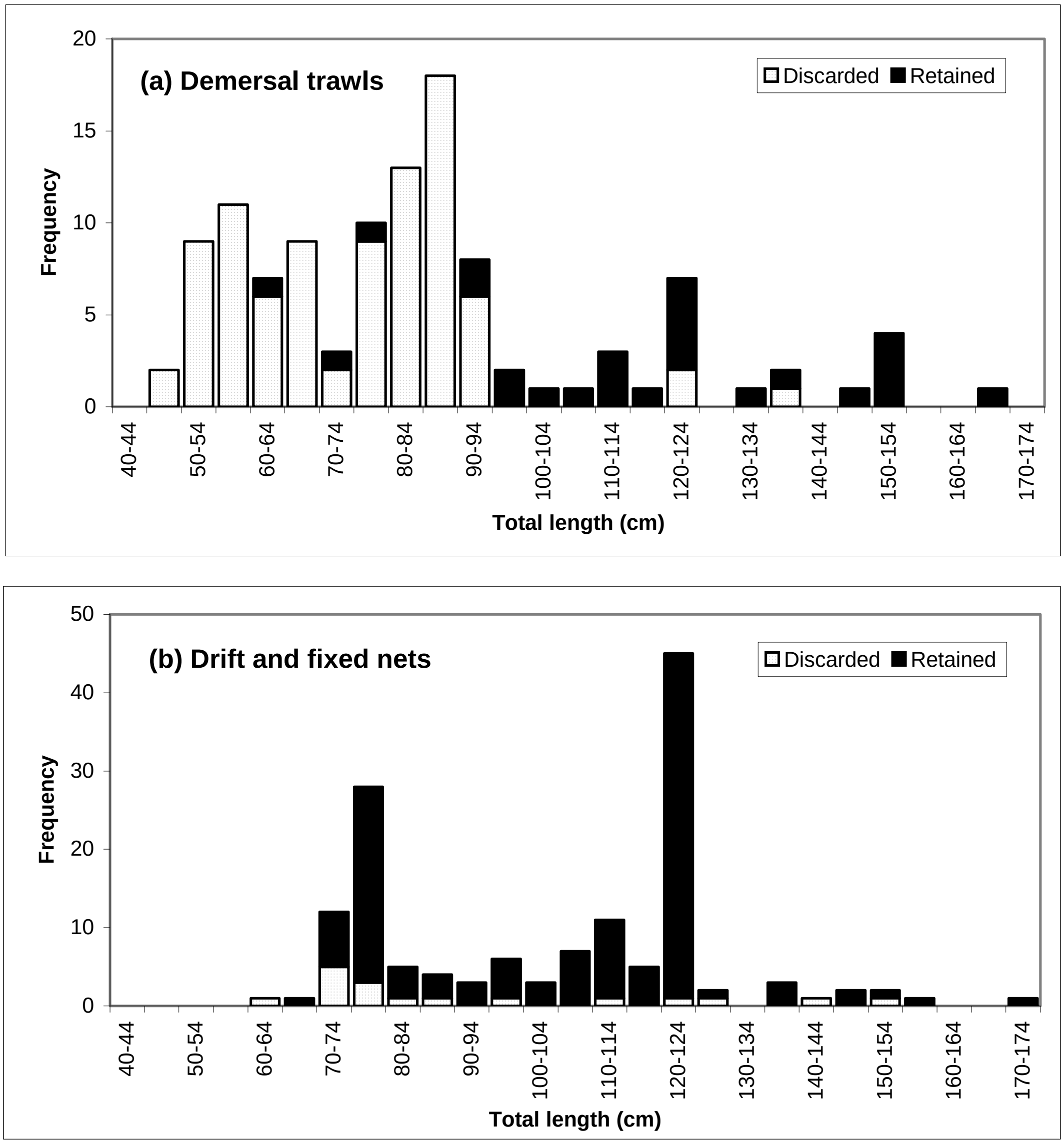

Figure 10.3. Tope in the North East Atlantic and Mediterranean. Length frequency of discarded and retained tope in (a) demersal trawl and (b) drift and fixed net fisheries as observed in UK (England and Wales) discard sampling.

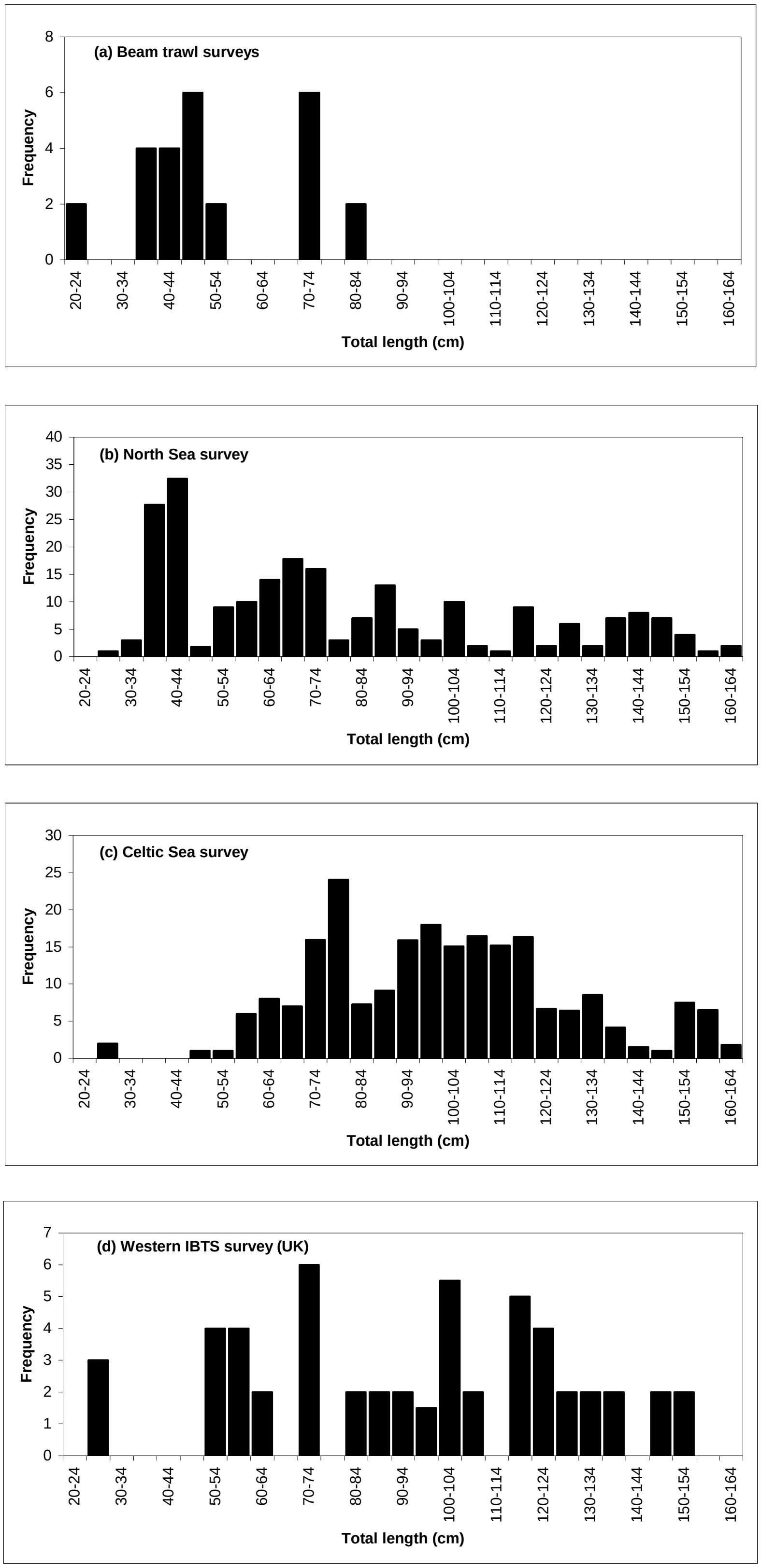

Figure 10.4. Tope in the North East Atlantic and Mediterranean. Length frequency graphs for UK surveys including (a) beam trawl surveys in the English Channel, Bristol Channel and Irish Sea; (b) North Sea; (c) Celtic Sea and (d) Irish Sea and Celtic Sea. For further information on these surveys see Sections 15 and 18.

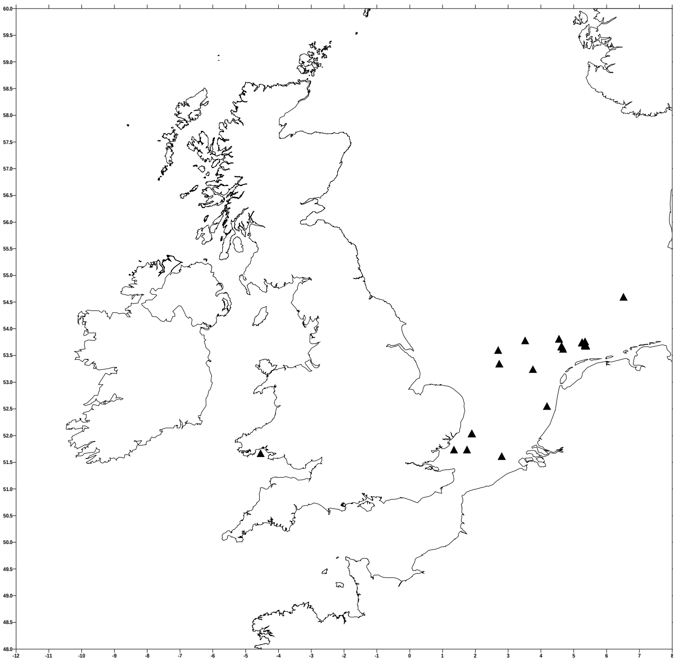

Figure 10.5. Tope in the North East Atlantic and Mediterranean. Sites where tope pups (24–45 cm total length) have been reported during UK surveys.

11 Thresher sharks in the North East Atlantic and Mediterranean Sea

11.1 Stock distribution

Two species of thresher shark occur in the ICES areas: common thresher *Alopias vulpinus* and bigeye thresher *A. superciliosus.* Of these, *A. vulpinus* is the dominant species taken in the continental shelf fisheries of the ICES area. There is little information on the stock identity of these circumglobal sharks.

A NMFS tagging study (Kohler *et al*., 1998) running from 1962–1993 tagged 329 bigeye thresher and 48 common thresher, mainly from the NW Atlantic, of which seven and two recaptures were made, respectively. From the tagging and recapture positions, there is no evidence to suggest that transatlantic movements in either species have occurred. However, the bigeye thresher made relatively large-scale movements with a maximum distance travelled of 1494 nm (2767 km), the range of movement in the common thresher was much smaller, with a maximum distance travelled of 86 nm (159 km) observed. However, with such small numbers of recaptures, it is not possible to draw any firm conclusions on movements of these species.

Studies by Moreno and Moron, 1992 and Tudela *et al*., 2005 have identified nursery grounds for common thresher in the Alboran Sea and off the southwestern Iberian Peninsula for bigeye thresher. In the absence of records of transatlantic migrations, WGEF assume there to be a single NE Atlantic and Mediterranean stock of *A. vulpinus*. The presence of a nursery ground in the Alboran Sea provides the rationale for including the Mediterranean Sea within the stock area. This stock could possibly extend into the CECAF area.

11.2 The fishery

11.2.1 History of the fishery

NE Atlantic

There are no target fisheries for thresher sharks in the NE Atlantic; although they are taken as a bycatch in longline and driftnet fisheries (e.g. Buencuerpo *et al*., 1998; Macias *et al*., 2003; Mejuto *et al*., 2001; Tudela *et al*., 2005). Both species are caught mainly in longline fisheries for tunas and swordfish, although they may also be taken in driftnet and gillnet fisheries. The fisheries data for the ICES area are scarce, and they are unreliable, because it is likely that the two species (*Alopias vulpinus* and *A. superciliosus*) are mixed in the records.

Mediterranean

As in the NE Atlantic, there are no targeted fisheries, however, they are taken as a bycatch in various fisheries, including the Moroccan driftnet fishery in the southwest Mediterranean (Tudela *et al*., 2005). This study reported that during a 10-month survey of 369 fishing operations, 464 common threshers were taken. They estimated that during a 1-year period, between 20 262–25 610 pelagic sharks would be taken in the Alboran Sea, of which the common thresher would likely make up approximately one third. Additional bycatch of these sharks will occur in the Straits of Gibraltar.

11.2.2 The fishery in 2007

There were some well publicised captures of large thresher sharks taken in UK waters during 2007. One specimen (estimated length 4.87 m, and 453 kg) was taken in inshore nets off the coast of Filey (Yorkshire) on 19th July (Fishing News, 20th July

2007). In November, a large specimen of (4.75 m long and weighing ca. 510 kg) was taken by a trawler operating off the Cornish coast. There was also a record of one being taken in the same general area the previous month, with this 400 kg specimen tangled up in potting ropes (Timesonline 22nd November 2007).

11.2.3 ICES Advice applicable

ICES has never provided advice for this stock.

11.2.4 Management applicable

EC Regulation No. 1185/2003 prohibits the removal of shark fins of this species, and subsequent discarding of the body. This regulation is binding on EC vessels in all waters and non-EC vessels in Community waters.

11.3 Catch data

11.3.1 Landings

The landings are irregularly reported and rather variable: from 10–206 t in the NE Atlantic and the Mediterranean Sea (ICCAT and national data; Tables 11.1–11.2; Figure 11.1). The main landing countries are Portugal (107 t in 2006), Spain (ca. 105 t in 2005) and France (30 t in 2005).

Thresher sharks are taken occasionally in Subarea IV, but the main catches seem to occur in Subareas VII–IX.

The two species are recorded mixed or separately; however analysis of the available data seems to indicate that they are often mixed even when recorded under specific names. Also, some discrepancies are observed when different sources of data are compared (e.g. FAO, ICCAT, national data). Landings of thresher shark in coastal waters are most likely to represent *A. vulpinus*, but some of these landings may be reported as 'sharks *nei*'.

During 2003, some landings of thresher sharks were recorded in Danish waters, however, this was under 0.5 tonnes, and is likely to be negligible before or after this record. Similarly, the UK had a <0.5 tonnes landing record in 2006, yet nothing beforehand. Ireland, also has <0.5 tonne landings during 2003, 2004 and 2006. The countries with more consistent estimated landings are France, Portugal and Spain. The landings of thresher sharks in French waters have typically ranged from 2–21 tonnes, however in 2000 and 2001, the landings increased up to 113–116 tonnes. The Portuguese (ICES area VII–IX) estimated landings began in 1986, at 7 tonnes, and peaked 2 years later in 1988, then remained relatively stable ranging from 7–37 tonnes annually, until 2005, when another surge increased this to 80 tonnes. The Portuguese area off West Africa has nominal estimated landings between zero and at most 2 in 1998. Spanish landings began in 1997 at 53 tonnes, and after 3 years this fell to just 1 tonne, then to zero by 2001. However, began again in 2003, and in 2004 the landings were an estimated 84 tonnes. Consequently, the overall estimated landings ranged from just 3 tonnes, the lowest level, in 1984 to 152 tonnes in 2005.

11.3.2 Discards

No data available.

11.3.3 Quality of catch data

Thresher sharks have not routinely been reported at either a species-specific or generic level, although such data collection has improved in recent years.

11.4 Commercial catch composition

No data available.

11.5 Commercial catch-effort data

NE Atlantic

There are very limited cpue data available for the ICES area.

Senba and Nakano, 2005 reported on the nominal cpue of pelagic sharks based on observer data from the Japanese longline fishery in the high seas of the Atlantic Ocean (1995–2003) and although only one of the areas studied covered the NE Atlantic, the cpue was zero for both *A. vulpinus* and *A. superciliosus.* Similarly in the western North Atlantic the trend was also low, with just six bigeye and one common thresher taken as bycatch. The largest bycatch of thresher was made off the southwest African coast (134 bigeye and 41 common) with a cpue (catch number per 1000 hooks) of 0.5 (80% percentile) for the bigeye thresher. Overall the cpue for the bigeye thresher in the Atlantic Ocean by Japanese longliners was on average 0.16 (SD = 0.44).

Mediterranean

Rough estimates have been given for the driftnet fishery in the Alboran Sea (7000 individuals/year, 0.7–1.5 ind./fishing operation, 0.092–0.117 ind./km net set). Additionally, some cpue data for *A. vulpinus* have been provided for the Italian swordfish fisheries in the frame of the STECF report (Anon, 2003): 0.9 kg/1000 hooks, 1.2 kg/haul, 0.006 to 0.02 individuals/1000 hooks for the longline fisheries and 0.002 individuals/ 1000 m net for the driftnet fisheries in 1998–1999.

A further publication (Megalofonou *et al.*, 2005) of these data from 1998–1999 indicated that *A. vulpinus* was the third most caught shark species in eight of the nine areas studied in the Mediterranean, and constituted 0.74% of the catches. The highest catch rates were in the American-type swordfish longline, with a mean cpue for *A. vulpinus* of 0.02 fish/1000 hooks, and in the Aegean Sea the mean catch rate reached 0.05 fish/1000 hooks.

11.6 Fishery-independent surveys

No fishery-independent data are available for the NE Atlantic.

11.7 Life-history information

11.7.1 Habitat

The common thresher and bigeye thresher are distributed circumglobally in the Atlantic, Pacific, and Indian Oceans and in the Mediterranean (Smith *et al.*, 2008). Threshers are active, strong-swimming sharks occurring in oceans and shelf seas in tropical and temperate seas. They are found from the surface to 500 m depth (deepest record 723 m). Threshers are mostly epipelagic, but may stay at 200–500 m depth over the continental slope during the day and in open waters at 80–130 at night. Common thresher in the northern hemisphere apparently undertakes inshore and northerly coastal migrations during the warm season (~ April to August) in the eastern and western Atlantic and eastern Pacific (Moreno *et al.*, 1989; Bedford, 1992; cited in Smith *et al.*, 2008).

In the NE Atlantic, *A. vulpinus* has been recorded from Norway to the Mediterranean Sea and the Black Sea, and off Madeira and the Azores, and *A. superciliosus* from Portugal, Spain and recently from UK (Thorpe, 1997), also from Madeira and the

Azores, and in the Mediterranean Sea. Their main biological parameters are summarized in Table 11.3.

11.7.2 Nursery grounds

A nursery area for *A. superciliosus* is suspected in the waters off the southwestern Iberian Peninsula (Moreno and Moron, 1992). Also, the same authors observed aggregations of gravid females of *A. vulpinus* in the Strait of Gibraltar. Juvenile *A. vulpinus* are also known to occur in the English Channel and southern North Sea (Ellis, 2004).

11.7.3 Diet

A. vulpinus: This species is found to feed on small schooling species such as anchovy, hake, mackerel, sardine and squid (Gubanov, 1972; Stick and Hreha, 1989; Bedford, 1992; Preti *et al*., 2001, 2004). Bowman *et al*., 2000 found that in 19 stomachs analysed from the Northwest Atlantic, seven were empty, and the remaining contained 97% fish (66.3% Northern sand lance, *Ammodytes dubius*) and 3% squid (2.2% Northern shortfin squid, *Illex illecebrosus*).

A. superciliosus: This species is found to eat a wider range of prey items, with pelagic and demersal fish and squid, making up the largest proportion (Fitch and Craig, 1964; Bass *et al*., 1975; Stillwell and Casey, 1976; Gruber and Compagno, 1981; Castro, 1983). Bowman *et al*., 2000 found from analysis of 24 stomachs from Northwest Atlantic animals, that six were empty, and the remaining contained 83.5% pelagic and demersal fish (scorpionfish, Scorpaenidae being most abundant at 53.8%) and 15% squid (Northern shortfin squid, *Illex illecebrosus* was most abundant making up 11.9%).

11.7.4 Life history parameters

Biological data of the NE Atlantic thresher sharks are very scarce, with few published studies (e.g. Moreno *et al*., 1989; Moreno and Moron, 1992; Munoz-Chapuli, 1984; Rey and Munoz-Chapuli, 1992). A lot of the reproductive life-history parameters we know of the NE Atlantic and Mediterranean stock, comes from Moreno and Morón, 1992. They found lengths at maturity for males and females (~ 267and ~ 340 cm L_T respectively), a larger maximum size of males than previously recorded (410 cm L_T), and described reproduction parameters such as size at birth (≥100 cm L_T), litter size (mostly 2 and up to 4) and seasonality (a preferential reproductive period during autumn to winter), as well as the possible existence of a nursery area in waters off the south-western Iberian Peninsula. However, most of biological parameters have been obtained from studies from the NW Atlantic and Californian and Taiwanese fisheries (Tables 11.3–11.4).

11.7.5 Conversion factors

Data from the NE Atlantic are too limited to provide conversion factors. Conversion factors for both species are available from the western North Atlantic (Kohler *et al*., 1995; Table 11.5):

(a) Fork length (L_F) to total length (L_T) relationship ($L_F=(a)L_T+b$):

Common thresher $L_F = 0.5474.L_T + 7.0262$

Bigeye thresher $L_F = 0.5598.L_T + 17.660$

Alopiidae $L_F = 0.4882.L_T + 37.9566$ ($r^2 = 0.8577$)

(b) Fork length (L_F) to total weight (W) relationship. Based on $W=(a)L_F^b$

Common thresher $W = (1.8821 \times 10^{-4})L_F^{2.5188}$

Bigeye thresher $W = (9.1069 \times 10^{-6})L_F^{3.0802}$

(c) Relationship between fork length (L_F, cm) and total body weight (W, kg) (sexes combined)

Bigeye thresher $W = 9.1069 \times 10^{-6} L_F^{3.0802}$ ($r^2 = 0.91$)

Common thresher $W = 1.8821 \times 10^{-4} L_F^{2.5188}$ ($r^2 = 0.88$)

11.8 Exploratory assessment models

11.8.1 Previous studies

No previous assessments have been made of thresher shark in the NE Atlantic. The lack of landings data (see Section 11.3) and absence of fishery-independent survey data preclude assessments of these stocks at the present time.

Despite its midrange intrinsic rebound potential (Table 11.3), the management of *Alopias vulpinus* is of concern, as demonstrated by the quick decline of the USA Pacific fishery targeted on this species, which ended in the 1990 because of overfishing (Hanan *et al*., 1993; Cailliet *et al*., 1993). Landings in this fishery fell by more than 70% (Cailliet *et al*., 1993) and the average size declined by 25% between 1982–1989 (Hanan *et al*., 1993), yet despite the end of this fishery, the population may only be at nearly half of prefishing levels, judging from trends in catch rates (PFMC, 2003) and is still recovering (Smith *et al*., 2008).

11.8.2 Stock assessment

No assessment was undertaken, as a consequence of insufficient data. Species-specific landings are required and any assessment will need to be undertaken in collaboration with ICCAT.

11.9 Quality of assessments

No assessment was undertaken, as a consequence of insufficient data.

11.10 Reference points

No reference points have been proposed for these stocks.

11.11 Management considerations

The lack of accurate fishery data does not allow determining the stock structures and the status of both thresher shark species occurring in the NE Atlantic. However, Liu *et al*., 1998, 2006 consider that *Alopias* spp. are particularly vulnerable to overexploitation and in need of close monitoring because of its high vulnerability resulting from its low fecundity and relatively high age of sexual maturity.

In 2006, the IUCN Red List classified all three species of thresher as Data Deficient (IUCN, 2006), but their status was re-evaluated in 2007 (Camhi, 2008), which listed both species as Vulnerable.

Castro *et al*., 1999 stated that a lack of fisheries data made it difficult to evaluate the status of the bigeye thresher, but they also indicated that its slow growth, low reproductive potential, and prevalence in longline bycatch made the bigeye thresher vulnerable to exploitation and hence assigned it a Category 3 status (Category 5 being the most exploited), whereas the common thresher also having a low reproductive potential, being targeted widely in intensive fisheries, and having suffered substantial decline under fishing pressure was assigned a Category 4. Other authors have suggested that bigeye thresher may be the more vulnerable because of its very low reproductive potential (2–3% per year; Smith *et al*., 2008) and because it is regularly encountered in longline and net fisheries throughout the tropics and temperate regions (Camhi, 2008).

Precautionary management measures could be considered for the NE Atlantic thresher sharks, attributable to the fishing effort for large pelagic fish in the region.

11.12 References

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Table 11.1. Thresher sharks in the North East Atlantic and Mediterranean Sea. Landings of thresher sharks by European countries from 1997 to 2007 (ICCAT and national data). Landings prior to 1997 are in combined sharks.

DATA SOURCE	ICCAT				ICCAT			ICCAT	NATIONDATA	NATION. DATA	NATIONDATA	TOTAL
Nation	Spain				Portugal			France	UK	Ireland	DK	
Year	A. vul.	A. sup.	Alopias spp.	Total	A. vul.	Alopias spp.	Total	A. vul.	A. vul.	A. vul.	A. vul.	
1997	30	138	25	193				13				206
1998	44	104	27	175				7				182
1999 (1)	15	44	(57)	59	1		1	35				96
2000	8	21	23	52		2	2	128				182
2001	21	35	61	117		2	2	129				248
2002	11	38	25	74	21		21	24				119
2003	7	18	1	26	17		17	28		+	+	71
2004	17	37	11	65(2)	22	+	21	23		+		109
2005	na	na	na	?(2)	8		8	30	+			38
2006	na	na	na	na	107		107	12	+			119
2007	na	na	na	na	na	na	na	9	1			10

(1) Data from ICCAT document SCRS/2001/049 providing the landings of thresher sharks by the Spanish longline fleet in 1999; as the unidentified threshers (*Alopias spp*) reported in the ICCAT database are so similar to the sum of *A. vulpinus* and *A. superciliosus,* these are assumed to reflect the same landings.

(2) Spain previously reported 159 t in 2004 and 105 t in 2005, clarification of these catches is required.

Table 11.2. Thresher sharks in the North East Atlantic and Mediterranean Sea. Estimates of landings of thresher sharks (*Alopias* spp.) by country and ICES subarea.

COUNTRY	DENMARK	FRANCE	IRELAND	PORTUGAL	PORTUGAL	SPAIN	UK (E&W)	MED	TOTAL
ICES Subarea	IV	VII to IX	VII–VIII	VII–IX	W Africa	VII–IX	IV		
1984		3							3
1985		6							6
1986		2		7					9
1987		7		11	+				18
1988		12		103	+				115
1989		10		13	+				23
1990		9		14	+				23
1991		13		31	1				45
1992		14		13	+				27
1993		14		12	+				26
1994		11		16					27
1995		13		7					20
1996		7		13	+				20
1997		13		37	1	53			104
1998		7		24	2	54			87

COUNTRY	DENMARK	FRANCE	IRELAND	PORTUGAL	PORTUGAL	SPAIN	UK (E&W)	MED	TOTAL
1999		21		12	+	36			69
2000		116		15		1			132
2001		113		25					138
2002		11		21					32
2003	+	11	+	17		3			31
2004		13	+	33		84			130
2005		18		80		54	+		152
2006		12	+				+		12
2007		9					1		9

Table 11.3. Thresher sharks in the North East Atlantic and Mediterranean Sea. Summary of biological parameters for *Alopias vulpinus*.

PARAMETER	VALUES	SAMPLE SIZE	AREA	REFERENCE
Reproduction	Ovoviviparous with oophagy			Compagno, 2001
Litter size	2–7(usually 2–4)		NW Atl. and other areas	Castro, 1983 Compagno, 2001 Gubanov, 1978a; Cailliet *et al.*, 1983a; Bedford, 1992a Moreno *et al.*, 1989a
Fecundity (F)	4		California	Cailliet and Bedford, 1983
Gestation period	9 months			Bedford, 1985 Compagno, 2001 Goldman, 2005a
Size at birth (LT)	114–160 cm		various	Castro, 1983 (?) Compagno, 2001
Age at maturity (both sexes)	3–7 years			Cailliet and Bedford, 1983
Female maturity age (α) (years)	5.3	107	California	Smith *et al.*, 2008
Male maturity age (years)	4.8	68	California	Smith *et al.*, 2008
Male maturity size	314–420 cm (LT) 179–237 cm (LF)*		?	Compagno, 2001
	~303 (LT) (160 cm LF)	68	California	Smith *et al.*, 2008
Female maturity size	315–400 cm (LT) 179–226 cm (LF)*		?	Compagno, 2001
	~303 cm (LT) (160 cm LF)	107	California	Smith *et al.*, 2008
Maximum size	573 cm at least possibly 610 cm (LT) 321–341 cm (LF)*			Compagno, 2001
A max	45–50 years			Cailliet *et al.*, 1983

PARAMETER	VALUES	SAMPLE SIZE	AREA	REFERENCE
Average maximum reproductive age	~ 25 years		US West Coast	Smith *et al*., 2008
Maximum reproductive age (w) (years). Estimated from von Bertalanffy growth equation	19	?	California	Cailliet and Bedford, 1983
Natural mortality (M)	0.234	?	Pacific	Smith *et al*., 1998+
Survival to maturity when adult mortality Z=2M (see above)	0.187	?	Pacific	Smith *et al*., 1998+
Length (cm)-weight (kg) relationship	For both sexes : W = 1.8821 x 10–4 LF 2.5188	88	NW Atlantic (1961–89)	Kohler *et al*., 1995
Fork length (cm) – total length (cm) relationship	LF = 0.5474 x LT + 7.0262	13	NW Atlantic (1961–89)	Kohler *et al*., 1995
Growth parameters	L ∞ = 651 cm T0 = – 2.36 K = 0.100		California	Claro and García-Arteaga, 1994
Productivity (R2m) estimate : intrinsic rebound	R2m = 0.069 (assuming no fecundity increase)	?	Pacific	Smith *et al*., 1998¤
Population growth rate λ (year–1)	1.090		Northeast Pacific	Cortés, 2008§
Population doubling time TD (years)	TD = 10 (assuming no fecundity increase)	?	Pacific	Smith *et al*., 1998¤
Generation time (years)	7.5		Northeast Pacific	Cortés, 2008§
Trophic Level	4.2–4.5		Med NW Atlantic	Ferretti *et al*., 2008 Cortés, 1999 Bowman *et al*., 2000

[a] **Cited in Smith *et al*. 2008.**

[*] **Calculated using equation from Kohler *et al*. 1995.**

[+] **Based on (*w*) by Cailliet and Bedford, 1983.**

[¤] **Based on population parameters of Cailliet and Bedford, 1983.**

[§] **Derived using life-history traits from Cailliet *et al*., 1983.**

Table 11.4. Thresher sharks in the North East Atlantic and Mediterranean Sea. Summary of biological parameters for *Alopias superciliosus.*

Parameters	Value	Sample size	Area	Reference
Reproduction	Ovoviviparous with oophagy		TaiwanNW Atl.	Chen *et al*., 1997 Gilmore, 1983
Reproductive potential	Very low 2–3% per year			Smith *et al*., 2008
Litter size	Usually 2 (range: 1–4, however not confirmed by studies)		Northeastern Taiwanand other areas	Chen *et al*., 1997 Liu *et al*., 1998 (I cannot see this in 1998) Moreno and Morón, 1992a Nakamura, 1935b Cadenat, 1956b Stillwell and Casey, 1976b Gruber and Compagno, 1981b Gilmore, 1983b
Gestation period	Possibly 12 months (suggested by Holden, 1974)		Taiwan	Liu *et al*., 1998 (? cannot see this in 1998 and Chen *et al*., 1997 couldn't determine gestation)
Age-at-maturity	Males : 9–10 years Females : 12.3–13.4 years	126 245	Taiwan	Liu *et al*., 1998
Male maturity size	276 cm (LT)	6	NE Atl.	Moreno and Moron, 1992
	270–287 cm (LT) (150–155 LPC) (size at 50% maturity)	200	Taiwan	Chen *et al*., 1997
	180 cm (LF)		NW Atl.	Kohler *et al*., 1995×
Female maturity size	340 (?) cm (LT)	10	NE Atl.	Moreno and Moron, 1992
	332–366 cm (TL)	429	Taiwan NW Atlantic and others	Chen *et al*., 1997 Kohler *et al*., 1995× Compagno, 1984b Gruber and Compagno, 1981b Nakamura, 1935b Stillwell and Casey, 1976b

Parameters	Value	Sample size	Area	Reference
Size at birth (TL)	135–140 cm	2	Taiwan	Chen *et al.*, 1997
	60–106		various	Bass et al., 1975b Bigelow and Schroeder, 1948b Cadenat, 1956b Compagno, 1984b Gilmore, 1983b Gruber and Compagno, 1981b Gubanov, 1978b Moreno and Morón, 1992b Nakamura, 1935b Osipov, 1968b
Sex ratio of embryos	1:1	40	Taiwan	Chen *et al.*, 1997
Maxium size (TL)	461 cm			Nakamura, 1935
Life span (not necessarily lifespan - these were oldest in sample n=321)	Males : 19 years Females : 20 years		Taiwan	Liu *et al.*, 1998
Length (cm)-weight (kg) relationship	Males : W = (3.73 x 10–5)LT 2.57	65	Taiwan	Liu *et al.*, 1998
	Females : W = (1.02 x 10–5)LT 2.78	175	Taiwan	Liu et al., 1998
	Combined : W = (9.1069 x 10–6) x LF 3.0802	55	Florida	Kohler *et al.*, 1995
Fork length-total length relationship	LF = 0.5598 LT + 17.6660	56	Florida	Kohler *et al.*, 1995
Growth (calculated from vertebral reading)	Males : L ∞ = 218.8 cm (LT) T0 = – 4.24 K = 0.088/year Females : L ∞ = 224.6 cm (LT) T0 = – 4.21 K = 0.092/year	321	Taiwan	Liu *et al.*, 1998

Parameters	Value	Sample size	Area	Reference
Growth (calculated from length–frequency analysis)	Males: L ∞ = 224.4cm (LT) T0 = – 4.61 K = 0.087/year Females : L ∞ = 230.5 cm (LT) T0 = – 3.69 K = 0.092/year	821	Taiwan	Liu *et al*., 1998
				(this species was not considered in Smith's study)
Population growth rate λ (year–1)	1.009		Northwest Pacific	(derived using life-history traits from Chen *et al*., 1997 and Liu *et al*., 1998)
Generation time (years)	17.2		Northwest Pacific	(derived using life-history traits from Chen *et al*., 1997 and Liu *et al*., 1998)
Trophic level	4.2–4.5		Cuba and the Med NW Atl.	Sierra *et al*., 1994; Ferretti *et al*. 2008; Cortès, 1999; Bowmann *et al*., 2000

[a] **Cited in Smith *et al*., 2008**

[b] **Cited in Chen *et al*., 1997**

[×] **Taken from Castro, 1983**

Table 11.5. Thresher sharks in the North East Atlantic and Mediterranean Sea. Conversion factors for (a) fork length-total length (top) and (b) weight-fork length (bottom) for thresher sharks (adopted from Kohler *et al.*, 1995).

Species	N	Mean LT (cm)	LT range (cm)	Mean LF (cm)	LF range (cm)	LF = (a)LT+b		
						a	b	r2
Bigeye thresher	56	312	155–371	192	100–228	0.5598	17.6660	0.89
Common thresher	13	373	291–450	211	168–262	0.5474	7.0262	0.89

Species	Sex	N	Mean LF (cm)	LF range (cm)	Max. LF (cm)	LF at maturity (cm)	Mean LT (calc. from LF – see above)	Mean W (kg)	W range (kg)	W=(a)LFb		
										a	b	r2
Common thresher	Combined	88	201	154–262			354	122	54–211			
	Male	46	197	154–228	276	184	347	116	54–181	1.8821 x 10–4	2.5188	0.88
	Female	41	207	155–262		226	365	129	59–211			
Bigeye thresher	Combined	55	190	100–228			307	99	11–170			
	Male	34	188	100–221	270	180	304	92	11–150	9.1069 x 10–6	3.0802	0.91
	Female	21	194	123–228		214	315	110	23–170			

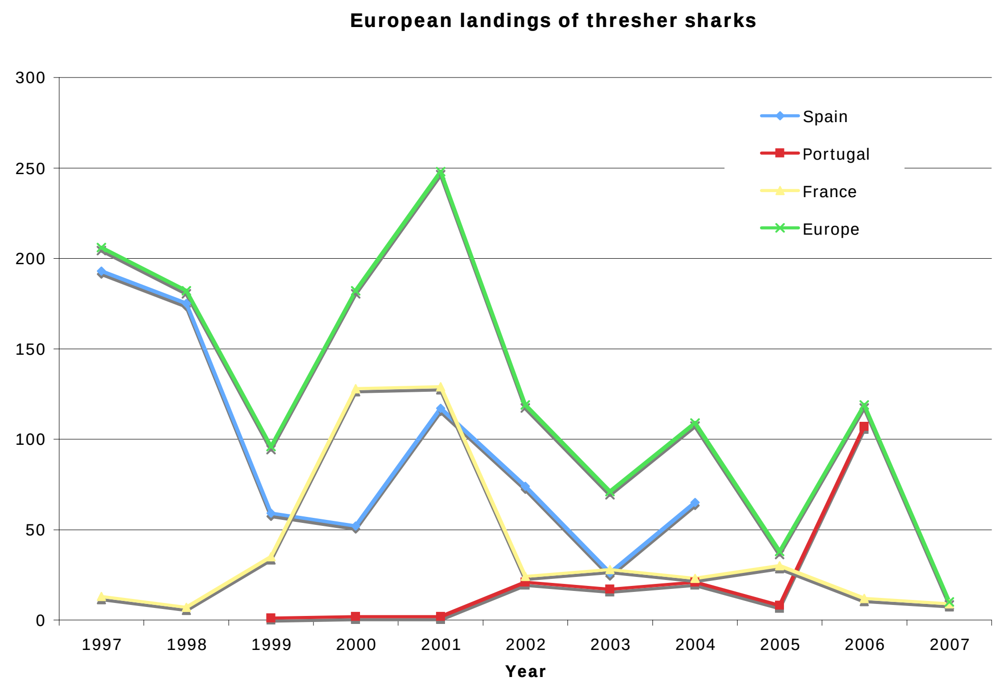

Figure 11.1. Thresher sharks in the North East Atlantic and the Mediterranean Sea. Reported landings of thresher sharks by Spain, Portugal and France (1997–2007, ICCAT and national data).

12 Other pelagic sharks in the North East Atlantic

12.1 Ecosystem description and stock boundaries

In addition to the pelagic species discussed in previous sections (see Sections 6–11) several other pelagic sharks and rays occur in the ICES areas, including:

Lamniformes:	White shark	*Carcharodon carcharias*
	Longfin mako	*Isurus paucus*
Carcharhiniformes	Spinner shark	*Carcharhinus brevipinna*
	Silky shark	*Carcarhinus falciformis*
	Oceanic whitetip	*Carcharhinus longimanus*
	Dusky shark	*Carcharhinus obscurus*
	Sandbar shark	*Carcharhinus plumbeus*
	Night shark	*Carcharhinus signatus*
	Tiger shark	*Galeocerdo cuvier*
	Scalloped hammerhead	*Sphyrna lewini*
	Great hammerhead	*Sphyrna mokarran*
	Smooth hammerhead	*Sphyrna zygaena*
Myliobatiformes	Pelagic stingray	*Pteroplatytrygon violacea*
	Devil ray	*Mobula mobular*

Many of these taxa, including many of the hammerhead sharks (*Sphyrna* spp.) and requiem sharks (*Carcharhinus* spp.) are mainly tropical to warm temperate species, and often coastal pelagic species. There is limited information with which to examine the stock structure of these species, and the ICES area would only be the northern extremes of their NE Atlantic distribution range.

Other species, including *I. paucus, C. falciformis* and *C. longimanus* are truly oceanic, and are likely to have either North Atlantic or Atlantic stocks, although once again, data are lacking. Within the ICES area, these species are also found mostly in the southern parts of the ICES areas (e.g. off the Iberian Peninsula), though some may occasionally occur further north.

In terms of the North Atlantic pelagic ecosystem, this is affected by the subtropical anticyclonic Atlantic gyre, and it is influenced by subtropical water intrusions and subject to strong seasonality. ICES 2007 provides a more detailed description of this ecosystem.

12.2 The fishery

12.2.1 The history of the fishery

These pelagic sharks and rays are taken as bycatch in tuna and swordfish fisheries (mainly by longliners, but also by purse-seiners). Some of them, like the hammerheads and the requiem sharks, could constitute a noticeable component of the bycatch and are landed, but other are only sporadically recorded (e.g. white shark, tiger shark, pelagic stingray and devil ray). Some of these species are an important bycatch in high seas fisheries (e.g. silky shark and oceanic whitetip) and others are taken in continental shelf waters of the ICES area (e.g. various requiem sharks and hammerhead sharks).

12.2.2 The fishery in 2007

No new information.

12.2.3 ICES advice applicable

ICES do not provide advice on these stocks.

12.2.4 Management applicable

EC Regulation No. 1185/2003 prohibits the removal of shark fins of these species, and subsequent discarding of the body. This regulation is binding on EC vessels in all waters and non-EC vessels in Community waters.

EC Regulation No. 40/2008 prohibits Community vessels to fish for, to retain on board, to tranship and to land white shark (*Carcharodon carcharias*) in all Community and non-Community waters.

12.3 Catch data

12.3.1 Landings

No accurate estimates of catch are available, as many nations that land various other species of pelagic sharks will record them under generic landings categories. Reported species-specific landings are given in Table 12.1. Portugal and Spain have reported landings of hammerheads and the requiem sharks in ICES Subareas VI, VIII, IX and X, totalling 86 t in 2004. Since 1997, landings are also recorded in the ICCAT database (Table 12. 2) for the NE Atlantic by Spain and Portugal, totalling 562 t of hammerhead sharks in 2005. Data on requiem shark species are scare and variable. Total landings of requiem sharks varied from 2–158 t for the period 1997–2006. Landings for *Carcharhinus falciformis* and *C. longimanus* are sporadically reported by Spain (Table 12.1). Some landings of longfin mako are reported by Spain, varying from 8–65 t for the period 1997–2004. Catch data are provided by Castro *et al*., 2000 and Mejuto *et al.*, 2002 for the Spanish longline swordfish fisheries in the NE Atlantic in 1997–1999 (Table 12.3).

There are few catch data for the other pelagic species (e.g. tiger shark, manta ray and pelagic stingray) in national datasets, nor in the ICCAT database, except for some sporadic records of 1–10 t of tiger and silky sharks.

Studies by Castro *et al*., 2000 and Mejuto *et al*., 2002 demonstrate that 99% of the bycatch of offshore longline fisheries consist of pelagic sharks (Table 12.3), although the bulk of them are blue sharks (87%).

12.3.2 Discards

No data available. Some species are usually retained, although pelagic stingray are most often discarded.

12.3.3 Quality of catch and biological data

Catch data are of poor quality, except for some occasional studies, such as those of Castro *et al*., 2000 and Mejuto *et al*., 2002, which relate to the Spanish swordfish longline fishery in the Atlantic. Biological data are not collected under the Data Collection Regulations, although some generic biological data are available (see Section 12.7). Field identification of some of these genera (e.g. *Carcharhinus* and *Sphyrna*) can be problematic.

12.4 Commercial catch composition

Data on the species and length composition of these sharks are limited.

12.5 Commercial catch-effort data

No cpue data are available for these pelagic sharks in the ICES area. However Cramer and Adams, 1998; Cramer *et al*., 1998 and Cramer, 1999 provided catch rates for the Atlantic US longline fishery targeting tunas and swordfish; where cpue ranged from 2.7 indivuals/1000 hooks in 1996 to 0.35 ind./1000 hooks in 1997.

12.6 Fishery-independent surveys

No data were available.

12.7 Biological parameters

A summary of the main biological parameters are given in Table 12.4.

Little information is available on nursery or pupping grounds. Silky shark are thought to use the outer continental shelf as primary nursery ground (Springer, 1967; Yokota and Lessa, 2006), and young oceanic whitetip have been found offshore along the SE coast of the USA, suggesting offshore nurseries over the continental shelf (Seki *et al*., 1998). The scalloped hammerhead nurseries are usually in shallow coastal waters.

The overall biology of several species has recently been reviewed, including white shark (Bruce, 1998), silky shark (Bonfil, 2008), oceanic whitetip (Bonfil *et al.*, 2008) and pelagic stingray (Neer, 2008).

12.8 Stock assessment

12.8.1 Previous studies

No previous assessments have been made of these stocks in the NE Atlantic.

12.8.2 Stock assessment

No assessment was undertaken, as a consequence of insufficient data.

12.9 Quality of the assessment

No assessment was undertaken, as a consequence of insufficient data.

12.10 Reference points

No reference points have been proposed for this stock.

12.11 Management considerations

There is a paucity of the fishery data on these species, and this hampers the provision of management advice. Some of the species have conservation status: for example white shark is listed on Appendix II of the Barcelona Convention, Appendix II of the Bern Convention, Appendices I/II of the CMS and Appendix I of CITES.

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Table 12.1. Other pelagic sharks in the North East Atlantic. Summary of available landing data of hammerhead and requiem sharks in the ICES Subareas.

ICES	HAMMERHEAD SHARKS					SPHYRNA SPP.		REQUIEM SHARKS					CARCHARHINUS SPP.		TOTAL
	Portugal					Spain	Total Sphyrna	Portugal					Spain	Total Requiem	pelagic sharks
Year	VIIIc	IX	IXa	X	Total	IXa, b		VIb	IX	IXb	X	Total	IXa, b		
1999	1	6		1	8		8				9	9		9	17
2000		8			8		8	1	1		24	26		26	34
2001		4			4		4				31	31		31	35
2002		5			5		5	1	7		47	55		55	60
2003		5		2	7		7		129		16	145		145	152
2004			18	1	19	2	21		2	3	43	48	17	65	86

Table 12.2. Other pelagic sharks in the North East Atlantic. NE Atlantic landings of hammerhead sharks, requiem sharks and longfin mako by Spain and Portugal recorded on the ICCAT database. Value in brackets have not been validated by ICCAT in 2008. OCS: *Carcharhinus longimanus*-FAL: *Carcharhinus falciformis* LMA: *Isurus paucus*-SPK: *Sphyrna mokarran*-SPL: *Sphyrna lewini*-SPN: *Sphyrna spp*- SPZ: *Sphyrna zygaena*.

ICCAT	SPAIN											PORTUGAL		TOTAL
NE Atlantic	SPN	SPL	SPK	SPZ	Total Sphyna	FAL	OCS	RSK	Total Requiem	LMA	Total Spain	SPZ	RSK	
1997	(353)			220	573					26.6	599.6			599.6
1998	(343)	(3)	(1)	103	450			(158)	158	8.2	616.2			616.2
1999								(60)	60	0	60			60
2000	(312)			(1)	313		2.5		2.5	19.7	335.2	14		349.2
2001	(249)			(4)	253		6.7	(100)	106.7	51.3	411	6		417
2002	(263)			(9)	272		0.6	(80)	80.6	64.5	417.1	16.3		433.4
2003	(231)	290		88	609	31	1.1	(86)	118.1	61.9	789	11.5	(155)	955.5
2004	(364)	139		146.4	649	4		(97)	101	51.2	801.2	7		808.2
2005		317.3		217.5	534.8	15.9			15.9		550.7	12		562.7
2006		147.8			147.8	27.3			27.3		165.1			165.1

Table 12.3. Other pelagic sharks in the North East Atlantic. Sharks bycatches of the Spanish swordfish longline fisheries in the NE Atlantic. Data from Castro *et al.*, 2000 and Mejuto *et al.*, 2002.

SHARK BYCATCHES OF THE SPANISH LONGLINE SWORDFISH FISHERY								
NE Atlantic	Carcharhinus spp	Sphyrna spp	Galeocerdo cuvier	Isurus paucus	Mobula spp.	Total bycatches	% sharks	% blue shark
1997	148	382	3	8		28 000	99.4	87.5
1998	190	396	5	8	7	26 000	99.4	86.5
1999	99	240	4	18	1	25 000	98.6	87.2

Table 12.4. Other pelagic sharks in the North East Atlantic. Preliminary compilation of life-history information for NE Atlantic sharks.

	Distribution Depth range	Max. TL cm	Egg development	Maturity size cm	Age at maturity (years)	Gestation period (months)	Litter size	Size at birth (cm)	Life span years	Growth	Trophic level
White shark *Carcharodon carcharias*	Cosmopolitan 0–1280 m	720	Ovoviviparous+ oophagy	372–402	8–10	?	7–14	120–150	36	L∞ = 544 K= 0.065 T0 = –4.40	4.42–4.53
Longfin mako *Isurus paucus*	Cosmopolitan	417	Ovoviviparous				2				4.5
Silky shark *Carcharhinus falciformis*	Circumtropical 0–500 m	350	Viviparous	210–220 M 225 F	6–7 7–9	12	2–15	57–87	25	L∞ = 291/315 K= 0.153 / 0.1 T0 = –2.2 / –3.1	4.4–4.52
Spinner shark *Carcharhinus brevipinna*	Circumtropical 0–100 m	300	Viviparous	176–212			Up to 20	60–80		L∞ = 214 FL K= 0.210 T0 = –1 .94	4.2–4.5
Oceanic whitetip *Carcharhinus longimanus*	Cosmopolitan 0–180 m	396	Viviparous	175–189	4–7		1–15	60–65	22	L∞ = 245 / 285 K= 0.103 / 0.1 T0 = 2.7 / – 3.39	4.16–4.39
Dusky shark *Carcharhinus obscurus*	Circumglobal	420	Viviaparous	220–280	14–18		3–14	70–100	40	L∞ = 349 / 373 K= 0.039/ 0.038 T0 = –7.04/ –6.28	4.42–4.61
Sandbar shark *Carcharhinus plumbeus*	Circumglobal 0–1800 m	250	Viviparous	130–183	13–16		1–14	56–75	32	L∞ = 186 FL K= 0.046 T0 = –6.45	4.23–4.49

	Distribution Depth range	Max. TL cm	Egg development	Maturity size cm	Age at maturity (years)	Gestation period (months)	Litter size	Size at birth (cm)	Life span years	Growth	Trophic level
Night shark *Carcharhinus signatus*	Atlantic 0–600 m	280	Viviparous	185–200			4–12	60		L∞ = 256 / 265 K= 0.124 / 0.114 T0 = –2.54 / – 2.7	4.44–4.5
Tiger shark *Galeocerdo cuvier*	Circumglobal 0–350 m	740	Oviviviparous	316–323	8–10	13–16	10–82	51–104	50	L∞ = 388 / 440 K= 0.18 / 0.107 T0 = –1.13 / –2.35	4.54–4.63
Scalloped hammerhead *Sphyrna lewini*	Cosmopolitan 0–512 m	430	Viviparous	140–250	10–15	9–10	13–31	45–50	35	L∞ = 320 / 321 K= 0.249 / 0.222 T0 = –0.41 / – 0.75	4.0–4.21
Great hammerhead *Sphyrna mokarran*	Circumglobal 1–300 m	610	Viviparous	250–292			13–42	60–70			4.23–4.43
Smooth hammerhead *Sphyrna zygaena*	Circumglobal 0–200 m	500	Viviparous	210–265			20–50	50–60			4.32–4.5
Pelagic stingray *Pteroplatytrygon violacea*	Cosmopolitan 37–238	160	Ovoviviparous	35–40 DW			4–9	15–25 DW		L∞ = 116 DW K= 0.0180	4.36
Devil ray *Mobula mobular*	NE Atl. + Med. epipelagic	520	Ovoviviparous								3.71

13 Demersal elasmobranchs in the Barents Sea

13.1 Eco-region and stock boundaries

The eight skate species inhabiting the offshore area of the Barents Sea ecoregion are starry ray (or thorny skate) *Amblyraja radiata*, Arctic skate *Amblyraja hyperborea*, round skate *Rajella fyllae*, common skate *Dipturus batis*, spinytail skate *Bathyraja spinicauda*, sailray *Dipturus linteus*, longnose skate *Dipturus oxyrinchus* and shagreen ray *Leucoraja fullonica* (Andriyashev, 1954; Dolgov, 2000; Dolgov *et al.*, 2004b). Of these eight species, few occur in great abundances. All species may be taken as bycatch in demersal fisheries, but there are no directed fisheries targeting skates in the Barents Sea. *A. radiata* is the dominant species, comprising 96% by number of total number and about 92% by biomass of skates caught in surveys or as bycatch. The following most abundant species are Arctic and round skate (3% and 2% by number, respectively), and the remaining species are scarce (Dolgov *et al.*, 2004b; Drevetnyak *et al.*, 2005). In all eight species have also been demonstrated to inhabit the coastal area of this ecoregion. The species diversity differs from that listed in the offshore area with *D. oxyrinchus* and *D. linteus* absent and thornback ray *Raja* cf. *clavata* present. Spurdog *Squalus acanthias* is also present in this area (see Section 2).

The species composition of skates caught in the Barents Sea differs from those recorded in the Norwegian Deep and northeastern Norwegian Sea (Skjaeraasen and Bergstad, 2000, 2001). Although *A. radiata* is the dominant species in both areas, the proportion of warmer-water species (*B. spinicauda*, *D. linteus*) is lower and the portion of cold-water species (*A. hyperborea*) is higher in the Barents Sea.

Stock boundaries are not known for the species in this area. Neither are the potential movements of species between the coastal and offshore areas. The adjacent Norwegian coastal area has been included within the Barents Sea ecoregion. Further investigations are necessary to determine potential migrations or interactions of elasmobranch populations within this ecoregion and adjacent areas.

13.2 The fishery

13.2.1 History of the fishery

Detailed data on catches of skates from the Barents Sea are only available from bycatch records and surveys from 1996–2001 and 1998–2001, respectively (provided by Dolgov *et al.*, 2004a, 2004b). Bottom trawl fisheries mainly target cod *Gadus morhua* and haddock *Melanogrammus aeglefinus*, and longline fisheries target cod, blue catfish *Anarhichas denticulatus* and Greenland halibut *Reinhardtius hippoglossoides*. These are conducted through all seasons and have a skate bycatch, which is generally discarded. Dolgov *et al.*, 2004a estimated the total catch of skates taken by the Russian fishing fleet operating in the Barents Sea and adjacent waters in 1996–2001 ranged from 723–1891 t (average of 1250 t per year). *A. radiata* accounted for 90–95% of the total skate bycatch.

13.2.2 The fishery in 2007

No new information.

13.2.3 ICES advice applicable

ICES has never provided advice for any of the demersal elasmobranch stocks within this ecoregion.

13.2.4 Management applicable in 2007

There are no TACs or other management measures for any of the demersal elasmobranch species in this region.

13.3 Catch data

13.3.1 Landings

Data for the most recent years are either preliminary or unavailable and are for all skate species combined. The landings data given here are for ICES Division I (Figure 13.1 and Table 13.1). The peak in Russian landings in the 1980s corresponds to an experimental fishery for skates, whereby bycatches were landed as opposed to discarded (Dolgov personal communication, 2006). Landings from the most westerly parts of the Barents Sea ecoregion fall within Subarea II, and are described in Section 14.

13.3.2 Discards

Initial estimates by Dolgov *et al*., 2005 indicate that the total annual bycatch of skates from commercial trawl and longline fisheries in the Barents Sea ranged from 723–1891 t. *A. radiata* accounted for 90–95% of the total skate catch.

13.3.3 Quality of catch data

Landing data do not reflect the true catches of skates in the commercial fishery in the Barents Sea as a consequence of discarding. Species-specific data are lacking.

The Norwegian oceanic reference fleet (commercial vessels) collect biological data for the Institute of Marine Research (IMR) in Bergen, and some of these vessels are trawlers and longliners operating in the Barents Sea in various parts of the year. Personnel on board these vessels are obliged to measure the quantity of all fish species, including elasmobranchs. Catch data of elasmobranchs in the Barents Sea from these vessels may provide new information regarding quantities and proportions of elasmobranchs in relation to commercial teleosts such as cod and haddock. Such data should be examined in future meetings of WGEF.

13.4 Commercial catch composition

13.4.1 Species and size composition

No new commercial data were available to WGEF. Larger skates are more often caught in longline fisheries than in the trawl fisheries. Dolgov *et al*., 2005 described a 1:1 sex ratio in commercial catches for all skate species except *A. hyperborea*, of which males dominated in the longline fishery (see ICES, 2007 for further information).

13.4.2 Quality of catch data

Only limited data are available.

Data on catch composition of elasmobranchs from the Barents Sea collected by the reference fleet should be provided by IMR in Bergen next year.

13.5 Commercial catch-effort data

Relative cpue data are available for *A. radiata*, *A. hyperborea*, *R. fyllae* and *D. batis*, and *A. radiata*, *A. hyperborea* and *D. batis* in trawl and longline fisheries respectively. Total catches of skates of Russian fisheries in the Barents Sea and adjacent areas for the years 1996–2001 were summarized in ICES, 2007.

Catch data from other nations are limited and analyses of more recent Russian data are required.

13.6 Fishery-independent surveys

13.6.1 PINRO surveys

For the offshore areas, data from survey cruises were available from Dolgov *et al.*, 2004b and Drevetnyak *et al.*, 2005 covering the years from 1998–2001, and describing the distribution and habitat utilization of skates (*A. radiata*, *A. hyperborea*, *R. fyllae*, *D. batis*, *B. spinicauda* and *D. linteus*) in the Barents Sea. These results were summarized in ICES, 2007.

13.6.2 Norwegian coastal survey

For the coastal area, the distribution and diversity of elasmobranch species' in North-Norwegian coastal areas were assessed and presented by Williams, 2007 and Williams *et al.*, 2007 WD (summarized in ICES, 2007). Seven skate species were recorded from the Norwegian coastal area of the Barents Sea.

Amblyraja radiata was the most abundant species, being caught in every survey and along the entire coast. In all 509 individuals were recorded at depths of 30–515 m. *Raja* cf. *clavata* appeared to be the next most abundant species with 64 individuals recorded at depths between 41–465 m. The data regarding this species must be treated with caution, as there may have been some identification problems.

Of the less common species, *R. fyllae* (n = 36) were recorded at depths of 98–415 m, *B. spinicauda* (n = 10) at 48–410 m, *D. batis* (n = 7) at 229–425 m, *L. fullonica* (n = 5) at 82–380 m, and *A. hyperborea* (n = 3) at 80–202 m.

13.6.3 Quality of survey data

There are concerns regarding the accuracy of skate species identification with regard to the Norwegian Autumn Coastal Survey data. This is particularly relevant to confusion between *A. radiata* and *R. clavata*, and possibly other species.

Length-frequency data from the Norwegian coastal area were not available at the WGEF.

13.7 Life-history information

Length data are available for *A. radiata*, *A. hyperborea*, *R. fyllae*, *D. batis* and *B. spinicauda* (see ICES, 2007). Some biological information is available in the literature (e.g. Berestovsky, 1994).

13.8 Exploratory assessment models

No assessments have been conducted.

13.9 Quality of assessments

No assessments have been conducted.

13.10 Reference points

No reference points have been proposed.

13.11 Management considerations

The elasmobranch fauna of the Barents Sea is little studied and comprises relatively few species. The most abundant demersal elasmobranch in the area is *A. radiata*, which is widespread and abundant in this and adjacent waters. *B. spinicauda*, *D. batis*, *A. hyperborea* and *L. fullonica* are listed as Data Deficient in the Norwegian Red List, 2006. Further and more extensive studies are required, particularly for some of the larger-bodied species (e.g. larger skates), which could be more vulnerable to overfishing. Issues regarding misidentification of some species during surveys needs to be resolved before sound and reliable advice can be given for elasmobranchs in the Barents Sea ecoregion.

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Table 13.1 Demersal Elasmobranchs in the Barents Sea. Total landings of skates and rays from ICES Area 27 Subdivision I, 1973–2007. Total landings (tonnes).

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Belgium	.	.	.	1	.	.	.	.	.	.	.	.
France	.	.	.	81	49	44	.	.	.	.	.	.
Germany	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Iceland	.	.	.	.	.	.	.	.	.	.	.	.
Norway	.	.	.	1	3	4	8	2	2	2	1	10
Portugal	.	.	100	11	1	.	.	.	.	.	.	.
Russian Federation	.	.	.	.	.	1126	168	93	3	1	n.a.	563
Spain	.	.	.	.	.	.	.	.	.	.	.	.
UK - England & Wales	78	46	49	33	70	9	8	4	.	1	.	.
UK – Scotland	.	.	1	2	2	.	.	.	.	.	.	.
Total	78	46	150	129	125	1183	184	99	5	4	1	573

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	.	.	.	.	.	.	.	.	.	.	.	.
France	.	.	.	.	.	.	.	.	.	.	.	.
Germany	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	.	.	.	2	.	.
Iceland	.	.	.	.	.	.	.	.	1	.	.	.
Norway	11	3	14	7	4	1	5	24	29	72	9	27
Portugal	.	.	.	.	.	.	.	.	.	.	.	.
Russian Federation	619	2137	2364	2051	1235	246	n.a.	399	390	369	.	.
Spain	.	.	.	.	.	.	.	.	.	.	7	.
UK - England & Wales	.		2	.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
UK – Scotland	.	.	.	.	.	.	.	.	.	.	.	.
Total	630	2140	2380	2058	1239	247	5	423	420	443	16	27

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	.	.	.	.	.	n.a.	n.a.	n.a.			
France	.	.	.	.	.	.	.	.	.		
Germany	.	.	.	.	.	n.a.	n.a.	n.a.			
Iceland	1	.	.	4	.	n.a.	n.a.	n.a.			
Norway	3	13	21	12	30	26	2	1	4	13	4
Portugal	.	.	.	.	.	n.a.	n.a.	n.a.	.		
Russian Federation	399	790	568	502	218	173	38	n.a.	n.a.	n.a.	24
Spain	.	.	.	.	.	n.a.	n.a.	n.a.	.		
UK - England & Wales	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	.		
UK – Scotland	.	.	.	.	.	n.a.	n.a.	n.a.	.		
Total	403	803	589	518	248	199	40	1	4	13	28

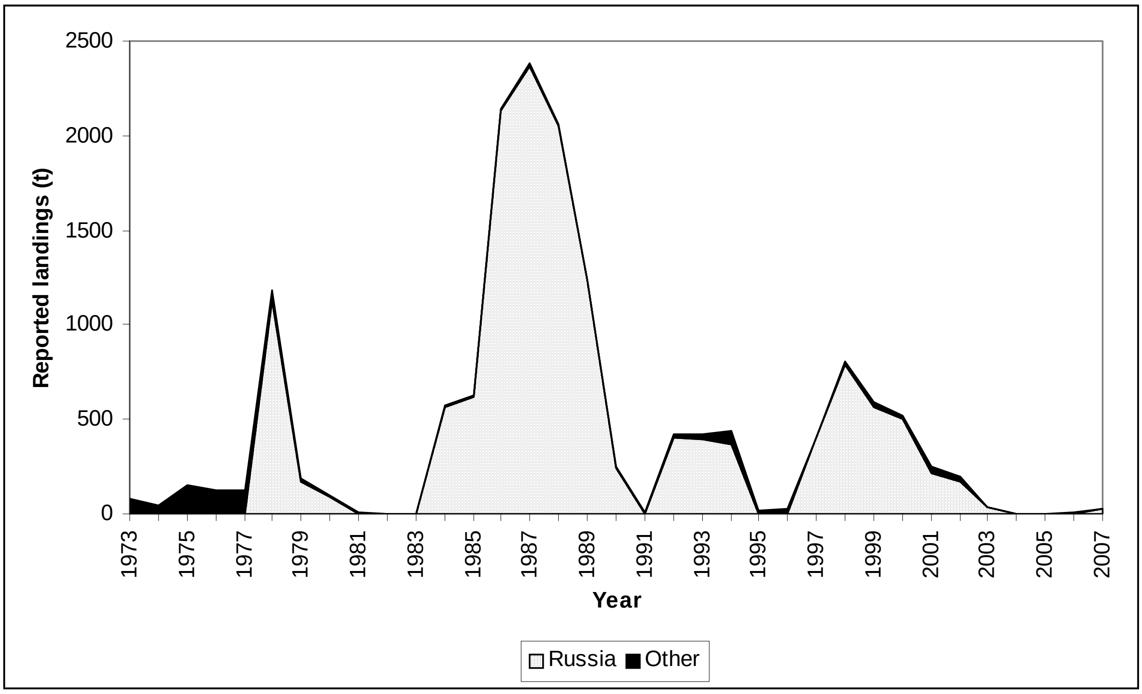

Figure 13.1 Demersal elasmobranchs in the Barents Sea. Skates and rays from ICES Area 27, Subdivision 1, 1973–2007. Total landings (tonnes).

14 Demersal elasmobranchs in the Norwegian Sea

14.1 Eco-region and stock boundaries

Williams *et al.*, 2007 reported that 17 demersal elasmobranch species were present along that part of the Norwegian coastal area included in the Norwegian Sea ecoregion (Table 14.1). Starry ray (thorny skate) *Amblyraja radiata* is the most abundant skate species. Whilst abundances are higher in the north, this species does occur in fairly large numbers at all latitudes along the coast. Long-nose skate *Dipturus oxyrinchus* is mainly distributed along the southern section of coastline, south of latitude 65°N. The other species found in the coastal area are thornback ray *Raja clavata*, spotted ray *R. montagui*, blonde ray *R. brachyura*, common skate *D. batis*, sailray *D. linteus*, Norwegian skate *D. nidarosiensis*, sandy ray *Leucoraja circularis*, shagreen ray *L. fullonica*, round skate *Rajella fyllae*, arctic skate *Amblyraja hyperborea*, and spinetail ray *Bathyraja spinicauda*.

Sharks in the area include spurdog *Squalus acanthias* (see Section 2) and several deep-water species (see Section 5), such as velvet belly lantern shark *Etmopterus spinax*, blackmouth catshark *Galeus melastomus* and Greenland shark *Somniosus microcephalus*. Little information is available about the skate species inhabiting the offshore area of the Norwegian Sea ecoregion. Skjaeraasen and Bergstad, 2001 noted several species of skate in the Norwegian Sea and the Norwegian Deep. *A. hyperborea* and *B. spinicauda* were found in bottom trawls mainly in depths of 800–1400 m and 650–850 m respectively. *A. hyperborea* has not been recorded in the Norwegian Deep (Section 15). Other species occurring in this area are *A. radiata*, *D. batis*, *D. linteus*, *D. nidarosiensis*, *D. oxyrinchus*, *L. circularis*, *L. fullonica*, *R. clavata*, *R. fyllae*. A more detailed description of the skates in the Norwegian Sea can be found in Stehmann and Bürkel, 1984.

Stock boundaries are not known for the species in this area, neither are the potential movements of species between the coastal and offshore areas. Parts of the adjacent Norwegian coastal area have been included within the Barents Sea ecoregion. Further investigations are necessary to determine potential migrations or interactions of elasmobranch populations within this ecoregion and adjacent areas.

14.2 The fishery

14.2.1 History of the fishery

There is no directed fishery on skates and rays in the Norwegian Sea, though they are caught in mixed fisheries targeting teleost species. Landings data for skates are demonstrated in Table 14.2 and Figure 14.1 for the years 1973–2007.

14.2.2 The fishery in 2007

No new information.

14.2.3 ICES advice applicable

ICES has never provided advice for any of the demersal elasmobranch stocks within this ecoregion.

14.2.4 Management applicable

There are no TACs or other management measures for any of the demersal skate species in this region.

14.3 Catch data

14.3.1 Landings

Data are very limited and only available for ICES Division II for all skate landings combined (Figure 14.1 and Table 14.2). This area covers all of the Norwegian Sea ecoregion, but also includes the most westerly parts of the Barents Sea ecoregion (Section 13).

Overall landings throughout time have been low, at about 200–300 t per year for all fishing countries, with moderate fluctuations. The peak in the late 1980s resulted from Russian fisheries landing over 1900 t of skates in 1987, subsequently dropping to low levels two years later. This peak was as a consequence of an experimental fishery, when skate bycatch was landed, whereas normally they are discarded (Dolgov, pers. comm., 2006). Russia and Norway are the main countries landing skates from the Norwegian Sea.

Landings data are not resolved to species and are provided by Norway and France in the most recent years.

14.3.2 Discard data

No information.

14.3.3 Quality of catch data

Catch data are not species disaggregated.

14.4 Commercial catch composition

14.4.1 Species and size composition

No information.

14.4.2 Quality of the data

Information on the species composition of commercial catches is required.

14.5 Commercial catch-effort data

No information.

14.6 Fishery-independent surveys

For offshore areas, Skjaeraasen and Bergstad, 2001 noted that *A. hyperborea* were caught in considerable numbers over a length range of 14–97 cm and a mean of about 60 cm, whereas *B. spinicauda* were scarce in distribution.

The distribution and diversity of elasmobranchs in North-Norwegian coastal areas were assessed and presented by Williams, 2007 and Williams *et al.*, 2007, WD. The southern portion of the coastal area studied is incorporated within the Norwegian Sea ecoregion. For the purposes of this report, the inshore boundary between the Norwegian and the Barents Sea is defined as the border between Norwegian Directorate of Fisheries Statistical Areas 04 and 05 (as demonstrated in Fiskeridirektoratet, 2004). Data for this assessment were taken from demersal trawl surveys carried out annually during autumn from 1992 to 2005. From 1995–2005 each annual survey covered the entire coastal area included in the Norwegian Sea ecoregion. In the three previous surveys, the coastline was split into three parts. 1992 covered north of 69°42′N, 1993 covered from 66°19′N to 69°27′N, and in 1994 from

62°28′N to 65°24′N. A Campelen 1800 shrimp trawl was used as standard for all surveys. Door spread was constrained by strapping to approximately 47 m for the majority of samples. The headline height was 4.5 m ± 0.5 m.

Thirteen skate species and four species of sharks were recorded as inhabiting the coastal region. Average catch rates for the majority of species were low (see Table 14.1). Presence/absence analyses have been carried out for all species and shifts in abundances by latitude were assessed for the more abundant species. There were no notable absences of species that were previously known to inhabit this area (Williams *et al.*, 2007, WD).

A. radiata was the most abundant of the skate species. In all 226 individuals were recorded over all surveys. Abundances appeared to be higher at the most northerly latitudes, but it occurred in all latitudinal bands along the coastline. *A. radiata* was the only species demonstrated to have significant annual changes in average abundances over the total survey area. From 2002–2003, abundances were demonstrated to have increased from 2 to 5 individual per km^2. This species was recorded and appears to be similarly abundant at all depths (<50 m to >700 m).

A. hyperborea: Five individuals were recorded at depths of 170–620 m.

D. batis: In total 24 individuals were caught in specific areas along the whole coastline covered by the survey. Most were taken in the surveys in 1997 and 1998 (seven caught in each year). Depth of capture ranged from 85–420 m.

D. nidarosiensis: Recorded only in five of the surveys from 1996 to 2004 and up to three specimens per year were taken. Depths ranged from 130–590 m. All observations were made south of 64°N with the exception of one individual caught in the Lofoten area (approx. 68°N) in 1997.

D. oxyrinchus: In total, 106 individuals were registered, with almost half of these being caught in 1994. The high catch rate in 1994 was spread over 25 positive trawl samples covering depths of less than 50 m to over 650 m, and the latitudinal range 62°N to 65°N.

Raja cf. *clavata*: Throughout the surveys 33 individuals were recorded over all latitudes, however, no latitudinal or temporal trends in abundance were identified. *R.* cf. *clavata* was more abundant in shallower areas, but was caught in areas as deep as 460 m. There is particular concern regarding the validity of the data for this species with regard to identification and further scrutiny of the data could well lead to disagreement with the description given here.

Rajella fyllae: In all 20 individuals were recorded from depths of 83–365 m. The distribution of observations was mainly confined to along the coastline north of 67°N. Four individuals were observed between 2002 and 2004 further south between 62° and 65°N.

L. fullonica: In all 20 individuals were identified, six of which were caught in one trawl during the 2001 survey. Depth of capture ranged from 77–512 m.

One individual of *B. spinicauda* was identified in 1993 at 315 m at approximately 68°N. The only observation of *D. linteus* occurred in 1997. This individual was identified in the Lofoten region at 68°N at a depth of 588 m. *R. montagui*, *R. brachyura* and *L. circularis* were caught between 62–64°N, which appears to be the northern limit of these species distributions. All three species were caught at shallower depths <250 m, and mostly in areas <100 m deep.

Of the non-skate species, *E. spinax*, appeared to be the most abundant elasmobranch present, followed by *G. melastomus* and *S. acanthias*. The number of individuals recorded during the surveys exceeded 8000 for the two former species. Latitudinal abundance trends of these small shark species all indicated a southerly distribution, with few or no individuals caught north of 65°N. All appeared to inhabit the same broad range of depths (<50 m to >700 m). Throughout all the surveys, only one *S. microcephalus* was recorded (in 1993 at 69°N and at a depth of 480 m).

No clear shifts in abundance over time were detected for any species. Annual observed abundances are shown in Figures 14.2 and 14.3. A more robust assessment is necessary to better identify temporal trends in abundances.

14.6.1 Quality of survey data

The difficulties associated in identifying skate species are a serious concern when considering the validity of the data used in this assessment. A detailed description of this issue was given in Williams *et al*., 2007 and Williams, 2007 and summarized in ICES, 2007. There are concerns about misidentification with regard to skates (Rajidae), and in particular the possible confusion between *A. radiata* and *R. clavata*. The survey data for skates must be thoroughly examined before these are used in assessments. In order to achieve a satisfactory quality of survey data in future, better identification practices, using applicable identification literature, needs to be put in place.

14.7 Life-history information

No new information.

14.8 Exploratory assessment models

No assessments have been conducted, as a consequence of insufficient data.

14.9 Quality of assessments

No assessments have been conducted, as a consequence of insufficient data. Analyses of survey trends may allow the general status of the more frequent species to be evaluated, although taxonomic irregularities need to be addressed first.

14.10 Reference points

No reference points have been proposed for any of these species.

14.11 Management considerations

There are no TACs for any of the demersal skates in this region. Eight of the species included in this section are listed in the Norwegian Red List, 2006 as data deficient. The demersal elasmobranch fauna of the Norwegian Sea comprises several species that occur in the Barents Sea (Section 13) and/or the North Sea (Section 15). Further investigations are required, and could also offer valuable additional information for managing the neighbouring ecoregions.

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Table 14.1 Catch data (number of individuals per species) for the Norwegian Sea ecoregion from the Annual Autumn Bottom Trawl Surveys of the North Norwegian Coast, from 1992 to 2005.

Species	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total catch	Total % of positive samples	Catch rate (No. per survey)
Amblyraja radiata	7	44	23	15	8	41	9	16	9	6	10	10	19	9	226	11%	17.4
Bathyraja spinicauda	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0%	0.1
Rajella fyllae	0	4	0	0	0	1	0	0	0	0	5	6	4	0	20	1%	1.5
Raja clavata	0	4	15	1	0	2	3	6	0	0	0	0	2	0	33	2%	2.5
Dipturus batis	0	2	0	1	3	7	7	1	1	1	1	0	0	0	24	1%	1.8
Leucoraja fullonica	0	0	0	0	0	0	0	4	3	9	3	0	0	1	20	1%	1.5
Leucoraja circularis	0	0	0	0	0	0	0	0	1	0	1	9	5	7	23	1%	1.8
Raja montagui	0	0	0	0	0	0	0	2	1	0	1	0	1	0	5	<1%	0.4
Dipturus oxyrinchus	0	0	54	3	2	30	2	0	0	1	2	6	4	2	106	5%	8.2
Dipturus nidarosiensis	0	0	0	0	1	1	0	0	0	3	1	0	1	0	7	<1%	0.5
Amblyraja hyperborea	0	0	1	0	0	0	0	0	0	0	4	0	1	0	6	<1%	0.5
Raja brachyura	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	<1%	0.3
Dipturus linteus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	<1%	0.1
Galeus melastomus	0	24	1883	1197	105	1269	189	480	258	812	1196	275	640	48	8376	24%	644.3
Etmopterus spinax	0	829	8453	473	1061	2733	584	3881	1485	1401	2417	785	2305	1369	27 776	33%	2136.6
Squalus acanthias	0	21	51	26	20	5	106	168	12	68	43	21	104	17	662	8%	50.9
Somniosus microcephalus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	<1%	0.1
Number of samples	17	163	106	77	74	96	78	81	76	56	78	65	77	63			

Table 14.2 Demersal elasmobranchs in the Norwegian Sea. Total landings (t) of skates and rays from ICES Area 27 Subdivisions II+IIa+IIb from 1973–2007.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983		
Belgium			1										
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		
Faroe Islands				5	2	1	1						
France			1	68	61	18	2	1	12	109	2		
Germany		1	52	12	59	114	84	85	53	7	2		
Iceland													
Netherlands							2						
Norway	201	158	89	34	99	82	126	191	137	110	96		
Portugal				34	39								
Russian Federation						302	99	39					
Spain											28		
UK - Eng+Wales +N.Irl	65	18	14	20	90	10	6	2					
UK - Scotland	2	1			1								
Total of Submitted Data	**268**	**178**	**157**	**173**	**351**	**527**	**320**	**318**	**202**	**226**	**128**		
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994		
Belgium													
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		
Faroe Islands			4		15		42		2				
France	6	5	11	21	42	8	56	11	15	9	7		
Germany	112	124	102	95	76	32	52						
Iceland													
Netherlands													
Norway	150	104	133	214	112	148	216	235	135	286	151		
Portugal										22	11		
Russian Federation	537	261	1633	1921	1647	867	208		181	112	257		
Spain		17	5		9								
UK - Eng+Wales +N.Irl	5	1	2	4		2	1		1				
UK - Scotland				2	1								
Total of Submitted Data	**810**	**512**	**1890**	**2257**	**1902**	**1057**	**575**	**246**	**334**	**429**	**426**		
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium								n.a.	n.a.	n.a.	0		
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5	n.a.	n.a.			
Faroe Islands						n.a.		n.a.	2	n.a.			
France	8	6	8	5	n.a.	5	4	7	2	7	8		
Germany						2		2	2	7	0		
Iceland							4		n.a.	n.a.			
Netherlands								n.a.	n.a.	n.a.			
Norway	239	198	169	214	239	244	233	118	111	135	133	146	173
Portugal		10	28	46	10	6	3	n.a.	8	n.a.	.		
Russian Federation			77	139	247	400	113	38	6	n.a.			
Spain	3		3	15	6		7	11	32	n.a.	.		
UK - Eng+Wales +N.Irl	1	4			1			n.a.	n.a.	n.a.	.	0	0
UK - Scotland					1	1	1	3	3	n.a.	.	4	1
Total of Submitted Data	**251**	**218**	**285**	**419**	**504**	**658**	**365**	**184**	**166**	**149**	**141**	**150**	**174**

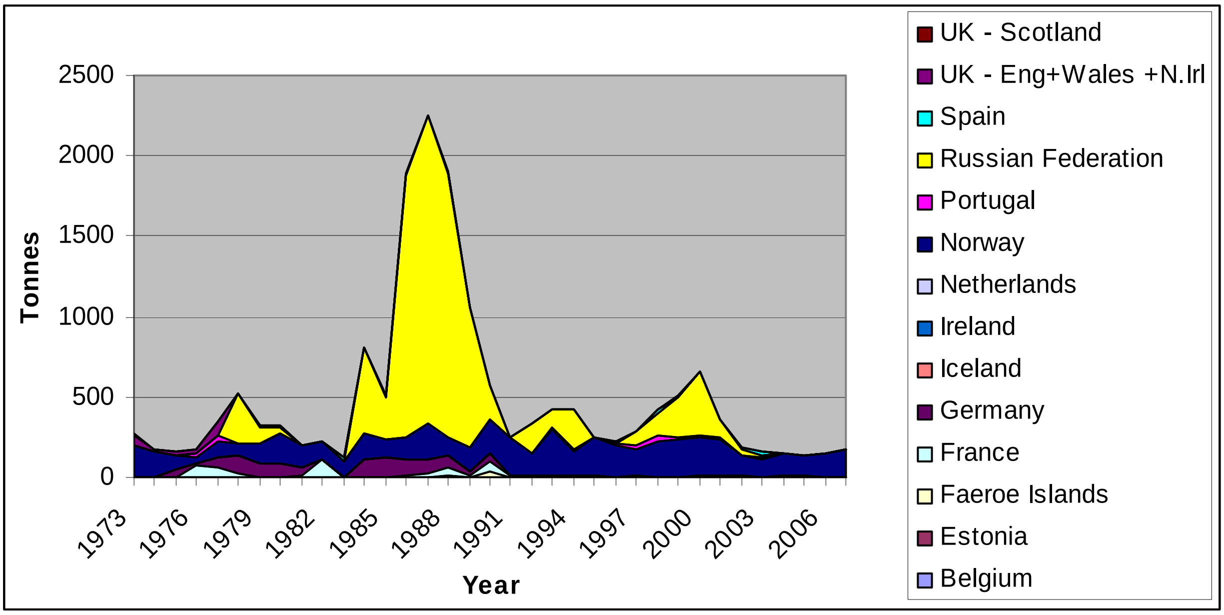

Figure 14.1 Demersal elasmobranchs in the Norwegian Sea. Total landings (t) of skates and rays from ICES Area 27 Subdivisions II+IIa+IIb from 1973–2007.

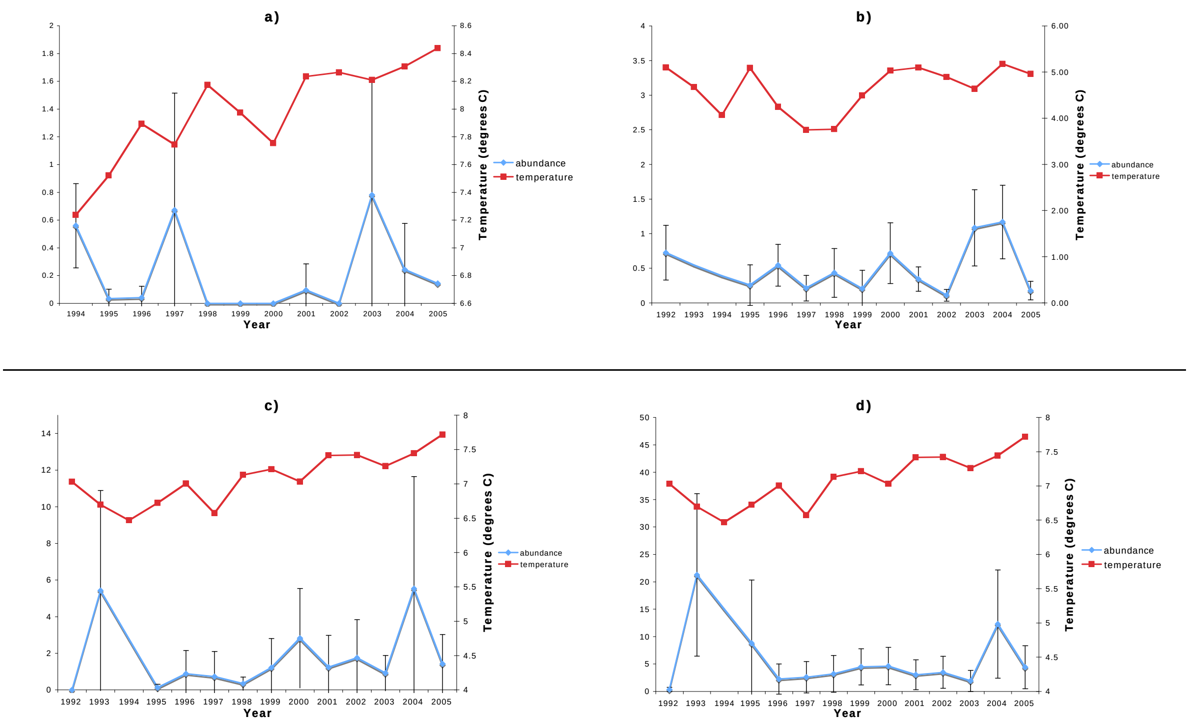

Figure 14.2 Demersal elasmobranchs in the Norwegian Sea. Species abundance with 95% confidence intervals against temperature for a) *Dipturus oxyrinchus* in the area 62°N, b) *Amblyraja radiata* in area East (69–71°N), c) velvet-belly in area West (69–71°N) and d) *Chimaera monstrosa* in area West (69–71°N). See Williams *et al.*, 2007, WD for description of areas.

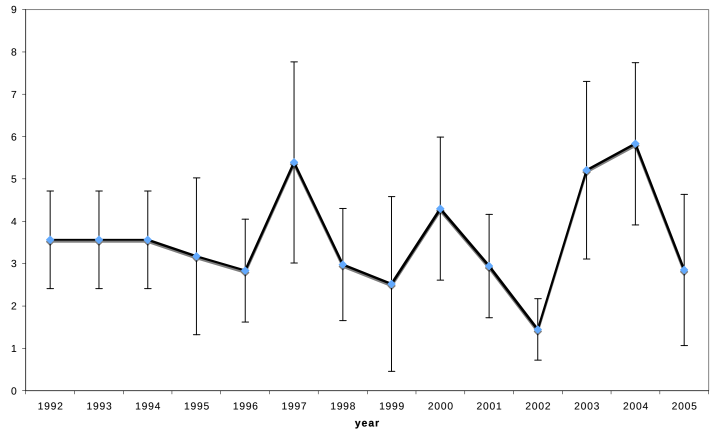

Figure 14.3 Demersal elasmobranchs in the Norwegian Sea. Average annual mean densities in number km^{-2} (with 95% confidence intervals) for *Amblyraja radiata* (1992–94 given as a combined average).

15 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel

15.1 Eco-region and stock boundaries

In the North Sea about 10 skate and ray species occur as well as seven demersal shark species. Thornback ray *Raja clavata* is probably the most important ray for the commercial fisheries. Preliminary assessments for this species were presented in ICES, 2005 and ICES, 2007a, based on research vessel surveys. Although this year the landings data have been updated, no further analyses of survey data were undertaken. WGEF is still concerned over the possibility of misidentifications of skates in some of the recent IBTS surveys (especially between *R. clavata* and starry ray (or thorny skate) *Amblyraja radiata*).

For most demersal species in the North Sea ecoregion the stock boundaries are not well known. The stocks of cuckoo ray *Leucoraja naevus*, spotted ray *R. montagui*, *R. clavata* and the lesser-spotted dogfish *Scyliorhinus canicula* probably continue into the waters west of Scotland (and for *R. clavata, R. montagui,* lesser-spotted dogfish also into the eastern English Channel). The stock boundary of common skate *D. batis* is likely to continue to the west of Scotland and into the Norwegian Sea. Blonde ray *Raja brachyura* has a patchy distribution in the North Sea. The stock boundaries of *Mustelus mustelus* and *M. asterias* are not known.

15.2 The fishery

15.2.1 History of the fishery

Demersal elasmobranchs are caught as a bycatch in the mixed demersal fisheries for roundfish and flatfish. A few inshore vessels target skates and rays with tanglenets and longline. For a description of the demersal fisheries see the Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (ICES, 2007b) and the report of the DELASS project (Heessen, 2003).

15.2.2 The fishery in 2007

WGFTFB in their report (ICES, 2007c) mention a significant bycatch of skates in outrigger trawls. This was based on a Belgian study of three Belgian beam trawlers and one Eurocutter during 12 months in 2006–2007 while fishing with outrigger trawls as an alternative for beam trawls (Vanderperren, 2008). In the overall catch, skates were most important in terms of weight (32–45%). It cannot, however, be excluded that these vessels were targeting skates.

The 25% bycatch ratio implied by the EC (see also Section 15.2.4) has restrained the fishery and has likely resulted in misreporting in 2007, both of area and species composition.

15.2.3 ICES advice applicable

In 2005 ICES provided advice for 2006 for these stocks, stating that "Target fisheries for common skate *D. batis* and thornback ray *R. clavata* should not be permitted, and bycatch in mixed fisheries should be reduced to the lowest possible level". Moreover, ICES advised that "if the fisheries for rays continue to be managed with a common TAC for all ray species, this TAC should be set at zero for 2006". No advice was provided for 2008.

15.2.4 Management applicable

In 1999 the EC first introduced a common TAC for "skates and rays". In 2006 the EC TAC for skates and rays for areas IIa (EC waters) and IV (EC waters) was set at 2737 t, which was 15% less than the TAC for 2005. The TAC for 2007 was 20% less than that for 2006 (on no particular scientific ground). This TAC was indicated to comprise of "bycatch quota" and it is specifically mentioned that "These species shall not comprise more than 25% by live weight of the catch retained on board".

The TAC for 2008 was set at 1643 t, which is 25% less than the TAC for 2007. From 2008 onwards the EC has obliged member states to provide species-specific landings data for the major North Sea species: *R. clavata, R. montagui, R. brachyura, L. naevus, A. radiata* and *D. batis*. WGEF is of the opinion that this measure is ultimately expected to improve our understanding of the skate fisheries in the area.

Within the North Sea area, the Kent and Essex Sea Fisheries Committee (England) has a minimum landings size of 40 cm disc width for skates and rays.

In Sweden a number of demersal and deep-water elasmobranchs are contained in the Swedish Red List: velvet belly *Etmopterus spinax*, Greenland shark *Somniosus microcephalus*, *D. batis*, and rabbit fish *Chimaera monstrosa*. Furthermore, fishing for and landing of lesser-spotted dogfish, *R. clavata* and *D. batis* is prohibited.

15.3 Catch data

15.3.1 Landings

The landings tables for all skates and rays combined (Table 15.1–15.4) and for lesser-spotted dogfish (Table 15.5) were updated, but not all data for 2007 were available. Figure 15.1 shows the total international landings of rays and skates from IIIa, IV and VIId since 1903, plus the TAC for recent years. Data from 1973 onwards are WG estimates.

15.3.2 Discard data

Information on discards in the different demersal fisheries is being collected by several countries. Length frequency distributions of discarded and retained elasmobranchs, covering the period from 1998–2006, were provided by UK (England) and illustrated in ICES, 2006.

15.3.3 Quality of the catch data

Species-specific landings data are not available. Several nations now have market sampling and discard observer programmes that can provide information on the species composition, although comparable information is lacking for earlier periods.

15.4 Commercial catch composition

15.4.1 Species and size composition

Only France and Sweden provide landings data by species but the accuracy of the data provided remains doubtful.

Data for the landings by the Dutch beam trawl fleet are presented in Table 15.6. UK (England and Wales) provides data by gear and by species (Table 15.7).

In Table 15.8 and 15.9 some length composition data for North Sea skates are presented from the Netherlands and the UK (England and Wales).

There are no specific effort data for North Sea skates.

15.4.2 Quality of data

Although two countries have provided species-specific landings data, based on information from logbooks or auctions, these were not considered reliable. The WG is of the opinion that analyses of data from market sampling and observer programmes will provide reliable data on the recent species composition of landings and discards. Species-specific landings should be available from 2008. More robust protocols for ensuring correct identification are also needed (e.g. for separating *R. brachyura* and *R. montagui*.

The peak in the landings of rays and skates in 1981 is the result of one year with exceptionally high landings reported by France for IV and VIId. This is likely to be caused by misreporting. Misreporting may have taken place in 2007 as a consequence of limited quota and the 25% bycatch limitation.

15.5 Commercial catch-effort data

There are no effort data specifically for North Sea skates and rays.

15.6 Fishery-independent surveys

15.6.1 Availability of survey data

Fishery-independent data are available from the International Bottom Trawl Survey (IBTS), in winter and summer, and from different beam trawl surveys (in summer). An overview of North Sea elasmobranchs based on survey data were presented in Daan *et al.*, 2005. Distribution maps are provided in ICES, 2005 and ICES, 2006.

Daan *et al.*, 2005 also analysed the time-series of abundance for the major species caught for the period 1977–2004 (see Figure 12.3 of ICES, 2006). Spurdog has clearly declined markedly over time, whereas lesser-spotted dogfish and smoothhounds have increased markedly. *Amblyraja radiata* appears to have increased from the late seventies to the early eighties, possibly followed by a decline. The same pattern also seems to apply to the *L. naevus* and *R. montagui*. *Dipturus batis* demonstrated an overall decline, supporting the findings of ICES, 2006. *Raja clavata* has largely remained stable in recent years, with one outlier in 1991 owing to a single exceptionally large catch (confirmed record).

Ellis *et al.*, 2005 analysed catches from UK surveys. Lesser-spotted dogfish demonstrated a small increase in the eastern Channel. *A. radiata* demonstrated an increase in the North Sea in the period 1982–1991. *D. batis* was not caught in the North Sea since 1991, whereas in the 1980s they were still caught sporadically.

Martin *et al.*, 2005 analysed data from the Channel Ground Fish Survey (IFREMER) and the Eastern Channel Beam Trawl Survey (Cefas) for the years 1989–2004. Migratory patterns related to spawning and nursery areas are demonstrated. An apparent trend for lesser-spotted dogfish distribution to be increasing towards the Straits of Dover and into the North Sea was evident, whereas the SE English coast is an important habitat for *R. clavata*.

15.6.2 Eastern English Channel and southern North Sea

The Cefas beam trawl survey in the Irish Sea and Bristol Channel started in the late 1980s, although the survey grid was not standardized until 1993. The primary target species for the survey are commercial flatfish (plaice and sole) and so most sampling effort occurs in relatively shallow water. Lesser-spotted dogfish, *R. brachyura*, *R. clavata*, *R. montagui* and *R. undulata* are all sampled during this survey. Smoothhounds caught by the gear tend to be juveniles. See Ellis *et al*., 2005 and Parker-Humphreys, 2005 for a description of the survey.

Catch rates ($n.h^{-1}$) for this survey have been summarized, with analyses (a) omitting data collected prior to 1993, and (b) only including those fixed stations fished at least 11 times during the 15 year time-series (1993–2007).

Although *R. brachyura* have generally increased over the period, there are only low catch rates for this species. Catch rates for *R. montagui* have declined in recent years. Given that this survey generally catches juveniles of these species, it is unclear as to whether there are identification issues involved in these contrasting trends. *R. clavata* have broadly increased over the period, though the greatest catches and increase is from stations in IVc. Over the entire time-series, there have been a limited number of stations fished routinely in this Division, although an increased number of sampling stations have been fished in recent years, and these data should be examined in future studies. Although only small numbers of *R. undulata* are captured in this survey (VIId is the eastern part of their geographic range), the absence of this species in the last two years is a cause of concern.

15.6.3 Changes in abundance and spatial variation

In 2007 two methods, the GAM method and SPANdex modelling, were undertaken to examine the changes in abundance and spatial variation in the more commonly occurring skate species in the North Sea. Both methods are explained briefly in Sections 15.6.3.1 and 15.6.3.2. A further detailed explanation on these analyses can be found in ICES, 2007a.

15.6.3.1 GAM analyses of survey trends

The GAM analysis followed focused on the most abundant species caught in the Q1 IBTS across this ecoregion: *R. clavata*, *L. naevus*, *A. radiata* and lesser-spotted dogfish. Only 'filtered' Q1 IBTS data (see ICES, 2007a) were used and, as haul and depth data were not available at the WG, the model effects were year and statistical rectangle only.

The results of the fitted GAMs differ per species. For *R. clavata* the fitted GAM demonstrates an increase through the 1980s, followed by a decline to the mid 1990s then a subsequent increase (Figure 15.2). Catch rates are estimated to be highest across a small number of statistical rectangles in the southwestern North Sea specifically those around the Thames estuary and the Wash. Across the rest of the North Sea, catch rates are generally estimated to be low. The fitted GAMs of the *L. naevus*, *A. radiata* and the lesser-spotted dogfish also demonstrate some fluctuations over the 25-year period. In recent years the fitted GAMs for the *A. radiata* decreased, for the lesser-spotted dogfish increased and for the *L. naevus* stabilized. The highest catch rates of these species are found in the central North Sea, the western North Sea and off the east coast of Scotland respectively and further around Orkney and Shetland.

Further exploration of these survey data (in terms of individual model fit, residual patterns, interaction terms, etc) was not as thorough as would be ideal. However, general trends in estimated year effect appeared to be relatively robust to distributional assumptions although the actual magnitude of fluctuations in year effect and smoothness of the function were less so. Additionally, the consistency of spatial effects between years was not explored.

15.6.3.2 Estimation of abundance and spatial analysis-application of the SPANdex method

In 2007 the SPANdex approach was used to examine changes in abundance and distribution of four more common skate species in the North Sea (*A. radiata, L. naveus, R. clavata* and *R. montagui*). The resulting density strata providing a visual representation of distribution changes over time in the form of maps.

Density surfaces (distribution based strata) were created using potential mapping in SPANS (Anon., 2003). The technique converts geo-referenced point data, in this case survey set mean number per tow, to surfaces that describe spatial density of fish. Quarter 1 catch rate data from the North Sea IBTS survey employing a GOV demersal trawl, from 1980 to 2006 were used for the analysis.

The distribution maps of all four skate species (*A. radiata, L. naveus, R. clavata* and *R. montagui*) demonstrated that the species have been restricted to the consistent areas (e.g. Figure 15.3: *R. clavata*). The area occupied (AO) illustrated in the distribution maps of the species changes over time (Figure 15.4) and their relative abundance has been maintained or increased (Figures 15.5A, 15.6A). The relationship between total AO and abundance differed between the species. For *R. montagui* a significant linear relationship was found (Figure 15.5B). The observed patterns in the relative abundance of *R. clavata*, however, demonstrated little resemblance with the changes of total AO (Figure 15.5B). For *L. naevus* and *A. radiata* the AO varied even in a manner quite different from the changes in abundance (Figure 15.6B). It appeared that for all species the high density area occupied corresponded more closely to observed abundance changes (Figures 15.5C, 15.6C). Overall, it is clear from this study that AO may not reflect population changes and should therefore be used with caution when being used as metric for population status.

15.7 Life history information

Elasmobranchs are not routinely aged, although techniques for ageing are available (e.g. Walker, 1999; Serra-Pereira *et al.,* 2005). Limited numbers of some species have been aged in special studies.

Some information on maturity at length exists and should be combined for different countries, to maximize the sample sizes.

Demographic modelling (see Section 1.10.2) requires more accurate life-history parameters, in terms of age-length keys and fecundity. For example, recent studies of the numbers of egg-cases laid by captive female *Raja clavata* were 38–66 eggs over the course of the egg-laying season, whereas other studies using oocyte counts and the proportion of females carrying eggs have suggested that the fecundity may be >100.

No information is available on recruitment, although parts of the southern North Sea (e.g. the Thames area) are known to have large numbers of juveniles (Ellis *et al.*, 2005).

15.8 Exploratory assessment models

15.8.1 Previous assessments of *Raja clavata*

Under the DELASS project (Heessen, 2003), various analyses of survey data were conducted (ICES, 2002). The high frequency of zero catches in combination with a few, in some cases, high catches were analysed statistically using a two-stage model approach. First, the probability of getting a catch with at least one *R. clavata* was made using a GLM with a binomial distribution and a logit link function. Non-zero catches were then modelled using a Gamma distribution and a log link function.

ICES, 2002 concluded that "The North Sea stock of thornback ray has steadily declined since the start of the 20th century. One hundred years ago, the distribution area of the stock included almost the whole North Sea. Today, survey data demonstrate a concentration in the southwest North Sea (from the Thames Estuary to the Wash), and this reduced distribution area is confirmed by the steep decrease in the probability of a catch including thornback ray estimated by statistical models. Apparently, there are still patches left in the North Sea with stable local populations. Whether these areas are self-sustaining and whether the number of patches will remain high enough for a sustained North Sea population is, however, unknown."

ICES, 2005 subsequently undertook GIS analyses of survey data, and these studies also suggested that the stock was concentrated in the southwestern North Sea (see Sections 10.5 and 10.8 of ICES, 2005) and the stock area had declined.

From comparisons of recent survey data with data for the early 1900s it can be seen that, in the first decade of the 20th century, *R. clavata* was widely distributed over the southern North Sea, with centres of abundance in the southwestern North Sea and in the German Bight, north of Helgoland. The area over which the species is distributed in recent years is much smaller than 100 years ago. The species has disappeared from the southeastern North Sea (German Bight), and catches in the Southern Bight have become limited to the western part only (see also ICES, 2002).

15.9 Quality of assessments

Analyses of survey data for *R. clavata* undertaken by ICES in 2002 and 2005 (ICES, 2002 and 2005) may have been compromised by misidentifications in submitted IBTS data, and so the extent of the decline in distribution reported in these reports may be exaggerated. The distribution of *R. clavata* in the southern North Sea has certainly contracted to the southwestern North Sea, and they are now rare in the southeastern North Sea, where they previously occurred (as indicated by historical surveys). The perceived decline in catches in the northeastern North Sea may have been based, at least in part, on bycatches of *A. radiata*. Excluding questionable records from analyses still indicates that the area occupied by *R. clavata* has declined, with the stock concentrated in the southwestern North Sea, with catch trends in IVc more stable/increasing in recent times (ICES, 2007a).

15.10 Reference points

No reference points have been proposed for *R. clavata* or other stocks in this ecoregion.

15.11 Management considerations

Demersal elasmobranchs are usually caught in mixed fisheries for demersal teleosts, although some inshore fisheries target *R. clavata* in seasonal fisheries in the southwestern North Sea. They have traditionally been landed and reported in mixed categories such as "skates and rays" and "sharks". For assessment purposes species-specific landings data are essential. The examples given above, of species-specific landings based on different sources, clearly demonstrate that only actual sampling of the catches and landings provides reliable data. Species-specific landings data for 2008 will be examined next year.

Since a TAC was introduced for North Sea "skates and rays" in 1999 it has always been higher than the landings (Table 15.10 and Figure 15.1). This TAC, however, has gradually been reduced, for example from 2005 to 2006 by 15%, from 2006 to 2007 by 20% and from 2007 to 2008 by 25%. In its 2006 report, WGEF mentioned that the 2006

TAC might become restrictive for some countries and that discarding was therefore expected to increase. Discard survivorship is not known for skates and rays caught in commercial gears, although there are currently studies to evaluate discard survivorship. The 2008 TAC is considerably less than recent landings and if fishers do not change, their practices must either lead to an increase of discarding and/or to misreporting. WGEF feels that the current TAC should not be reduced any further at this time.

From 2008 onwards, species-specific landings data for the major skate species are required. Information on the catches of the next couple of years should demonstrate what effect the small TAC will have on the fisheries.

WGEF was informed that the 2007 "skate" bycatch quota had impacted on UK fishers operating in coastal waters of the Outer Thames area and east coast. For example, some IVc landings may be reported as originating in VIId, and certain fisheries may have landed other species (e.g. tope, smoothhounds, lesser-spotted dogfish etc.) in order to increase the amount of *R. clavata* that can be landed ("skates and rays" may comprise no more than 25% by live weight of the catch retained on board). These fish may then be dumped when they have served their purpose. Such 'loopholes' can be a problem when managing through ratios. Additionally, if skates and rays are retained at the start of a fishing trip, but subsequent fishing does not comprise large quantities of other commercial species that can be landed; this can result in discarding of dead fish. In terms of managing the inshore fleet, measures other than ratios (e.g. trip limits, size restrictions) might be more appropriate measures for decreasing fishing mortality on the stock. The bycatch ratio was discontinued for small boats in 2008.

Due to effort restrictions, and high fuel prices, effort may divert to small inshore fisheries that may target skates. The main areas of *R. clavata* occur in the Thames estuary and the Wash in the southwestern North Sea.

The TAC for "skates and rays" should only apply to areas IIIa, IV and VIId and not to IIa since only a part of IIa belongs to the present North Sea ecoregion.

Technical interactions of fisheries in this ecoregion are demonstrated in Table 15.11.

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Table 15.1 **Total landings (t) of Rajidae in III.**

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	.	.	.	.	.	.	.		0	0	n.s
Denmark	16	7	11	41	56	22	36	127	62	24	5
Germany	.	+	.	.	.	+			.	1	n.s.
Iceland	.	.	.	.	.		.				
Netherlands	n.a.	.	.	.	.	.			0	0	n.s.
Norway	160	134	208	123	154		163	85	94	51	13
Sweden	5	1	2	2	12	13	9		10	18	11
UK (E&W_NI_+)	.	.	.	.	.	.	.	.	0	0	0
UK (Scotland)	.	.	.	.	.	.	.	.	0		0
Total of submitted data	181	142	221	166	222	35	208	212	166	93	29

Table 15.2 **Total landings (t) of Rajidae in IV.**

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	428	373	336	332	370	436	323	276	327	350	n.s.
Denmark	33	20	45	93	65	34	33	23	23	26	27
Faroe Islands	.	.	.	n.s.	n.s.						
France	52	47	n.s.	31	61	62	36	37	34	15	n.s.
Germany	35	9	16	23	11	22		17	29	16	n.s.
Iceland	.	.	.	.	.		.			0	
Ireland	.	.	.	.	.		.		0	0	119
Netherlands	n.a.	609	515	693	834	805	686	561	680	603	n.s.
Norway	106	180	152	161	173		113	77	87	69	45
Poland	.	.	.	.	.						
Sweden	+	+	+	+	+	+	+	20	0	0	0
UK (E&W_NI_+)	1009	794	618	516	476	500	537	550	434	348	329
UK (Scotland)	1494	1381	965	860	822	853	741	512	404	374	331
Total of submitted data	3157	3413	2647	2709	2812	2711	2469	2073	2018	1801	851

Table 15.3 **Total landings (t) of Rajidae in VIId.**

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	117	66	93	69	79	113	153	96	94	109	n.s.
France	896	738	n.s.	693	729	725	796	695	602	687	n.s.
Germany	.	.	.	+	.	.	.	0	.	0	n.s.
Ireland	.	.	.	.	.	.	2	0	0	0	
Netherlands	na	.	.	.	.	.	.	.		13	n.s.
Spain	na	na	na	na	na	na	na	+	0		
UK (E&W_NI_+)	213	246	437	355	169	140	186	157	147	139	188
UK (Scotland)	+	+	.	.	.	.	.	.	0	2	0
Total of submitted data	1226	1050	530	1117	977	978	1137	948	843	948	188

Table 15.4 Combined landings (t) of Rajidae in IIIa, IV and VIId.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	545	439	429	401	449	548	476	372	422	459	n.s.
Denmark	49	27	56	134	121	56	69	151	85	50	32
Faroe Islands	.	.	.	n.s.	n.s.	.	.	.	0	0	0
France	948	785	n.s.	724	790	725	796	n.s.	636	701	n.s.
Germany	35	9	16	23	11	22	.	.	29	17	n.s.
Iceland	.	.	.	.	.	.	.	.	0	0	0
Ireland	.	.	.	.	.	.	2	0	0	0	119
Netherlands	n.a.	609	515	693	834	805	686	561	680	615	n.s.
Norway	266	314	360	284	327	.	276	162	181	120	58
Poland	.	.	.	.	.	.	.	.	0	0	0
Spain	na	na	na	na	na	na	na	+	0	0	0
Sweden	5	1	2	2	12	.	9	20	10	18	11
UK (E&W_NI_+)	1222	1040	1055	871	645	640	723	707	580	487	517
UK (Scotland)	1494	1381	965	860	822	853	741	512	404	375	331
Total of submitted data	4564	4606	3398	3992	4011	3649	3778	2484	3027	2843	1068

Table 15.5 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Landings of *Scyliorhinus canicula* in IIIa, IV and VIId.

	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	NA	NA	NA	NA	226	91.4	265	n.s.
France	1633	1811	1899	1777	1472	1614	1453	n.s.
UK (E&W)	NA	NA	NA	13	57	92	118	n.s.
UK (Scotland)	.	.	1	5	3	22	6	n.s.
	1633	1811	1900	1795	1758	1819.4	1842	0

Table 15.6 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel: species-specific landings (t) for North Sea rays and skates. Data for the Netherlands beam trawl fishery, based on market sampling.

Year	A. radiata	L. naevus	R. brachyura	R. clavata	R. montagui	Total
2000	1.2	3.2	135.9	264.9	287.6	693
2001	1.7	4.0	115.2	314.5	398.5	834
2002	not available					805
2003	not available					383
2004	-	-	116.0	217.3	228.0	561
2005	1.0	1.4	168.6	131.6	262.7	565
2006	-	-	155.6	251.9	208.5	616
2007	-	-	215.0	249.5	278.2	743

Table 15.7 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel: preliminary quantification of species composition (% in numbers) of rays in UK North Sea fisheries based on market sampling of longline, otter trawl and gillnet catches (From UK (England & Wales) market sampling in 2004).

SPECIES	LONGLINE	OTTER TRAWL	GILLNETS
Amblyraja radiata	0	1.9	0
Leucoraja naevus	0.6	5.4	0
Raja brachyura	8.6	8.5	1.9
Raja clavata	78.8	79	97.7
Raja montagui	11.9	5.2	0.5

Table 15.8 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel: North Sea rays and skates. Length frequency distributions (numbers in '000).

Country: the Netherlands
Gear: beam trawl
Category: landings

	Raja clavata					*Raja montagui*					*Raja brachyura*				
length	2000	2001	2005	2006	2007	2000	2001	2005	2006	2007	2000	2001	2005	2006	2007
25															
30	0.6	1.9	3.0	0.3	1.0	3.5	0.5	0.9	0.5						
35	9.4	11.2	7.8	8.6	7.1	34.2	6.3	4.7	2.5	0.4	1.2	1.0	0.3	1.5	
40	16.8	19.9	14.2	13.4	30.5	75.6	33.5	14.0	15.8	9.7	1.2	1.5	2.1	5.5	3.8
45	17.5	20.3	11.2	26.2	27.2	85.9	60.3	36.9	52.5	32.2	1.2	3.3	6.0	3.9	7.2
50	23.0	36.4	18.2	40.0	36.0	58.3	72.5	47.6	59.6	52.6	2.7	5.6	7.7	3.5	3.8
55	16.0	35.3	12.9	26.6	30.9	42.7	54.6	49.9	34.6	50.8	3.1	4.9	9.6	7.7	5.1
60	12.1	22.8	14.7	20.0	19.1	26.1	42.4	44.2	25.3	40.5	0.6	5.3	6.8	7.5	5.1
65	5.3	15.3	5.7	16.7	17.5	10.4	16.1	13.7	4.7	12.4	1.0	3.6	8.0	7.6	6.1
70	5.3	5.2	6.2	11.8	12.3	2.0	2.3	0.9	1.1	0.5	1.6	2.1	6.1	4.5	5.9
75	4.7	5.5	5.2	8.1	6.9	0.3		0.1			1.8	2.7	3.1	5.4	6.8
80	3.7	3.5	2.2	3.7	5.4						1.6	1.9	4.2	5.1	8.2
85	3.4	2.3	1.8	1.9	1.8						1.1	1.5	3.1	2.3	6.0
90	1.2	0.6	0.7	0.9	1.0						0.5	1.9	2.4	2.0	2.8
95	0.8	0.3	0.1		0.1						0.1	0.6	1.6	1.2	2.6
100											0.1		0.2	0.3	0.1
105													0.3		
110	0.1														
sum	119.8	180.5	103.9	178.2	196.7	339.2	288.4	212.9	196.6	199.2	17.7	35.8	61.5	58.0	63.5

Table 15.9 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel: Length distributions (numbers) of discards and landings from discard observations in the years 1998–2006.

Country:	UK England											
Gear:	all gears combined											
Category:	discards and landings											
	Raja brachyura		*Leucoraja naevus*		*Raja montagui*		*Dipturus batis*		*Amblyraja radiata*		*Raja clavata*	
length	discarded	retained	discarded	retained	discarded	retained	discarded	retained	discarded	retained	discarded	retained
5			2						10		22	
10	4		126		94		8		106		626	
15	43		232		62		55		1224		1911	
20	21		227		106	1	55		6879		994	
25	58		117	19	84	1	15	1	8368	52	1301	2
30	82	15	60	87	108	41	3	8	9005	147	1256	15
35	134	30	246	83	123	32		3	7802	118	636	53
40	16	56	127	38	211	38		1	9882	143	579	145
45	18	40	97	60	76	93			7379	53	779	410
50	12	29	50	88	19	119		1	2105	3	200	651
55	3	35	7	54	21	161			75	4	16	885
60		32	8	14		105			8			814
65		27		1		51				1		546
70		18										570
75		8								2		400
80		2										181
85		2										82
90		2										21
95		3										4
100		4										
105		2										
110												
115												
120												
sum	391	306	1299	444	904	642	136	14	52843	523	8320	4781

Table 15.10 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel: TAC (tonnes) for North Sea rays and skates, and EC landings.

Year	TAC	Landings
1999	6060	3038
2000	6060	3708
2001	4848	3684
2002	4848	3649
2003	4121	3502
2004	3503	2322
2005	3220	2846
2006	2737	2793
2007	2190 [1)]	
2008	1643 [2)]	

1) Considered as bycatch quota. These species shall not comprise more than 25% by live weight of the catch retained on board.

2) Catches of Cuckoo ray (*Leucoraja naevus*), Thornback ray (*Raja clavata*), Blonde ray (*Raja brachyura*), Spotted ray (*Raja montagu*i), Starry ray (*Amblyraja radiata*) and Common skate (*Dipturus batis*) shall be reported separately.

Table 15.11 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Technical interactions.

		Cod 347d	Cod katt.	Had 34	Vhg 47d	Sai 346	Ang 346	Ple 4	Ple 7d	Ple 3a	Sol 3a	Sol 4	Sol 7d	San 4	Nop 4	Nep stocks	Pan stocks	DemRays 347	DemSharks 347
Main gears	Cod 347d		L	H	H	M	??	M	M	M	M	M	M	L	L	H	??	L	L
	Cod kattegat	BT, OT		L	0	0	??	0	0	M	M	0	0	0	0	H	??	L	L
	Had 34	OT			H	M	??	L	0	L	L	L	0	L	L	H	??	L	L
	Whg 47d	OT				M	??	M	M	0	0	M	M	L	L	H	??	L	L
	Sai 346	OT					??	L	0	L	L	L	0	L	L	L	??	L	L
	Ang 346																	L	L
	Ple 4	BT		OT	BT	OT	??		0	0	0	H	0	L	L	L	??	H	H
	Ple 7d	BT			BT, OT		??			0	0	0	H	L	L	L	??	H	H
	Ple 3a	BT, OT	BT, OT	OT			??				H	0	0	0	0	L	??	L	L
	Sol 3a	BT,OT,GN	BT,OT,GN	OT	BT, OT					BT		0	0	0	0	L	??	L	L
	Sol 4	BT		OT	BT	OT		BT					0	0	0	L	??	H	H
	Sol 7d	BT			BT				BT					0	0	L	??	H	H
	San 4	Ind		Ind	Ind	Ind									M	0	0	L	L
	Nop 4	Ind		Ind	Ind	Ind								Ind		0	0	L	L
	Nep. stocks																H?	L	L
	Pan stocks																	L	L
	DemRays 347							BT	BT			BT	BT						H
	DemShar 347																		

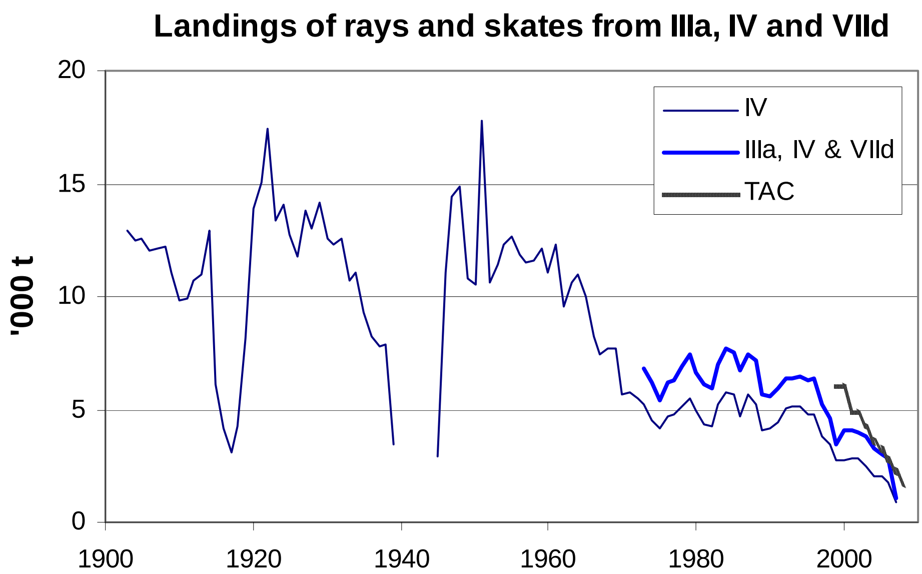

Figure 15.1 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel: total international landings of rays and skates since 1903. From 1973 based on WG estimates. TAC for the North Sea (Area IV and part of II) is added. Data for 2007 not complete.

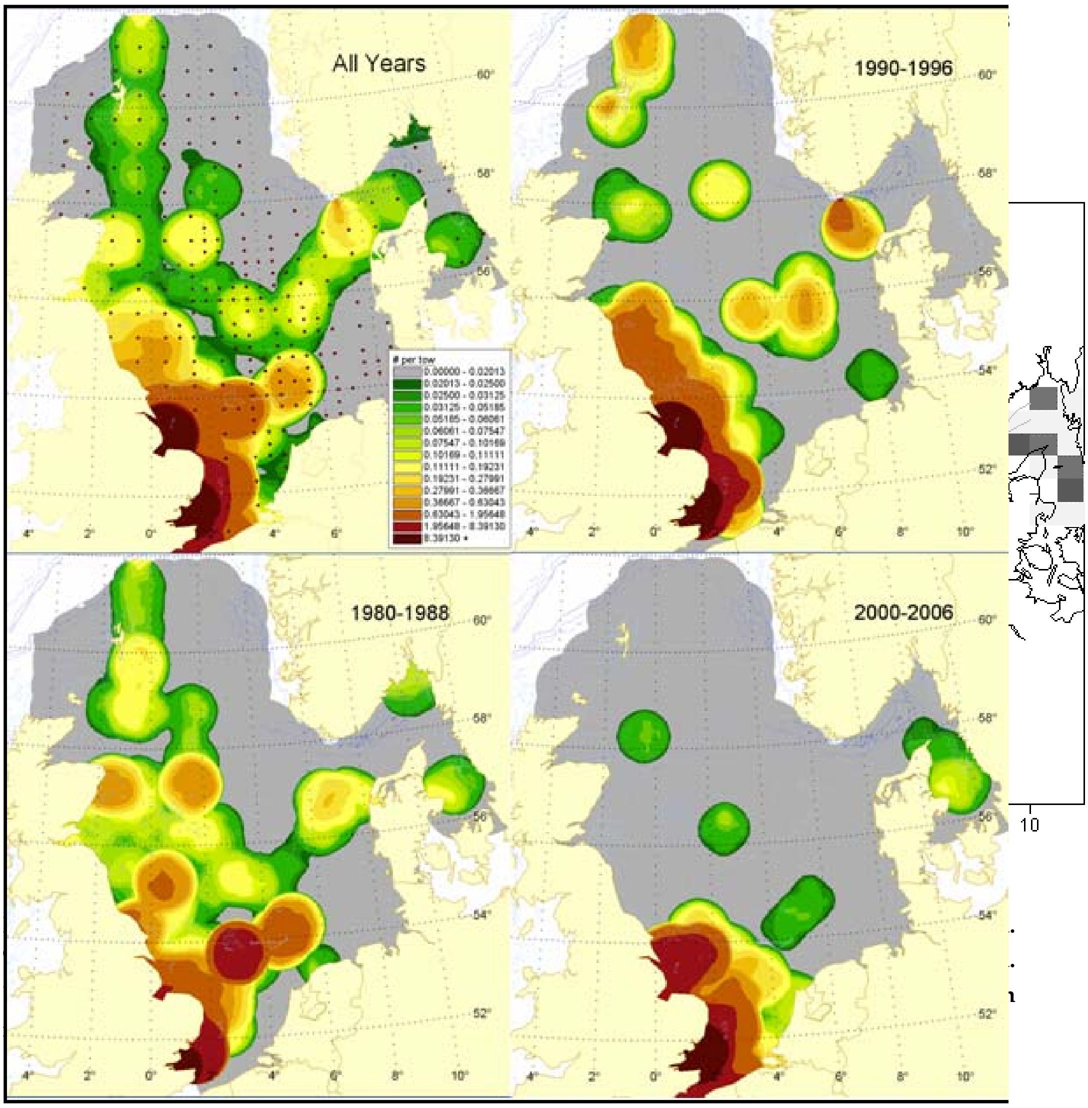

Figure 15.3 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Distribution of *Raja clavata* during four periods and averaged over the entire survey period (1980–2006). Density strata are expressed as mean number per tow. Points on "All Years" map are grid averaged survey location (Source: ICES, 2007a).

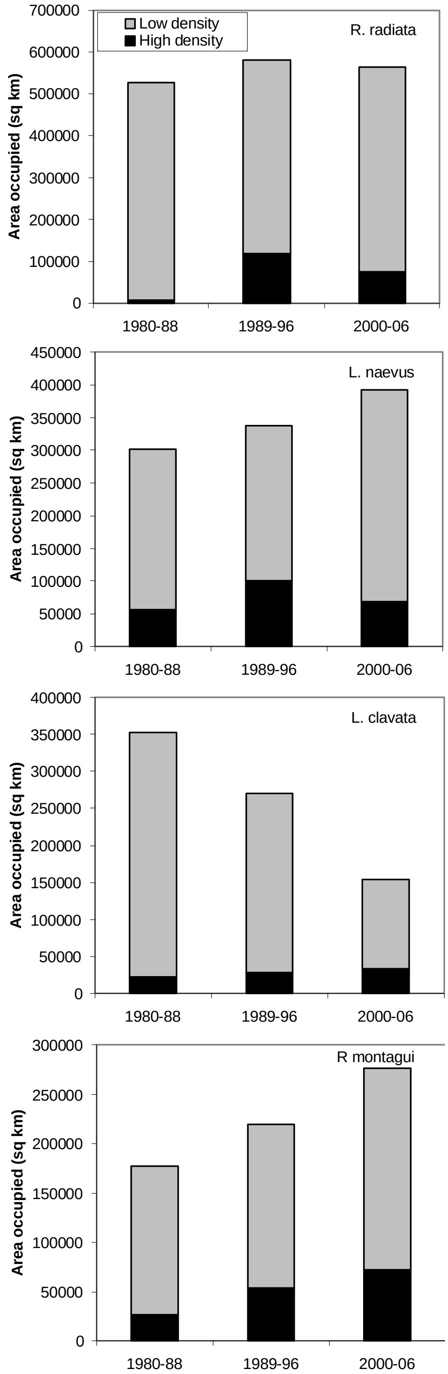

Figure 15.4 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Area occupied during three periods illustrated in the distribution maps for *Amblyraja radiata, Leucoraja naevus, Raja clavata* and *R. montagui* (Source: ICES, 2007a).

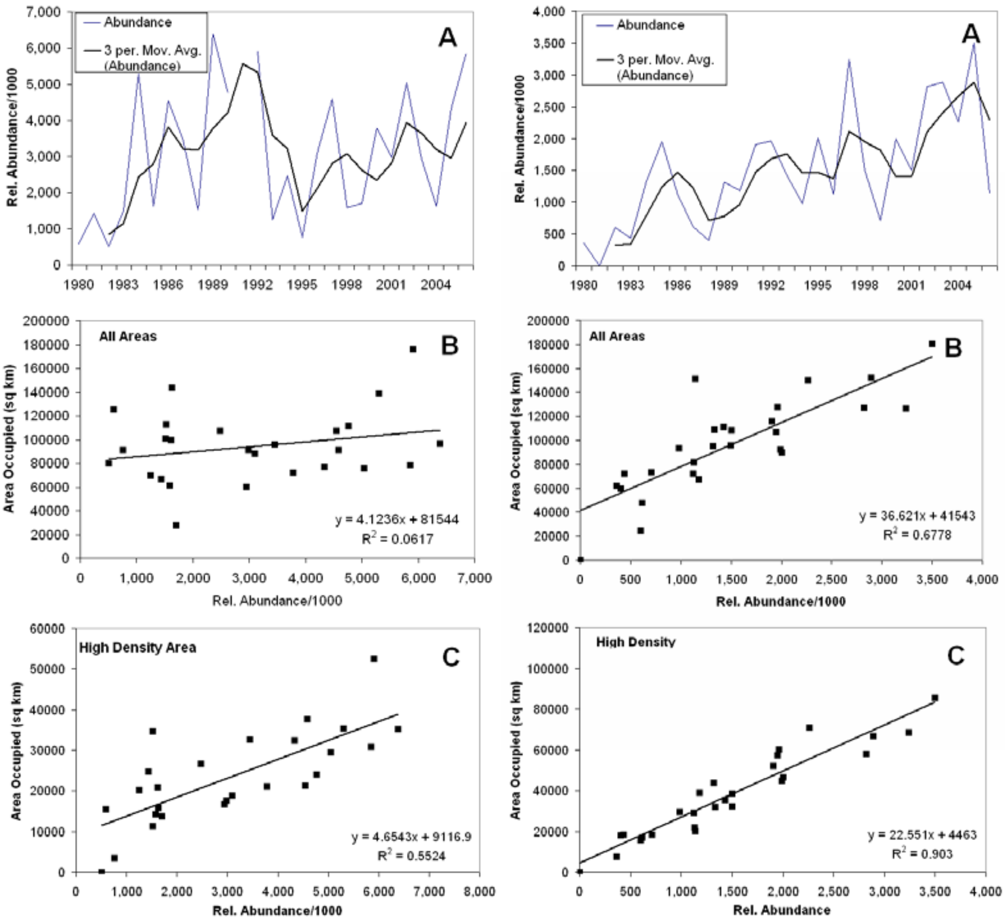

Figure 15.5 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Spatial patterns observed for *R. clavata* and *R. montagui* in the North Sea. A-Annual estimates of relative abundance using SPANdex. A 3 year running average is represented to smooth the high interannual variation of the estimates. B-Relationship between total area occupied and relative abundance. C-Relationship between high density area occupied and relative abundance (Source: ICES, 2007a).

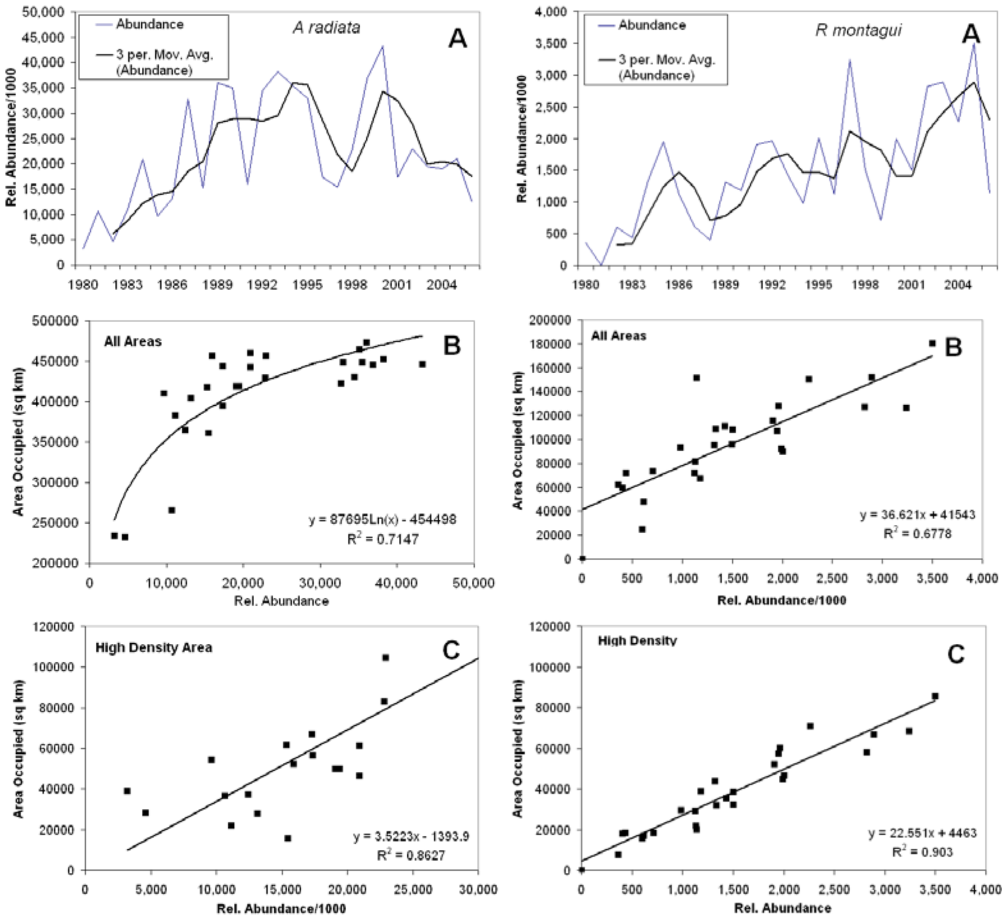

Figure 15.6 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Spatial patterns observed for *A. radiata* and *L. naevus* in the North Sea. A-Annual estimates of relative abundance using SPANdex. A 3 year running average is represented to smooth the high interannual variation of the estimates. B-Relationship between total area occupied and relative abundance. C-Relationship between high density area occupied and relative abundance (see ICES, 2007a).

16 Demersal elasmobranchs at Iceland and East Greenland

16.1 Eco-region and stock boundaries

The elasmobranch fauna off Iceland and Greenland is little studied and comprises relatively few species. Skates occurring in the area include spinytail skate *Bathyraja spinicauda,* deep-water ray *Rajella bathyphila,* round skate *Rajella fyllae,* Arctic skate *Amblyraja hyperborea,* starry ray (or thorny skate) *A. radiata* and roughskin skate *Malacoraja spinacidermis* with shagreen ray *Leucoraja fullonica,* common skate *Dipturus batis* and sailray *D. linteus* also recorded off Iceland. Chimaeras, Iceland catshark *Apristurus laurussonii,* black dogfish *Centroscyllium fabricii* and Greenland shark *Somniosus microcephalus* all occur in the area. Other species in this ecoregion include spurdog (Section 2), Portuguese dogfish (Section 3), porbeagle (Section 6) and basking shark (Section 7).

Stock boundaries are not known for the species in this area. Neither are the potential movements of species between the coastal and offshore areas. Further investigations are necessary to determine potential migrations or interactions of elasmobranch populations within this ecoregion and neighbouring areas.

16.2 The fishery

16.2.1 History of the fishery

Skates are a bycatch in demersal fisheries, with Iceland the main fishing nation operating in the region.

16.2.2 The fishery in 2007

No new information.

16.2.3 ICES advice applicable

ACOM has not provided advice on these stocks.

16.2.4 Management applicable

No new information.

16.3 Catch data

16.3.1 Landings

This section deals only with the demersal skates and dogfish not detailed elsewhere in the report (see above). Reported catches of skates and chimeras from Iceland (Subarea V) and eastern Greenland (XIV) are given in Table 16.1. Estimated landings were derived from the ICES database, with two exceptions. Estimated landings for *A. radiata* (1982–2002) and *D. batis* (1977–2002) were taken from Icelandic national data. These combined amounts closely matched what was recorded as '*Raja* rays nei' in FishStat in those years. Therefore, '*Raja* rays nei' from 1977–1991 were calculated by subtracting the FishStat reported amount of '*Raja* rays nei' from the published records of *D. batis* and *A. radiata*.

From 1973–2006, 13 countries (Belgium, Faroe Islands, France, Germany, Greenland, Iceland, Norway, Portugal, Spain and UK) have reported landings of skates, demersal sharks and chimaeras from Subareas Va (Iceland) and XIVa and XIVb (East Greenland). Iceland is the main nation fishing in these areas.

Reported skate landings peaked at 2100 t and 1900 t in 1995 and 2002 respectively. Landings have been under 1000 t since then (Table 16.1, Figure 16.1). Ninety-three per cent of the skate catches came from Subarea Va. The share taken by Iceland from this area increased from <50% in the 1970's to nearly 100% from 1999 to 2007.

Prior to 1992, all skates, with the exception of *A. radiata* and *D. batis* were reported as '*Raja* rays nei'. *A. radiata* and *D. batis* have accounted for about 47% of the catch since 1992 when it is thought that all species were reported to species. Only small quantities of *L. fullonica*, *D. linteus* and *B. spinicauda* have been reported. The 20 t of *D. linteus* reported in 2004 as preliminary statistics in 2005 suggest some expansion of effort in deep water in that year. Reported landings of chimaeras began in 1991, at a peak of 499 t, and have declined since then.

Information on bycatch of elasmobranchs in East Greenland waters is unavailable but several species are probably taken and discarded in the fishery for cod, shrimp and Greenland halibut *Reinhardtius hippoglossoides*. Anecdotal information indicates that some Greenland sharks taken in the shrimp fishery are landed in Iceland, but the amount is not known.

16.3.2 Discards

No information regarding discards was available.

16.3.3 Quality of data

The major nation fishing skates in this area now provides species-specific information.

16.4 Commercial catch composition

16.4.1 Species and size composition

No information regarding the length distribution or sex ratio from commercial landings was available.

16.4.2 Quality of data

No data available.

16.5 Commercial catch-effort data

No data available.

16.6 Fishery-independent surveys

16.6.1 Availability of survey data

Since 1998, the Greenland surveys have covered the area between 61º45'–67º N at depths from 400–1500 m. The area between 63–64ºN north was not covered by the survey as the bottom topography was too steep and rough. The surveys are aimed at Greenland halibut, although all fish species are recorded. The surveys use an ALFREDO III trawl (wingspread of about 21 m, headline height of about 5.8 m, and a mesh size of 30 mm in the codend) on rock-hopper groundgear. These data were presented to WGEF in a working paper by Jørgensen (ICES, 2006) and are summarized in Table 16.2.

Examination of Icelandic survey data are still to be undertaken.

16.7 Life-history information

No new information.

16.8 Exploratory assessment models

No assessments have been conducted, as a consequence of insufficient data.

16.9 Quality of assessments

No assessments have been conducted, as a consequence of insufficient data. Analyses of survey trends may allow the general status of the more frequent species to be evaluated.

16.10 Reference points

No reference points have been proposed for any of these species.

16.11 Management considerations

The elasmobranch fauna off Iceland and Greenland is little studied and comprises relatively few species. Many of the landings are reported to species (with ca. 21% of the catch not reported to species). The most abundant demersal elasmobranch in the southern parts of the area is *A. radiata,* which is widespread and abundant in this and adjacent waters.

As a species, *D. batis* been demonstrated to be vulnerable to exploitation and has been near-extirpated in the Irish and North Seas. Further investigation into *D. batis* and other skates in Iceland and east Greenland is required, including from fishery-independent sources.

16.12 References

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ICES. 2007. Report of the Working Group on Elasmobranch Fishes (WGEF), 22–28 June 2007, Galway, Ireland. ICES CM 2007/ACFM:27. 318 pp.

Jørgensen, O. A. 2006. Elasmobranchs at East Greenland, ICES Division 14B. Working paper ICES Elasmobranch WG. June 2006.

Table 16.1 Demersal Elasmobranchs at Iceland and east Greenland. Reported catches of skates and chimeras from Iceland (Subarea V) and E. Greenland (XIV) that are not reported in other sections.

WG Estimates of Landings (t) of elasmobranchs in ICES Area Va														
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Common skate	Iceland	230	183	176	123	112	151	121	84	125	147	169	140	117
Sailray	Iceland	.	.	.	.	.	.	.	.	1	8	20	8	7
Shagreen ray	Iceland	24	19	16	12	21	27	37	32	17	23	17	18	17
Starry ray	Iceland	1726	1498	1416	1296	1132	1058	1200	1796	1491	1013	657	530	472
Raja rays nei	Belgium	.	.	.	.	.	.	.	.	.	.	.		
	Faroe Is	9	2	2	7	5	.	2	1	.	8	.		
	Germany[1]	.	.	.	2	1	1	1	.	1	1	.	1	
	Iceland	.	.	.	.	.	.	.	.	.	.	.		
	Norway	.	.	.	.	.	.	.	.	.	.	.		
	Portugal	.	.	1	.	.	.	.	.	.	.	.		
	UK(E&W&NI)	.	.	.	.	.	.	1	.	.	1	.		
	UK (E&W)	.	.	.	.	.	.	.	.	.	.	.	1	
	UK (Scot)	.	.	.	.	.	.	.	.	.	.	.	0	
Raja rays nei	Total	9	2	3	9	6	1	4	1	1	10	0	1	0
Rabbit fish	Iceland	106	.	15	29	3	5	1	.	1	.	.	.	.
Total	.	**2095**	**1702**	**1626**	**1469**	**1274**	**1242**	**1363**	**1913**	**1636**	**1201**	**864**	**698**	**613**
WG Estimates of Total Landings (t) of elasmobranchs in ICES Area XIV														
Raja rays nei	Faroe Is	.	.	.	.	.	.	.	.	.	.	.	.	.
	Germany	.	.	.	.	.	.	.	.	.	.	.	.	.
	Norway	.	.	.	.	.	.	.	.	.	.	.	.	.
	Portugal	.	.	.	.	.	.	1	.	.	.	.	.	.
	UK (E&W)	.	.	.	.	.	.	.	.	.	.	.	.	.
	UK (Scot)	.	.	.	.	.	.	.	.	1	.	.	.	.
Total	**.**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**
WG Estimates of Total Landings (t) of elasmobranchs in ICES Area XIVa														
Raja rays nei	Germany	9	.	.	.	.	7	.	.	.	.	.	.	.
	Norway	.	.	.	.	.	.	.	.	1	.	.	.	.
	UK (E&W)	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	**.**	**9**	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
Total Landings (t) of elasmobranchs in ICES Area XIVb														
Blue skate	Norway	.	.	.	.	.	3	.	.	.	.	.	.	
Shagreen ray	Iceland	.	.	.	.	.	.	.	.	.	.	.	.	
Raja rays nei	Faroe Is	.	.	.	.	.	.	.	1	.	.	.	.	
	Germany	.	.	.	1	.	.	.	.	.	.	.	.	
	Norway	7	10	2	19	8	3	6	5	.	.	.	.	
	Russian Fed.	.	.	.	.	.	.	.	.	.	2	.	.	
	Spain	.	.	.	.	.	.	.	.	15	.	.	.	
	UK	4	.	.	1	2	.	.	.	.	.	.	.	

WG Estimates of Landings (t) of elasmobranchs in ICES Area Va														
	Norway	.	.	.	.	.	.	.	2	.	.	.	6	
Raja rays nei	Total	11	10	2	21	10	3	6	7	15	2	.	6	
Rabbit fish	Norway	.	.	.	.	.	.	.	.	1	5	.	.	
Spotted ratfish	Ireland	.	.	.	.	.	.	1	.	.	.	.	.	
Total	.	22	20	4	42	20	9	13	15	31	9	0	12	0
Grand Total		**2126**	**1722**	**1630**	**1511**	**1294**	**1258**	**1377**	**1928**	**1669**	**1210**	**864**	**710**	**613**

1 Iceland, starry ray-For the years 1977–1992 data are based on published records, could also include R. linteus.

2 Germany and Fed. Rep. of Germany combined.

3 Since 1993 data are available by gear and by month.

Table 16.2 Demersal Elasmobranchs at Iceland and east Greenland. Demersal elasmobranch species captured during groundfish surveys at east Greenland during 1998–2005. Total number, observed maximum weight (kg), depth range (m) and bottom temperature range ºC and most northern position (decimal degrees) (adapted from Jørgensen, 2006).

Species	N	Max wt (kg)	Depth range (m)	Temp range (°C)	Maximum latitude
Bathyraja spinicauda	82	61.5	548–1455	0.5–5.6	65.46ºN
Rajella bathyphila	57	45.3	476–1493	0.3–4.1	65.44ºN
Rajella fyllae	117	4.8	411–1449	0.8–5.9	65.46ºN
Amblyraja hyperborea	12	23.4	520–1481	0.5–5.4	65.47ºN
Amblyraja radiata	483	22.1	411–1281	0.8–6.6	66.21ºN
Malacoraja spinacidermis	3	3.1	1282–1450	2.3–2.7	62.25ºN
Apristurus laurussoni	3	0.7	836–1255	1.7–4.3	65.22ºN
Centroscyllium fabricii	812	128	415–1492	0.6–5.1	65.40ºN
Somniosus microcephalus	9	500	512–1112	1.4–4.9	65.35ºN

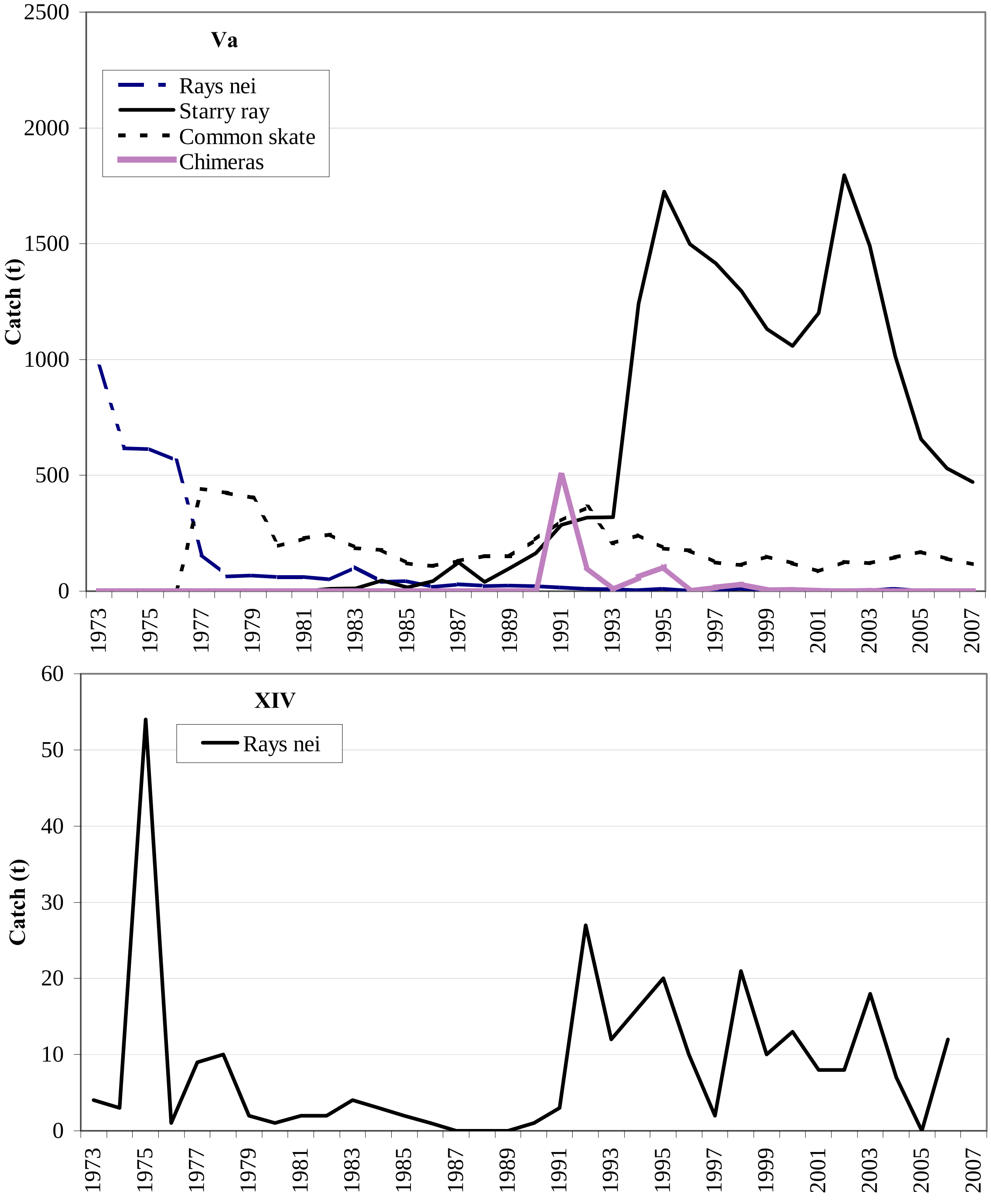

Figure 16.1 Demersal Elasmobranchs at Iceland and east Greenland. WG estimates of the most commonly reported rays and chimeras in Va (upper panel) and in XIV (lower panel), 1973–2006.

17 Demersal elasmobranchs at the Faroe Islands

17.1 Eco-region and stock boundaries

The elasmobranch fauna off the Faroe Islands is little studied in the scientific literature, though it is likely to be somewhat similar to that occurring in the northern North Sea and off NW Scotland and Iceland. Skates recorded in the area include common skate *Dipturus batis,* sailray *D. linteus*, long-nosed skate *D. oxyrinchus,* sandy ray *Leucoraja circularis*, shagreen ray *L. fullonica,* thornback ray *Raja clavata,* round skate *Rajella fyllae* and starry ray (thorny skate) *Amblyraja radiata.* Demersal sharks include *Centroscyllium fabricii* and *Galeus melastomus* (see Section 5) and spurdog (Section 2).

Stock boundaries are not known for the species in this area. Neither are the potential movements of species between the coastal and offshore areas. Further investigations are necessary to determine potential migrations or interactions of elasmobranch populations within this ecoregion and neighbouring areas.

17.2 The fishery

17.2.1 History of the fishery

Since 1973, nine countries (Denmark, Faroe Is, France, Germany, Netherlands, Norway, Poland, UK and Russia) have reported catches of demersal elasmobranchs from Division Vb. Faroese vessels include trawlers and, to a lesser extent, longliners and gillnetters. Norwegian vessels fishing in this area are longliners targeting ling, tusk and cod. UK vessels include a small number of large Scottish trawlers that are occasionally able to obtain quotas to fish in Faroese waters targeting gadoids and deep-water species. French vessels fishing in this area are probably from the same fleet that prosecute the mixed deep-water and shelf fishery west of the UK. Demersal elasmobranchs likely represent a minor to moderate bycatch in these fisheries.

17.2.2 The fishery in 2007

No new information.

17.2.3 ICES advice applicable

ACOM has not provided advice on these stocks.

17.2.4 ICES advice applicable management applicable

The majority of the area is managed by the Faroes through an effort based system which restricts days fishing for demersal gadoids. Some EU vessels have been able to gain access to the Faroes EEZ where they have been managed under individual quotas for the main target species.

17.3 Catch data

17.3.1 Landings

Landings of skates, mainly unidentified, are presented in Table 17.1 and rabbitfish in Table 17.2. No reports are available in 2005. French reported landings of *D. batis* do not represent the entire catch of this species and an unknown quantity is included in the category of unidentified rays for all counties. Total landings of skates and rabbitfish by all countries are combined in Figure 17.1.

17.3.2 Discards

The amount of discarding of skates and demersal sharks from this area is unknown.

17.3.3 Quality of catch data

Species-specific information for commercial catches is lacking.

17.4 Commercial catch composition

17.4.1 Species and length composition

All skates in Division Vb, with the exception of French landings (2000–2003) and Russian landings (2004) of *D. batis*, and one record of *D. oxyrinchus* by France in 2001, were reported as '*Raja* rays nei'. There were no port sampling data available to split these catches by species. It is likely that catches included *D. batis, L. fullonica, R. clavata* and *A. radiata.*

No information regarding size composition or sex ratio from commercial landings was available.

17.4.2 Quality of data

Information on the species and length composition is required.

17.5 Commercial catch-effort data

No information available to WGEF.

17.6 Fishery-independent surveys

No survey data from this area were available to the working group. Magnussen, 2002 summarized the demersal fish assemblages from the Faroe Bank, based on the analysis of routine survey data collected by the RV Magnus Heinason since 1983. Data on elasmobranchs taken in these surveys are summarized in Table 17.3. A more detailed analysis of the demersal elasmobranchs taken in Faroese surveys is still to be undertaken.

17.7 Life-history information

No new information.

17.8 Exploratory assessment models

No assessments have been conducted, as a consequence of insufficient data being available to WGEF.

17.9 Quality of assessments

No assessments have been conducted to date. Analyses of survey trends may allow the general status of the more frequent species to be evaluated.

17.10 Reference points

No reference points have been proposed for any of these species.

17.11 Management considerations

Total international reported landings of skates declined from 1973–2003 but increased to about the average of the time-series in 2004. Without further information on the fisheries such as better differentiation of species, amounts of discards, sizes caught, it is not possible to provide information on the pattern of exploitation or on the status of stocks.

The elasmobranch fauna off the Faroe Islands is little studied in the scientific literature, though it is likely to be somewhat similar to that occurring in the northern North Sea and off Iceland. Further studies to describe the demersal elasmobranch fauna of this region, and to conduct preliminary analyses of fishery-independent survey data are required.

17.12 References

Magnussen, E. 2002. Demersal fish assemblages of the Faroe Bank: Species composition, distribution, biomass spectrum and diversity. Marine Ecology Progress Series 238: 211–225.

Table 17.1 Demersal elasmobranchs at the Faroe Islands. Reported landings of skates from the Faroes area (Division Vb).

WG Estimates of Landings (t) of skates in ICES Division Vb													
Species	Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dipturus batis	France	1	1	3	.	3	2	2	3	5	1	2	
	Russian Fed.	.	.	.	.	.	.	.	.	35	n/a		
Dipturus oxyrinchus	France	.	.	.	.	.	3	.	.	.	0	0	
Raja rays nei	Faroe Islands	165	178	144	175	n/a	76	25	98	272	n/a	237	187
	France	1	1	.	.	23	99	.	5	71	6	20	
	Germany	.	.	.	1	1	.	.	2	1	n/a	1	
	Norway	60	14	45	45	50	21	15	5	.	n/a	10	
	UK	4	11	7	6	35	27	12	8	20	n/a	2	2
Total Vb		**231**	**205**	**199**	**227**	**112**	**228**	**54**	**121**	**404**	**7**	**35**	**2**

Table 17.2 Demersal elasmobranchs at the Faroe Islands. Reported landings of Rabbitfish from the Faroes area (Division Vb).

WG Estimates of Landings (t) of rabbitfish in ICES Division Vb													
Species	Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Rabbit fish	France	.	.	.	.	54	.	66	67	.	n/a		
	Norway	.	.	.	.	.	1	17	2	3	n/a		
Rabbit fish	UK	1	.	.	.	.	.	.	1	.	n/a		
Total Vb		**1**				**54**	**1**	**83**	**70**	**3**	**n/a**		

Table 17.3 Demersal elasmobranchs at the Faroe Islands. Elasmobranchs taken on the Faroe Bank during bottom-trawl surveys (1983–1996) by depth band. Symbols indicate frequency of occurrence in hauls (*: 60–100% of hauls, **: 10–60% of hauls, *: 3–10% of hauls, + : <3% of hauls). Adapted from Magnussen, 2002.**

Species	<100 m	100–200 m	200–300 m	300–400 m	400–500 m	>500 m	Total
Galeus melastomus	–	+	*	*	**	**	*
Galeorhinus galeus	–	+	–	–	–	*	+
Squalus acanthias	–	*	*	**	*	**	*
Etmopterus spinax	–	+	–	–	*	**	*
Centroscyllium fabricii	–	–	–	–	*	–	+
Amblyraja radiata	–	–	–	–	–	**	+
Dipturus batis	–	*	*	–	–	**	*
Leucoraja fullonica	–	+	+	–	–	*	+
Leucoraja circularis	–	–	*	–	–	–	+
Rajella fyllae	–	+	–	–	–	–	+
Dipturus linteus	*	+	–	–	–	–	+
Raja clavata	–	+	–	–	–	–	+
Chimaera monstrosa	*	*	**	***	***	***	**

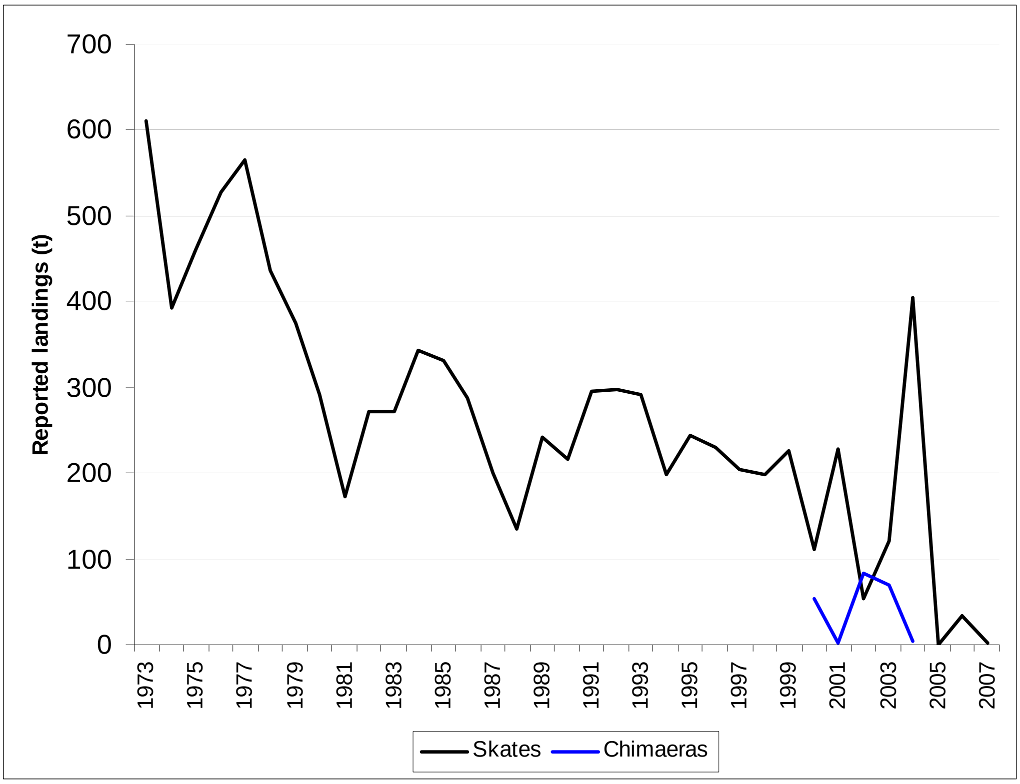

Figure 17.1 Demersal elasmobranchs at Faroe Islands. Reported landings of skates and rabbitfish from Division Vb based on ICES FISHST.

18 Demersal elasmobranchs in the Celtic Seas (ICES Subareas VI and VII (except Division VIId))

18.1 Eco-region and stock boundaries

The Celtic Seas ecoregion covers west of Scotland (VIa), Rockall (VIb), Irish Sea (VIIa), Bristol Channel (VIIf), the western English Channel (VIIe), and the Celtic Sea and west of Ireland (VIIb–c, g–k). This ecoregion broadly equates with the area covered by the North-western waters RAC. The southwestern sector of ICES Division VIIk is contained in the oceanic Northeast Atlantic ecoregion. The following provides a general overview of the different areas within the Celtic Seas ecoregion. Whereas some demersal elasmobranchs, such as spurdog *Squalus acanthias* (see Section 2) and lesser-spotted dogfish *Scyliorhinus canicula,* are widespread throughout this region, there are some important regional differences in the distributions of other species, which are described below.

Other than spurdog (Section 2) and tope (Section 10), the main species of shark taken in demersal fisheries in this ecoregion are lesser-spotted dogfish, smooth-hounds *Mustelus* spp. and greater-spotted dogfish *Scyliorhinus stellaris*. Sixteen species of skate and ray are recorded in the area, the most abundant skates being thornback ray *Raja clavata*, cuckoo ray *Leucoraja naevus*, blonde ray *R. brachyura*, spotted ray *R. montagui,* undulate ray *R. undulata*, common skate *Dipturus batis*, shagreen ray *L. fullonica* and smalleyed ray, *R. microocellata*. Other batoids (stingray *Dasyatis pastinaca*, marbled electric ray *Torpedo marmorata* and electric ray *T. nobiliana*) may be observed in this ecoregion, although they are more common in more southerly waters. These are generally discarded if caught in commercial fisheries and are not considered in this report.

Some of the rarer demersal elasmobranch species that previously occurred in this area include white skate *Rostroraja alba* and angel shark *Squatina squatina*. There are few or no recent records of these species in survey data.

West of Scotland (VIa): The main demersal elasmobranchs occurring in the shelf waters west of Scotland include lesser-spotted dogfish and various skates, especially *R. clavata*, *L. naevus* and *D. batis.* Offshore species, such as black mouth dogfish *Galeus melastomus, L. fullonica* and sandy ray *L. circularis* are distributed mainly towards the edge of the continental shelf.

Rockall (VIb): Though this division contains extensive deep-water areas (see Sections 3 and 5), many of the species occurring on the continental shelf off mainland Scotland also occur on the Rockall Plateau. It is possible that the shallow water skates on the Rockall Plateau form separate populations. There is little fisheries-independent data available from this area. *Raja clavata, R. brachyura, Raja montagui,* round skate *Rajella fyllae,* long-nosed skate *Dipturus oxyrinchus, L. circularis, D. batis, L. fullonica* and blackmouth dogfish have been recorded in Scottish surveys in this area.

Irish Sea (VIIa): The more common demersal elasmobranchs in the Irish Sea include spurdog (see Section 2) and lesser-spotted dogfish. *Raja clavata* and *R. montagui* are also abundant, especially in inshore areas, with *R. montagui* and *L. naevus* the dominant skate species on the coarser grounds further offshore. *Raja brachyura* occur sporadically in the main Irish Sea, though are locally abundant in parts of St George's Channel. In the southwestern Irish Sea *R. microocellata* is also present. Tope (see Section 10), smooth-hounds and greater-spotted dogfish all occur in this area, with these species locally abundant in Cardigan Bay and off Anglesey. Angel shark were formerly common in Cardigan Bay.

Bristol Channel (VIIf): The most abundant demersal elasmobranchs in the Bristol Channel include lesser-spotted dogfish, *R. clavata, R. montagui,* and *R. microocellata,* which is locally abundant in this area. Although *L. naevus* is one of the dominant skate species in the Celtic Sea, it is rarely observed in the shallower parts of the Bristol Channel and only occurs in the western parts of VIIf. Once again, tope, smooth-hounds and greater-spotted dogfish all occur regularly in this area.

Western English Channel, Celtic Sea and west of Ireland (VIIb, c, e, g–k): The most abundant demersal elasmobranchs in the Celtic Sea include lesser-spotted dogfish, *R. clavata, R. montagui* and *L. naevus*. Tope and smooth-hounds also occur in the area, with juveniles more common inshore and larger individuals also occurring around the offshore sandbanks in the Celtic Sea. Greater-spotted dogfish also occur regularly in this area, though is typically restricted to inshore, rocky grounds. Undulate ray *Raja undulata* is found in a very localized population on the southwest coast of Ireland, and also in the English Channel. *R. brachyura* can be locally abundant in parts of the area. Several other species occur on the offshore grounds of the Celtic Sea and along the edge of the continental shelf, including *D. batis, L. fullonica, L. circularis* and black-mouth dogfish.

Although there have been some tagging studies of skates in the Bristol Channel and Irish Sea (e.g. Pawson and Nichols, 1994), which have indicated some mixing between the Irish Sea and Bristol Channel, and some genetic studies of *R. clavata* (Chevolot *et al.*, 2006), the stock identity for many of these species is poorly known. Further studies on stock structure are required, especially for species such as *L. naevus*, which have a more offshore distribution. Tagging studies by the Irish Central Fisheries Board indicate that *R. clavata* recaptures occur all along the Irish coast, whereas *R. undulata* seem to form a discrete population in Tralee Bay (Green, 2007 WD).

18.2 The fishery

18.2.1 History of the fishery

Most skate species in the Celtic Seas ecoregion are taken as a bycatch in mixed demersal fisheries, which are either directed at flatfish or gadoids. The main countries involved in these fisheries are Ireland, UK, France, Spain, with smaller catches by Belgium and Germany. The main gears used are otter trawls and bottom-set gillnets, with the Belgian fishery carried out by a beam trawl fleet. There are also beam trawls from Ireland, the UK and the Netherlands in this area.

There are some localized fisheries targeting *R. clavata* using longline and tanglenets. There is a small fishery off southeast Ireland targeting various skate species in the southern Irish Sea (Area VIIa), using rock-hopper otter trawls and beam trawls, and some UK trawlers may target skates in the Bristol Channel (VIIf) at some times of year.

Most coastal dogfish (e.g. tope, smooth-hounds and catsharks) are taken as a bycatch in various trawl and gillnet fisheries (see above). Due to the low market value of these species, they tend to be discarded by some nations, though some of marketable sizes are sometimes retained. A largely unknown quantity is retained for use as bait in the Irish Sea and Bristol Channel whelk *Buccinum undatum* fishery, and the northwest Ireland crab fishery, and these may not routinely be declared in the landings.

There are *Nephrops* fisheries in the Irish Sea (VIIa), Celtic Sea (VIIg), Porcupine Seabight (VIIj) and at the Aran Islands, (VIIb) which may catch various elasmobranchs as a bycatch. In the deep waters of Area VI and VII there is a skate bycatch in fisheries for anglerfish, megrim, and hake, and these species include *L. fullonica, L. circularis* and *Dipturus* spp. (see Chapter 5).

There is also a large recreational fishery for skates, rays and dogfish, particularly for those species close to shore, with some ports having locally important charter boat fisheries.

18.2.2 The fishery in 2007

Landings tables for the relevant species are provided in Tables 18.1–18.5.

There is one notable addition to the fishery in 2007. A study carried out in Belgium aimed at testing the use of outrigger trawls in different areas as an alternative to traditional beam trawls (Vanderperren, 2008). Outrigger trawling as a fishing method replaces the two heavy steel beams on each side normally towed by beam trawlers with two lighter demersal trawls each with its own set of trawl doors. The main benefit is the reduced drag of the lighter gear resulting in a reduced fuel consumption. Other likely benefits are reduced benthic impact, improved fish quality, diversification into non pressure stock species and increased profitability. Similar trials were also carried out in the UK by Seafish. Initial results suggest that this gear catches a greater proportion of skates than traditional beam trawls (Table 18.6).

There are a number of potential reasons for the increased skate catch with the outrigger trawl, which relate to changes in fishing behaviour or differences in the dynamics of the outrigger trawl gear as follows:

1. The outrigger trawl is less effective at catching sole and there is evidence that Belgian and UK fishers have specifically targeted skates using outrigger trawls to compensate for the decrease in sole catch. In the beam trawl fishery, skates were always considered a bycatch species. There are no indications that Dutch fishers compensate their reduced catch of valuable species by higher skate catches.
2. Vessels involved in this trial regardless of horsepower have been allowed to fish inside the 12 mile and in certain areas this may lead to high skate catches (Polet *et al*., 2007) given there are known to be local populations inside 12 miles e.g. Irish Sea.
3. The main difference in the outrigger gear and beam trawls is the reduced weight and reduced fishing speed, giving rise to a substantial fuel saving, and the increase in spread. In the Seafish trials, gear monitoring equipment installed on the gear recorded from 7–9 m of spread between the doors per side, with a relatively small net, whereas vessels would be restricted to a 4m beam fishing the same area inside the 12 mile limit. This increased spread and ground coverage is likely to improve catch efficiency for skates and some other species.

An abundance of larger skates observed in the outrigger catches compared with beam trawls may be a result of the differences in groundgears and headline between the beam trawl and outrigger trawl (Rihan, 2008 WD).

This new method may catch a larger proportion of skates than beam trawls. However, at least in the short term, the uptake for this gear will be limited to smaller vessels and the impact on skate stocks may not be that significant, although this does needs monitoring.

There is no other new information specifically relating to elasmobranchs. Changes in fishing patterns in these areas are summarized by WGNSDS and WGSSDS.

18.2.3 ICES advice applicable

ICES has never provided advice for any of the demersal elasmobranch stocks within this ecoregion.

18.2.4 Management applicable

There are no TACs for any of the relevant species in this region.

Under current EU legislation, where a directed fishery for skates takes place, a mesh size in the codend of no less than 280 mm is required and not less than 220 mm in the rest of the trawl.

Under Regulation 850/1998 a minimum mesh size of 220 mm is required for gillnets targeting skates and rays (those catching <70% skates and rays) in Subareas VI and VII.

Within UK waters, the South Wales Sea Fisheries Committee (SFC), and the Cumbria SFC have bylaws stipulating a minimum landing size for skates and rays.

Tralee Bay (Area VIIj) is voluntarily closed to commercial fishing to protect regionally important elasmobranchs such as *R. undulata* and angel shark, which are only found in localized populations on the Irish West coast. There are no other known specific closed areas for the protection of elasmobranchs.

Dipturis batis and *Squatina squatina* were removed from the Irish Specimen Fish List in 1975 and 2005 respectively.

18.3 Catch data

18.3.1 Landings

Landings data are incomplete for 2007 as not every country (Belgium being the most significant for this ecoregion) was able to provide national data by the time of the WG. All data must be treated as provisional, even for those countries that provided data. For most countries, landings figures were less than they had been for 2006, but this may be an artefact of incomplete data. Therefore 2007 figures must be treated with caution, and will be revised by WGEF next year.

Landings tables for skates (Rajidae) by country are provided in Tables 18.1a–g. Landings for the entire dataseries available are shown in Figure 18.1. Landings by area with in the ecoregion are illustrated in Figures 18.2 a–f. Where species-specific landings have been provided they have been included in the total for the relevant year. Although there are about 15 countries involved in the fisheries in this ecoregion, only six of these (Belgium, France, Ireland, UK (England and Wales), UK (Scotland) and Spain) have continually landed large amounts of skates.

Species-specific French landings data for *Leucoraja naevus* is provided in Figure 18.2.

Landings appear as a series off peaks and troughs, with lows of approximately 14 000 t in the mid 1970s and 1990s, and highs of just over 20 000 t in the early and late 1980s and late 1990s. Although landings have fluctuated considerably over the time-series, there has been in a constant decline since 2003, and the 2007 adjusted figures are likely to be the lowest in the time-series.

West of Scotland (VIa)

Reported landings in this subdivision are at their lowest point since 1973. Average landings of around 3000 t in the early 1990s are now down to less than 1000 t. Landings by the UK (Scotland) in particular are at an all time low.

Rockall (VIb)

Reported landings of skates from Rockall have usually been less than 1000 t per year. Increased landings in the mid 1990s are as a consequence of new landings of 300–400 t per year by Spanish vessels. These no longer appear to take place with no Spanish landings reported in this area for the past two years. It is not clear what proportion of these catches may have been taken from Hatton Bank (VIb1 and XIIb).

Irish Sea (VIIa)

Reported landings of skates in the Irish Sea vary considerably, ranging from over 5000 t in the late 1980s to 1500 t in 1995, before increasing again to 3000 t. Landings are again at a low level. This may be as a consequence of effort changes ascribable to the cod recovery programme in the area. Most landings are from Ireland and the UK (England and Wales).

Bristol Channel (VIIf)

Reported landings from Division VIIf have declined for four years now. Only three countries (UK (England and Wales), France and Belgium) land skates from this area, with annual landings normally between 1100–1600 t.

Western English Channel, Celtic Sea and west of Ireland (VIIb, c, e, g-k)

Reported skate landings from Divisions VIIb, c, j, k increased dramatically in the late 1990s, to more than 4000 t, but have subsequently declined to approximately 1000 t per year. The highest landings have consistently occurred in the southern parts of this ecoregion (Divisions VIIe, g, h), but landings from here have declined each year for the last seven years and are now at their lowest point since 1974. Most skates are landed under generic landing categories, although France, Spain (Basque Country) and Belgium provide some species-specific landings data (Tables 18.2–18.4). These data suggest that the four major commercial species in French fisheries (Table 18.2) in Subarea VI are *R. clavata, L. naevus, D. batis* and *D. oxyrinchus*, with *L. naevus, R. montagui, R. clavata* and *D. batis* the major species in Subarea VII (WGEF consider that French landings of *R. montagui* also include quantities of *R. brachyura*). The importance of *R. clavata* and *L. naevus* is also apparent in Spanish (Basque country) and Belgian landings data (Tables 18.3–18.4).

Though there are reasonable landings data for spurdog (Section 2) and, to a lesser extent, tope (Section 10), data for other demersal sharks are more limited. Landings data for *Mustelus* spp. are provided in Table 18.5a and Figure 18.3.

Landings tables for lesser-spotted dogfish have not been provided, as it was not possible to disaggregate this species from the many categories under which it is declared and the lack of consistency by which it is categorized. Due to the lack of species-specific landings data for demersal sharks, and the absence of market sampling, it is not currently possible to identify the landings of demersal shark species in most areas.

Angel shark (historically termed monkfish) *Squatina squatina* is increasingly rare, and this species is now rarely reported in landings data (Table 18.5b). It is believed that the peak in UK landings in 1997 from VIIj–k (Figure 18.3) is misreported anglerfish (also called monkfish), as *S. squatina* is more of a coastal species. French landings have declined from >20 t in 1978 to 1 t in 2000.

It is possible that these will be granted greater protection in the UK in 2008.

18.3.2 Discards

No new discard information was presented for the Working Group.

Discard information from the Irish and UK fleets was presented by Borges *et al.*, 2005 and ICES, 2007a.

These studies indicate that skates below a certain size tend to be discarded, regardless of species. Although this size varies from vessel to vessel, in general, it is around 47 cm, though UK demersal fisheries land *R. clavata* of a smaller size. As skates are usually landed by grade (size) in mixed boxes, there is no size selection between different species. The only exception is in some fisheries taking *D. batis.* This species is now rarely caught by the Irish demersal trawl fleet, and in some fisheries are usually discarded when caught, regardless of size. However, *D. batis* are still caught and retained by the UK trawl fleet.

It has been suggested that buyers and processors do not favour the largest skates (e.g. adult *D. batis*), and discarding of this species may also be more prevalent in areas where there are important recreational fisheries targeting common skate.

Discard sampling in VIIg highlights the prevalence of juvenile (<25 cm) *Scyliorhinus* spp. compared with the other areas (Figure 18.6a), suggesting that this area may be an important nursery ground for lesser-spotted dogfish, as also indicated from groundfish surveys (Ellis *et al.*, 2005).

Lesser-spotted dogfish have high rates of discard survival (Revill *et al.*, 2005), and recent studies on skates need to be analysed.

18.3.3 Quality of catch data

There is no quota for “skates and rays” in this region. This means that there is a strong incentive for fishers to log quota species as “skates and rays”, leading to overestimation of catch quantities. Misreporting of quota species as elasmobranchs is known to occur, such as where anglerfish and hake are reported as “skates and rays” or under generic landings categories for dogfish, although the extent of this problem is unknown.

Since 1995 EU regulations require skippers to record all landings in the logbook, regardless of species. It is not clear what effect this had on the landings data for “skates and rays”, as it is not known if they were completely reported prior to this.

Vessels less than 10 m are not required to carry a logbook, so inshore catches of skates and rays may not be recorded at all. This may be important in areas where there may be locally abundant species that are otherwise rare.

The difficulty in species identification has been well documented (ICES, 2007a, ICES, 2006), as has the problem of declaring landed elasmobranch species in generic categories (Johnston *et al.*, 2005). Improved information on the species composition caught by various métiers in space and time (e.g. from observer and market sampling programmes) will be increasingly important.

18.4 Commercial catch composition

18.4.1 Species composition

Skates have traditionally been landed by grade (size), which often comprises a mixture of species. Only because the DELASS project has some recent information on species composition becomes available for various countries (Heessen, 2003). Some countries have continued to provide landings by species but most are supplied as mixed species information. Species breakdown per country (where available) is supplied in Tables 18.2–18.4 and 18.8.

No new information on species composition was provided. Information on species composition of landings provided by Belgium and Ireland was discussed in ICES, 2007a. Some historical information is available in scientific literature (Du Buit, 1966, 1968, 1970, 1972; Fahy, 1988, 1989a, 1989c, 1991; Gallagher *et al.*, 2005a).

18.4.2 Size composition

Only limited market sampling data are available for these species. Although elasmobranch sampling effort has increased, it is recommended that emphasis be placed on the sampling of these species as part of ongoing sampling programmes so that long-term trends may be detected. Species-identification is still considered to be an issue. Length frequencies for the most abundant species in the sampled skate catches are provided in Figure 18.7.

18.4.3 Quality of data

There is still some concern over some of the species identifications being reported. Although several national laboratories are undertaking market sampling, more critical analyses of these data are required to ensure that species identification issues are resolved and that the methods of raising the data are appropriate and can allow for seasonal, geographical and gear-related differences in the species composition of skate landings to be examined. Although there are market sampling programmes in place in several countries, in some of these skates are treated as low-priority species, so these species are not sampled as effectively as they might be.

Some working group members provide data that differs from that provided by Fishstat. These data are considered more reliable. The use of sale slip data is used by some other working groups to better quantify landings from some countries. It is recommended that this method of assessing landings figures be looked at for possible future use by this group.

18.5 Catch per unit effort

18.5.1 Commercial cpue

New French data examining lpue for *L. naevus* in the Celtic Sea (VIIg, j) was provided to the Working Group (Figures 18.4a–b). This reveals a strong declining trend, with landings in 2007 of ~3kg/h at one third of the level at peak catch in 1997.

Most elasmobranchs in this ecoregion are caught as a bycatch in demersal fisheries directed at teleosts. Landings per unit effort (lpue) by Basque Country fisheries in Divisions VI, VII and VIII between 1994 and 2005, is presented in Diez *et al.*, 2006, and is further examined in Section 19. For *Rajidae* in VII, lpue peaked in 1996 at 150 kg/day, decreased to a low of 17 kg/day in 2003, but has been increasing since. This is similar to the trends demonstrated in Biscay waters. However, lpue in VI has been decreasing since 2002.

Preliminary analyses of skate cpue from the Irish otter trawl fishery in VIIa were examined by the WGEF. However, these data were not considered to be indicative of stock trends. Changes in species reporting and fleet behaviour since the introduction of the Cod Recovery Plan in the Irish Sea need to be investigated before these data can be used for further analyses.

Discards per unit effort (dpue) of lesser spotted dogfish in VII have decreased slightly since 1999; although surveys indicate an increase in abundance of this species (see ICES, 2007a).

18.5.2 Recreational cpue

The Irish Central Fisheries Board began an effort recording programme in 1981 in Tralee Bay. Two charter-angling vessels record all their catch each year. These data (Figure 18.5) from southwest Ireland demonstrate that catches of *R. undulata*, a species that forms a discreet population in Tralee Bay, declined from a high of 80–100 fish per year when recording began to 20–30 fish per year in the mid 1990s, before increasing to 40–60 per year at the beginning of this century and now appears to be declining again, although catches fluctuate each year.

Catches of *Squatina squatina* have also declined since this programme began, from over 100 per year in 1981, to 20 in 1984, before increasing to 100 again in the late 1990s. These catches declined to very low levels in the 1990s and there have been no catches at all in the most recent years.

18.6 Fishery-independent surveys

18.6.1 Surveys in the ecoregion

Several fishery-independent surveys operate in the Celtic Seas ecoregion, as discussed below.

18.6.1.1 IBTS Q4 Westerly surveys

UK (Scotland), UK (England and Wales), Ireland, France and Spain (see below) undertake trawl surveys in the Celtic Seas ecoregion, as part of the internationally coordinated Q4 IBTS surveys for southern and western waters (see Figure 18.6). The trawls used in all these surveys are not standardized (see Table 18.7), though individual surveys should be able to provide regional data on the distribution, relative abundance, species composition, size composition and abundance trends for a variety of demersal elasmobranchs.

The Spanish Porcupine bottom-trawl survey, coordinated within the IBTSWG, aims to collect data on the distribution and relative abundance, and biological information of commercial fish in the Porcupine Bank area (ICES Division VIIb–k) (Figure 18.7). The primary target species for this survey are hake, anglerfish, white anglerfish, megrim, four-spot megrim, *Nephrops* and blue whiting. The survey time-series started in 2001 and since then it has been performed annually every autumn. It follows a random stratified design with two geographical strata (northern and southern) and 3 depth strata (170–300 m, 301–450 m, 451–800 m). Stations are allocated at random according to the strata surface. The gear used is a Porcupine baca 39/52 with 3 m vertical opening, 23 m wing spread and 134 m door spread, hauls last 30 minutes.

The UK (England and Wales) survey has only used a standardized gear since 2004, and data from this survey should be examined in future, when a longer time-series is available. Similarly, the time-series available from the Irish Groundfish Survey (IGFS) on the west coast of Ireland is also too short to provide data for analyses of temporal trends.

The French EVHOE survey has been carried out in the Bay of Biscay since 1987 and in the Celtic Sea since 1995, when it came under the IBTS.

18.6.1.2 Beam trawl surveys

An annual survey with a 4 m-beam trawl is undertaken in the Irish Sea and Bristol Channel each September on board RV *Corystes* (See Ellis *et al*., 2005 and Parker-Humphreys, 2004a, b). Updated information on this survey was provided this year. The primary target species for the survey are commercial flatfish (plaice and sole) and so most sampling effort occurs in relatively shallow water. Lesser-spotted dogfish, *R. brachyura, R. clavata, R. microocellata, R. montagui* and *L. naevus* are all sampled during this survey. Preliminary studies of survey data indicate that this gear may not sample large skates effectively, though this gear should be suitable for sampling smaller skate species (e.g. *R. montagui* and *L. naevus*) and juveniles and subadults of the larger species. Smoothhounds caught by the gear tend to be juveniles.

Catch rates ($n.h^{-1}$) for this survey have been summarized (Figures 18.8–18.10), with analyses (a) omitting data collected prior to 1993, and (b) only including those fixed stations fished at least 12 times during the 15 year time-series (1993–2007). Catch rates were analysed for the region as a whole for most species, although cuckoo ray were only examined for stations in the Central Irish Sea and St George's Channel (fixed station numbers: 22, 41, 42, 49, 53, 54, 55, 220, 229, 233, 302, 305, 309, 316, 321, 401,405, 409, 416, 419, 421, 423, 424, 425, 430, 438, 440, 441, 442, 443 and 447). In terms of inshore skates, the catch rates of *Raja brachyura, R. clavata* and *R. montagui* were also examined for three sectors of the study area (Eastern Irish Sea (primes 1–55 + 419; 35 stations); St George's Channel (inc. Caernarvon and Cardigan Bays) (fixed station numbers: 220, 229, 233, 302, 305, 309, 313, 316, 321, 409, 416, 421, 430, 438, 440, 441, 442, 443, 447; 19 stations) and Bristol Channel (stations 101–139 + 501; 33 stations). For *R. microocellata*, only stations in VIIf were used, as this species is considered as an occasional visitor in the Irish Sea.

Further analyses of these data will be undertaken next year.

18.6.1.3 Other surveys

Northern Ireland: Rockhopper trawl surveys of the Irish Sea are undertaken by DARD, though no recent data were available at the meeting. This survey may soon coordinate with the southern and western IBTS (ICES, 2007b).

UK (England and Wales): A Q1 survey with Portuguese High Headline Trawl (PHHT) was undertaken from 1982 to 2003, though the survey grid was most standardized between 1987 and 2002. Since 2004, the basis of the field programme changed to collecting additional biological data for commercial species, and so is not standardized with previous years.

UK (Scotland): There is also a Q1 west coast survey covering a similar area to the Q4 survey. A Q3 survey of the Rockall Bank has been conducted since 1991. During the period 1998–2004 this survey was conducted only in alternate years, with a deep-water survey along the shelf edge in VIa being carried out in the intervening years. Since 2005, both surveys have been carried out annually.

Ireland: An annual survey to collect maturity data on commercially important species takes place during the peak spawning season in spring. This survey began in 2004. Different areas are surveyed each year, so annual trends cannot be derived. An annual deep-water trawl survey to the west of Ireland began in 2006, covering an area of the continental shelf to the west of Ireland, at depths of 500–1800 m. This may provide information on certain skate species.

18.6.2 Species composition of Rajidae in surveys

Groundfish surveys should be able to provide some spatial and temporal trends in the species composition of the various skates (e.g. Quéro and Guéguen, 1981) as well as other demersal elasmobranchs.

18.6.3 Trends in survey data

It must be noted that catch rates for annual surveys tend to be low for many species and quite variable, with many zero catches. Analyses of more specific areas within the overall survey areas may be more appropriate for some species. Hence, these trends should be viewed with some caution. A complete examination of all surveys taking place in this ecoregion was undertaken in 2007 (ICES, 2007a).

Updated survey data were provided by Spain. For an examination of other survey trends, and surveys in other areas within this ecoregion, see ICES 2007a. Spain provided updated distribution and length composition data from their Porcupine Bank survey. These data for *L. naevus, L. circularis,* and *S. canicula* are presented in Figures 18.11–18.13., showing biomass trends, geographic and bathymetric distribution. Data on deep-water sharks from this survey series is presented in Section 5.

Western English Channel, Celtic Sea and west of Ireland (VIIb, c, e, g-k)

Several surveys take place in this area, including Irish, French and Spanish groundfish surveys.

Raja clavata: There has been no new information on this species since 2007 (ICES 2007a). The French EVHOE surveys demonstrated stable catch rates, but with a very large peak in abundance in 2001. This was attributed to very large catches of juvenile *R. clavata* on this survey This was not demonstrated by the UK PHHT survey, which demonstrated a slight decline from very small numbers in that year. The overall trend in the UK PHHT survey is downward. There were peaks in catch rates in the late 1980's and in 1994, and recent catch rates have been at low levels.

The peak abundance in the UK survey was in 1994, after which abundances remained at a low level, although there appears to have been a slow increase since 2000.

Leucoraja naevus: Different surveys demonstrated slightly different patterns of abundance for this species. The Spanish survey in the Porcupine Bank demonstrates a peak in abundance in 2003 (Figure 18.11), followed by a decline, with subsequent low but stable catch rates since 2004. The UK PHHT Q1 survey demonstrated large fluctuations in annual abundance with peak abundance in 1996, followed by a sharp decline to low levels since 1997, with catch rates of this species in the Irish Sea beam trawl survey also generally stable. The French EVHOE survey demonstrated a peak in abundance in 2002, with the lowest catches in 2000. The relative abundance in the Celtic Sea/Biscay region may have increased in recent years as reported from the French EVHOE survey (Mahé and Poulard, 2005), but catches are variable.

Leucoraja circularis: Only the Spanish Porcupine Bank survey covers this species area of distribution and demonstrated this species in any quantity (Figure 18.12a–c). Survey catches in 2007 are the highest since 2003, after three years of low, but stable catches. (Figure 18.12a). Peak catches were in 2003.

Leucoraja fullonica: Only the UK PHHT Q1 survey seemed to demonstrate this species regularly, although in small numbers. There are large fluctuations in catches, before 1997, with numbers per hour approaching zero in 1992 and also in 2001. More recent catch rates were at low levels, and the cessation of this survey precludes further analyses of recent trends.

Scyliorhinus canicula: Lesser-spotted dogfish is abundant and widespread over most parts of the Celtic Seas ecoregion. Like many elasmobranchs, it often aggregates by size and sex, and these aggregations can result in occasional large catches. All surveys demonstrate increasing/stable catch rates of lesser-spotted dogfish in recent years, although there is some variation in when the increase was first detected. The Spanish Porcupine survey demonstrates an increasing trend for *Scyliorhinus canicula* to the west of Ireland, with the highest catch levels in the time-series occurring during the 2007 survey. (Figure 18.13a–c). The French survey demonstrated a general increase in the Celtic Sea/Bay of Biscay (Mahé and Poulard, 2005); with this study indicating that the increase was associated with an increase in the abundance of smaller individuals. Both The UK survey and the French survey demonstrate an increase since 2000, but the Spanish survey on the Porcupine Bank (Figure 18.13a) does not reveal a significant increase until 2003.

The UK survey in the Celtic Sea revealed a peak in the relative abundance of *Mustelus* spp. in 2000, and though this peak was not apparent in the French survey in 2000, this species has also increased in recent years, peaking in 2004.

18.6.4 Size composition of demersal elasmobranchs

New length frequency information for *L. naevus*, *L. circularis* and *S. canicula* (Figure 18.14a–c) are provided from the Spanish Porcupine survey.

Preliminary analyses of the size distribution of the demersal elasmobranchs were undertaken in 2006. This study was to illustrate the life-history stages that may be represented in the various surveys, and so as to gauge whether existing surveys are likely to be appropriate for examining the pups, juveniles and adults of demersal elasmobranchs.

Several groundfish surveys, such as the earlier UK Q1 PHHT survey and the more recent and ongoing UK Q3 beam trawl survey and Irish Groundfish Survey can provide annual data in the Celtic Seas. Of these, the beam trawl survey that takes place in Q3 demonstrates the largest proportion of small (<20 cm) skates of the inshore species. Within the surveys, some species are only caught in relatively small numbers. Nevertheless, some of these species, such as *R. microocellata*, demonstrate several modes in size range. As age data are not available for these species, these modes may possibly be used to estimate relative age abundances for younger age classes.

Other relatively common species demonstrate similar size distributions across surveys and areas. See ICES 2007a for further discussion.

18.6.5 Localised populations

Several species of demersal elasmobranch that, although occurring sporadically throughout much of the Celtic Seas region, have certain areas where they are locally abundant. Localised depletions of the species at these sites could therefore have a major impact on the population as a whole. Hence, the status of such species may need to be monitored and assessed at a more local scale. More detailed studies are required to examine available data for:

Raja undulata in Tralee Bay (VIIj)

Raja microocellata in the Bristol Channel (VIIf)

Scyliorhinus stellaris off Anglesey and the Lleyn Peninsula (VIIa)

Squatina squatina in Tralee Bay

Although some of these local populations may be sampled with a reasonable number of trawl stations (e.g. *R. microocellata*) in VIIf, the number of trawl stations sampling other 'local' populations may currently be more limited.

18.6.6 Quality of data

The genus *Mustelus* is a problematic taxon, and it is likely that there is some confusion between *M. asterias* and *M. mustelus*. Hence, analyses for these species should use aggregated data for the two species. *Mustelus* spp. and tope may also be misidentified.

There are several identification problems with certain skate species that lead to uncertainty in the quality of both survey and commercial data. *Raja clavata* and *A. radiata* may be confused (although *A. radiata* does not occur over much of this ecoregion), as can *R. montagui* and *R. brachyura*. Neonatal specimens of *R. clavata*, *R. brachyura* and *R. montagui* can also be problematic. It is hoped that the production of a photo-id key may help alleviate these problems.

18.7 Life history information

Various published biological studies provide maturity and age data for skates in the Celtic Seas (e.g. Fahy, 1989b; Gallagher, 2000; Gallagher *et al*., 2005b). It is recommended that data from these sources be examined at future meetings of the WGEF.

Preliminary analyses of length at maturity for various skate species were presented in the 2006 report. Maturity information from the Irish Biological Surveys from the West of Ireland and Irish Sea are presented in Table 18.10.

Recruitment

Juveniles of many species are found in most groundfish surveys and in discards, although usually in small numbers. Annual beam trawl surveys in September catch recently hatched thornback rays (10–20 cm total length). Although catches of 0-groups tend to be low and may not be accurate indicators of recruitment, a more critical examination of these data could usefully be undertaken. However for areas where elasmobranch catches are low, such as skates in VIIj, it will not be possible to estimate recruitment without dedicated surveys.

18.8 Exploratory assessment models

No new model data were available in 2008.

18.8.1 Previous assessments

Preliminary assessments of the Celtic Sea stock of *L. naevus* were made during the DELASS project, using GLM analyses of commercial cpue and survey (EVHOE) data, a surplus production model and catch curve analysis. The results of these exploratory assessments did not give consistent results. *L. naevus* had demonstrated signs of an increase in number, followed by a decrease in the 1990s (Heessen, 2003). Longer-term cpue data and a better knowledge of the stock are required.

A GAM analysis of survey data were carried out by WGEF in 2007. This used Scottish Groundfish data for *R. clavata, L. naevus, R. montagui and S. canicula* in Divisions VIa, VIb and VIIa/f. Complete results , and a description of the methods used are available in ICES (2007a).

Division VIa

Raja clavata: Figure 18.15a shows the estimated effects from the fitted GAM. The survey catch rates in terms of no.h^{-1} are estimated to have been higher in recent years than in the mid 1990s. Highest catches are estimated to occur in the statistical rectangles around St Kilda and in waters less than 250 m deep. The seasonal pattern is rather uncertain, probably because most of the data were obtained in either the 1st or 4th quarters of the year.

Leucoraja naevus: The results of the fitted GAMs are shown in Figure 18.15b. The year effect estimated by the model demonstrates some fluctuations over the 20-year period, although recent catch rates are estimated to be the highest in the time-series. The estimated spatial distribution indicates lower catch rates in the Minches and Clyde with higher catch rates in the more offshore areas of the shelf. Catch rates are estimated to be highest in shelf seas. However, it should be highlighted that there is likely to be some confounding of spatial and depth effects and additionally the estimated form of the relationship between depth and catch rate may be too smooth.

Raja montagui: The estimated year effects for spotted ray in Division VIa demonstrate an increasing trend over time (Figure 18.15c). The highest catch rates are estimated to come from statistical rectangles to the south and north of the Hebrides.

Scyliorhinus canicula: Figure 18.15d shows the results of the fitted GAM. The estimated temporal trend in catch rate demonstrates a significant increase between 1990 and 2003 and has stabilized since then. Highest catch rates are estimated to occur in the offshore regions of the shelf, particularly to the northwest of Ireland.

Division VIb

The survey conducted at Rockall has very low catch rates of all elasmobranch species and is therefore only useful as an indicator of whether a species is present in this part of Division VIb. There is little useful survey information from the deeper water of Division VIb.

Division VIIa/VIIf

The analyses for the Irish Sea and Bristol Channel make use of the UK (E&W) beam trawl survey. This survey has been carried out at the same time each year and therefore no seasonal trends were included in the statistical model.

Raja clavata: Figure 18.16a shows the estimated effects from the fitted statistical models. The model estimates that there has been a significant increase in catch rate (N/h) over the period for which data are available (1993–2006). The highest catch rates come from Cardigan Bay and the other statistical rectangles around the coast of Wales, with lower catch rates apparent in more southerly and northwesterly regions.

Leucoraja naevus: The results of the analysis for cuckoo ray in VIIa/VIIf are shown in Figure 18.16b. The statistical model estimates a small (but marginally significant) decline in catch rate over the 14 years of survey data. The estimated spatial distribution of survey catch rates demonstrates that the highest rates come from the statistical rectangles in the central Irish Sea, with lower catch rates occurring around the coastline of England and Wales.

Raja montagui: Figure 18.16c shows the results of the fitted GAM for spotted ray in the Irish Sea and Bristol Channel. The model estimates a significant increase in catch rate over the time-series of available data. Catch rates are estimated to be highest in the statistical rectangles in the central Irish Sea.

Scyliorhinus canicula: The results of the analysis for lesser-spotted dogfish in VIIa/VIIf are shown in Figure 18.16d. The statistical model estimates a significant increase in catch rate over the 14 years of survey data. The estimated spatial distribution of survey catch rates demonstrates that the highest rates come from the statistical rectangles in the central Irish Sea, with lower catch rates occurring around the coastline of England and Wales.

18.8.2 Stock Status

In the absence of formal stock assessments for the species and stocks in this ecoregion, the following provides a qualitative summary of the general status of the major species.

West of Scotland (VIa)

Raja clavata: Uncertain, although catch rates seem to be stable/increasing in surveys.

Leucoraja naevus: Uncertain, with the different surveys giving contrasting signals. Catches seem to have increased in VIa. Better delineation of the stock structure is required to aid in the interpretation of these survey indices.

Raja montagui: Survey catches are stable/increasing.

Scyliorhinus canicula: Survey catches are stable/increasing.

Dipturus batis: Local populations still exist.

Rockall (VIb)

There is not enough information to assess the status of any species in this area.

Irish Sea (VIIa)

Raja clavata: Uncertain, although catch rates seem to be stable/increasing in surveys.

Leucoraja naevus: Uncertain, with the different surveys giving contrasting signals. There is a slight downward trend in catch rates. Better delineation of the stock structure is required to aid in the interpretation of these survey indices.

Raja montagui: Survey catches are stable/increasing.

Raja brachyura: Uncertain. No trends are apparent from surveys.

Dipturis batis: This has been described as extirpated (Brander, 1981). Occasional individuals have been reported from the northwestern Irish Sea (e.g. discard sampling in the North Channel and from recreational angling in Belfast Lough), although there is no evidence to suggest that *D. batis* has reappeared elsewhere in VIIa.

Scyliorhinus canicula: Survey catches are stable/increasing.

Scyliorhinus stellaris: Uncertain. Survey catches are stable/increasing, but only reported from coarse ground stations in small numbers. This species may be more abundant on rocky, inshore grounds.

Mustelus spp: Uncertain. Survey catches of *Mustelus asterias* are low in this ICES Division, but appear to be stable. The problems of identification of species within this genus make stock assessment difficult.

Bristol Channel (VIIf)

Raja clavata: Uncertain, although catch rates seem to be stable/increasing in surveys.

Raja microocellata: Uncertain, although catch rates seem to be stable in surveys.

Raja montagui: Survey catches seem to be stable/increasing.

Raja brachyura: Uncertain. No trends are apparent from surveys.

Scyliorhinus canicula: Survey catches are stable/increasing.

Scyliorhinus stellaris: Uncertain, only taken occasionally in survey hauls.

Mustelus spp.: Uncertain. Survey catches appear to be stable/increasing in this ICES Division.

Western English Channel, Celtic Sea and west of Ireland (VIIb, c, e, g-k)

Raja clavata: Uncertain, although catch rates seem to be stable/increasing in surveys.

Leucoraja naevus: Uncertain, with the different surveys giving contrasting signals. The Spanish survey demonstrates an increase in catches to the west of Ireland. Better delineation of the stock structure is required to aid in the interpretation of these survey indices.

Raja montagui: Survey catches are stable/increasing.

Leucoraja circularis: Uncertain. Survey catches appear stable, but only a short time-series is available.

Leucoraja fullonica: Uncertain. There is a poor signal from surveys.

Scyliorhinus canicula: Survey catches are stable/increasing.

Mustelus spp.: Uncertain. Survey catches in the PHHT appeared to increase, although this survey no longer operates. IBTS Q4 surveys may be able to detect more recent changes in relative abundance.

18.9 Quality of assessments

No new assessments were carried out in 2008. Data are insufficient for a full stock assessment. Species-specific catch data are not available. There have, however, been improvements in the collection of species-composition data in recent years, and there is some historical information on species composition for earlier periods.

The stock identity is not accurately known. For inshore oviparous species, assessments by ICES Division or adjacent divisions may be appropriate, although for species occurring offshore, including *L. naevus*, a better delineation of stock boundaries is required.

Age and growth studies have only been undertaken for the more common skate species, and IBTS surveys continue to collect maturity information. Other aspects of their biology, including reproductive output, egg-case hatching success, and natural mortality (including predation on egg-cases) are poorly known.

Surveys provide the most reliable species-specific information, and there are several surveys operating in the area. The French and UK (Scotland) IBTS surveys and the UK (England and Wales) beam trawl survey have been undertaken for 10–20 years, with other surveys covering a shorter time frame. Such data may be appropriate for examining the general status of the more common demersal elasmobranchs.

The identification of skate species is considered to be reliable for recent surveys, although there are suspected to be occasional misidentifications. It is recommended that any analyses of smoothhounds use the combined data for *M. asterias* and *M. mustelus.*

18.10 Reference points

No reference points have been proposed for these stocks.

18.11 Management considerations

There are no TACs for any of the other relevant species in this region.

Technical interactions for fisheries in this ecoregion are demonstrated in Table 18.11.

It has been difficult for WGEF to deal with elasmobranchs in this region adequately. This is as a consequence of a lack of species-specific landings data, limited knowledge of the species composition of skates in commercial landings (including taxonomic confusion in some datasets), poor knowledge of stock structure and limited time-series of some of the fishery-independent surveys in this ecoregion.

Commercial species

Thornback ray *Raja clavata* is one of the most important commercial species in the inshore fishing grounds of the Celtic Seas (e.g. eastern Irish Sea, Bristol Channel). It is thought to have been more abundant in the past, and more accurate assessments of the status of this species are required. Preliminary analyses of recent survey data indicate that the relative abundance of this species in VIa and VIIa, f suggest it has been stable in recent years.

Cuckoo ray *Leucoraja naevus* is an important commercial species in the Celtic Sea. Survey catch rates declined in the Celtic Sea during the 1990s, though have been stable/increasing in various areas in more recent years. Abundance trends are not consistent between the different surveys and so further studies to better define the stock structure are required.

The relative abundance of lesser-spotted dogfish *Scyliorhinus canicula*, smoothhounds *Mustelus* spp. and spotted ray *Raja montagui* in this ecoregion appear to be stable/increasing.

Other species

Contemporary surveys occasionally record other skate species, such as undulate ray, though catch rates of these species are highly variable. The absence of *R. alba* and *S. squatina* in contemporary surveys, as noted by ICES, 2006 is cause for concern.

There are anecdotal and historical reports suggesting that localized populations of white skate *Rostroraja alba* were targeted in fisheries in the western English Channel, Baie de Douarnanez (Brittany) and off the Isle of Man, and this species is now very rarely observed in the region. Further studies to determine whether viable populations of *R. alba* remain in this ecoregion are required.

Localised populations of angel shark in Start Bay (VIIe) and Cardigan Bay (VIIa) have declined severely and this species is now reported only infrequently in the area, though it was previously more common (Rogers and Ellis, 2000). Landings of this species have almost ceased, with only occasional individuals landed. Tagging studies from the Irish Central Fisheries Board demonstrate that these sharks can migrate further than previously thought. Although they are considered to be only abundant in Tralee Bay, and many tagged fish from this area have been returned from nearby areas along the west coast of Ireland, there have also been reported recaptures from the English Channel, France and Spain (Figure 18.24) (Green, 2007). Landings of this species have almost ceased, with only occasional individuals landed. It is an inshore species, distinctive, and may have a relatively good discard survivorship. Given the concern over *S. squatina* in this and adjacent ecoregions, and that it is not subject to any conservation legislation, a zero TAC for Subareas VII–VIII may benefit this species.

Historically, species such as *L. circularis, L. fullonica, D. batis* and *D. oxyrinchus* may have been more widely distributed in shelf seas. These species are now encountered only infrequently in surveys on the inner continental shelf, though they are still present in deeper waters along the edge of the continental shelf. Hence studies to examine the current status of these species in Subareas VI and VII should be undertaken next year. Future analyses should examine the long-term distribution and relative abundance of these species. In the first instance, data on the occurrences of these species should be collated. IBTS should be requested to compile and provide WGEF with any available data for the westerly IBTS and other national surveys.

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Table 18.1a Demersal elasmobranchs in the Celtic Seas. Total landings of skates (Rajidae) in the Celtic Seas ecoregion.

Table 18.1a	Total landings (t) of *Rajidae* in Area VIa																
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Belgium	.	2	.	1	2	7	1	2	2	4	2	4	2	8	9	4	4	na
Denmark	.	+	+	+	+	+	+	.	+	+	.	.	.	.	.	.	.	.
Faeroe Islands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	na	na	na
France	711	621	603	606	437	553	526	384	333	0	321	278	212	183	149	181	174	147
Germany	.	.	.	.	2	.	1	4	16	7	1	1	.	3	.	.	.	na
Ireland	150	200	350	331	265	504	681	596	488	388	274	238	311	364	363	186	176	119
Netherlands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norw ay	71	38	82	56	9	74	29	20	50	29	49	20	25	2	2	10	4	5
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	.	43	.	.	.	.	47	58	69	34	2	.	9	27	14	14	.	.
UK - (E,W&N.I.)	57	77	72	70	101	138	101	69	157	67	108	65	114	159	66	26	18	5
UK – Scotland	2007	2026	1605	1419	1429	1980	2606	1879	1460	1324	1316	1263	1136	1307	1012	623	369	426
Total	2996	3007	2712	2483	2245	3256	3992	3012	2575	1853	2073	1869	1809	2053	1488	1043	744	703

Table 18.1b	Total Landings (t) of *Rajidae* in Area VIb																
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Estonia	.	.	.	.	.	.	.	.	.	.	.	56	1	.	.	.	.	.
Faeroe Islands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	na	na	na	na
France	3	13	0	4	0	0	0	0	0	0	7	5	5	2	6	15	.	.
Germany	.	.	.	6	25	17	49	26	36	67	76	8	1	6	22.3	22	6	na
Ireland	.	.	.	24	23	60	68	23	15	28	20	10	1	18	7.28	9	24	14
Norw ay	203	248	234	170	272	176	95	101	98	59	120	80	44	61	45.95	39	82	81
Portugal	.	.	.	.	.	56	.	25	26	24	29	17	31	18	na	.	.	.
Russian Federation	.	.	.	.	.	.	.	.	.	.	5	8	.	.	na	na	na	na
Spain	.	14	.	.	.	.	328	410	483	322	347	158	36	46	+	.	.	.
UK - (E,W&N.I.)	4	11	12	21	28	73	175	105	134	147	156	120	92	47	47.8	20	20	9
UK – Scotland	76	67	57	70	98	97	83	91	101	123	204	97	79	146	164	59	51	30
Total	286	353	303	295	446	479	798	781	893	770	964	559	290	344	293.33	164.4564	183	134

Table 18.1c	Total landings (t) of *Rajidae* in area VIIa																
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Belgium	298	209	230	107	224	218	265	298	398	542	504	724	997	830	860	860	593	na
France	712	890	642	550	330	293	282	151	285	n.s.	163	343	349	322	183	192	114	54
Ireland	1811	1400	1301	679	514	438	438	593	692	827	759	807	1032	1086	825	786	645	721
Netherlands	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	4	4	6	+	+	+	+	.	.	.
Norw ay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
UK - (E,W&N.I.)	1378	1226	1150	1003	748	606	789	824	1009	936	671	983	863	1184	533	1252	271	260
UK (Scotland)	227	163	107	96	86	42	55	80	52	33	86	80	68	67	38	30	65	13
Total	4426	3888	3430	2435	1902	1597	1829	1946	2440	2342	2189	2937	3309	3489	2256	3120	1689	1047

Table 18.1d	Total landings (t) of Rajidae in area VIIf																
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Belgium	135	155	128	96	117	108	89	116	121	103	90	91	117	134	210	208	138	na
Denmark	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
France	326	607	663	565	468	394	432	485	464	453	538	642	526	536	478	429	313	345
Germany	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ireland	.	.	.	.	.	.	.	.	1	.	.	.	1	1	15	8	5.9	2.27
Netherlands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norw ay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain (b)	.	.	.	.	.	.	8	10	12	1	.	3	.	.	.	.	.	.
UK - (E,W&N.I.)	666	627	705	638	630	589	676	664	624	560	613	691	920	766	609	631	653	620
UK (Scotland)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	1127	1389	1497	1299	1215	1091	1205	1275	1222	1117	1241	1427	1564	1437	1312	1276	1109	967

Table 18.1e	Total landings (t) of Rajidae in area VIIegh																
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Belgium	242	97	183	209	172	203	177	293	260	240	223	248	347	576	407	432	582	na
Denmark	1	.	1	+	0	+	.	.	.	.	.	.	.	.	.	.	.	.
France	7734	7077	6477	5873	5836	6029	6425	7093	6114	6098	5710	5603	5273	5588	4261	4517	3740	3098
Germany	.	.	.	.	.	.	.	.	.	.	.	.	+	.	3	.	.	na
Ireland	100	68	.	120	106	162	349	479	446	408	203	481	729	838	844	334	315	285
Netherlands	na	na	na	na	na	na	na	na	9	na	7	7	11	.	.	.	1	.
Norw ay	5	.	.	.	.	.	.	.	.	.	.	11	.	.	.	.	.	.
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain (b)	.	21	.	.	.	.	312	932	1178	2647	1706	1142	653	31	15	9	1	1
UK - (E,W&N.I.)	1211	638	751	735	869	997	953	1098	1167	796	932	880	775	804	811	1024	727	730
UK (Scotland)	.	.	.	1	.	.	.	2	.	2	.	2	.	.	149	3	1	.
Total	9293	7901	7412	6938	6983	7391	8216	9897	9173	10191	8781	8374	7788	7837	6490	6318	5366	4114

Table 18.1f	Total landings (t) of *Rajidae* in area VIIbcjk																	
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	0	0	0	0	0	0	0	0	0	24	5	0	5	1	na	0	0	na
France	781	541	546	298	224	297	375	599	500	ns	568	362	272	192	101	257	255	347
Germany	0	0	0	7	18	3	4	9	17	10	21	7	+	3	15	17,07	0	na
Ireland	350	400	619	602	625	735	757	811	741	740	653	383	354	435	511	464,7	473	417
Norw ay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	4
Spain (b)	0	124	0	0	0	0	1341	1676	1978	2419	2573	1205	2939	1281	7	16	19	11
UK - (E,W&N.I.)	5	53	71	88	201	361	469	468	376	352	597	545	373	350	364	269	176	172
UK (Scotland)	14	15	10	34	43	73	58	36	67	121	189	162	124	226	70	58	77	.
Total	1150	1133	1246	1029	1111	1469	3004	3599	3679	3642	4601	2664	4062	2487	968	1081	1016	951

Table 18.1g	Total landings (t) of *Rajidae* in the Celtic Seas																	
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	675	463	541	413	515	536	532	709	781	913	824	1067	1467	1549	1485	1503	1316	na
Denmark	1	.	2	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Estonia	.	.	.	.	.	.	.	.	.	.	.	56	1	.	.	.	.	.
Faeroe Islands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	na	.	.
France	10267	9749	8931	7896	7295	7566	8040	8712	7696	6551	7307	7233	6637	6823	5178	5591	4595	3991
Germany	0	0	0	13	45	20	54	39	69	84	98	16	2	12	40	39	7	na
Ireland	2411	2068	2270	1756	1533	1898	2294	2502	2382	2390	1909	1919	2428	2742	2565	1787	1640	1558
Netherlands	na	na	na	na	na	na	na	na	13	4	13	7	11	na	na	0	1	.
Norw ay	279	286	316	226	281	250	124	121	148	88	169	111	69	63	48	49	101	90
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Portugal	.	.	.	.	.	56	.	25	26	24	29	17	31	18	na	.	.	.
Russian Federation	.	.	.	.	.	.	.	.	.	.	5	8	.	.	na	na	.	.
Spain	0	202	0	0	0	0	2036	3086	3720	5423	4628	2508	3637	1385	37	39	20	12
UK - (E,W&N.I.)	3321	2632	2761	2555	2577	2764	3163	3228	3467	2858	3077	3283	3137	3310	2431	3222	1865	1796
UK – Scotland	2324	2271	1779	1620	1656	2192	2802	2088	1680	1603	1795	1604	1407	1746	1433	773	562	469
Total	19278	17671	16600	14479	13902	15282	19044	20510	19981	19938	19854	17830	18828	17648	13217	13004	10107	7917

Table 18.2a Demersal elasmobranchs in the Celtic Seas. Species-Specific French Landings, all areas combined.

Species	1995	1996	1997	1998	1999	2000	2001
T. marmorata	15	16	27	33	24	7	1
D. batis	296	331	344	278	130	468	537
D. oxyrhinchus	366	330	315	356	20	96	47
L. circularis	529	519	537	454	82	327	275
L. fullonica	56	50	43	40	21	21	36
L. naevus	3741	4043	4722	3848	1021	2541	2236
R. clavata	1739	1652	1535	931	478	865	618
* R. montagui	882	973	1176	981	551	1062	1071
R. undulata	12	6	10	2	1	0	0
D. pastinaca	1	1	4		2	10	3
M. aquila	3	2	2	1	2	1	0
Various	2066	2507	2830	1111	6657	3558	2680
Total	9706	10430	11544	8035	8989	8956	7504

*** WGEF considers that records *of R. montagui* also include landings of *R. brachyuran.***

Table 18.2b Demersal elasmobranchs in the Celtic Seas. Species-Specific French Landings for Subareas VI and VII.

YEAR	1999	2000	2001	2002	1999	2000	2001	2002
Area	VI	VI	VI	VI	VII	VII	VII	VII
T. marmorata	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.2
D. batis	8.8	73.3	69.9	5.0	118.3	384.6	471.0	263.2
D. oxyrinchus	5.4	39.6	18.3	42.8	15.7	53.4	30.9	73.7
L. circularis	0.3	8.5	7.2	2.4	66.2	264.0	236.4	157.3
L. fullonica	0.0	0.4	0.1	0.3	22.5	45.0	47.3	65.1
L. naevus	5.6	57.0	61.1	43.3	706.8	1728.4	1660.2	1159.1
R. clavata	10.9	60.8	50.4	49.8	450.2	710.8	548.5	506.1
R. microocellata	0.0	0.0	0.0	0.0	7.5	0.5	0.9	0.0
*R. montagui**	0.1	0.5	0.7	0.8	533.9	1004.7	1065.8	886.2
R. undulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Large rays #	0.0	3.5	0.0	0.0	12.0	29.9	12.1	1.5
D. pastinaca	0.0	0.0	0.0	0.0	2.0	8.6	2.8	4.8
M. aquila	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total	31.1	243.6	207.6	144.5	1935.2	4229.9	4076.0	3117.3

*** WGEF considers that records *of R. montagui* also include landings of *R. brachyuran.***

 # Including D. batis, R. alba, D. oxyrinchus, D. nidarosiensis.

Table 18.3 Demersal elasmobranchs in the Celtic Seas. Species specific landings from Spain (Basque Country), in Subareas VI, VII and VIII (2000–2003).

YEAR	2000	2001	2002	2003
D. batis	8.3	9.6	0.0	0.0
D. oxyrhinchus	0.0	0.2	0.0	0.0
L. fullonica	5.3	33.5	0.0	1.5
L. naevus	330.3	290.9	290.0	287.0
* *R. asterias*	0.0	0.1	0.0	0.0
R. clavata	51.7	107.9	65.1	47.1
R. montagui	2.7	6.2	20.9	5.1
R. undulata	0.5	0.0	0.0	0.1
Total	398.8	448.4	376.0	340.9

No data available for 2004

*** Not in Celtic Seas ecoregion**

Table 18.4. Demersal elasmobranchs in the Celtic Seas. Belgian Species-Specific Landings by division for the years 2001 and 2002.

	2001	2002	2001	2002	2001	2002
AREA	VIIA	VIIA	VIID	VIID	VIIF,G	VIIF,G
*L. circularis**	9.3	22.7	6.0	3.2	104.7	86.5
L. naevus	77.6	137.3	0.0	0.2	27.9	44.3
R. brachyura	137.8	228.0	9.8	11.3	27.4	80.0
R.clavata	382.8	449.7	58.5	68.9	116.1	108.2
R. montagui	99.6	158.9	15.8	31.5	65.1	133.7
Total	707.0	996.6	90.1	115.2	341.2	452.8

*** These records are considered by WGEF to be misidentified *R. microocellata*.**

Table 18.5a Demersal elasmobranchs in the Celtic Seas. Nominal landings (tonnes) of smooth hounds (*Mustelus* spp.) in ICES Subareas VI and VII. (These data may include a quantity of tope).

	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	0	0	0	0	0	8	8.4	3
France	824	513	623	654	827	1401	1635	1538
Ireland	0.5	0.5	0.5	0.5	0.5	2	35	na.
Spain (Basque country)	4	6	20	24	36	17	9	.
UK - Eng+Wales+N.Irl.	0	12	74	54	67	56	171	103
Total	828	531	717	732	930	977	1858	1644

Table 18.5b Demersal Elasmobranchs in the Celtic Seas. Landings of *Squatina squatina*. French landings from ICES and Bulletin de Statistiques des Peches Maritimes. UK data from ICES and DEFRA. Belgian data from ICES.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Belgium	0	0	0	0	0	0	0	0	0	0	0
France (Bulletin)	8	3	32	26	29	0	0	18.7	19.5	0	0
France (ICES)	0	0	0	0	0	24	19	0	0	18	13
UK (E,W &N.I.)	0	0	0	0	0	0	0	0	0	0	0
Total	8	3	32	26	29	24	19	18.7	19.5	18	13

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Belgium	0	0	0	0	0	0	0	0	0	0	0	0
France (Bulletin)	9	11.5	0	8	13	9	5	4	2	2	2	2
France (ICES)	9	13	14	12	2	2	2	1	1	1	1	2
UK (E,W &N.I.)	0	0	0	0	0	2	1	1	0	0	0	0
Total	18	24.5	14	20	15	13	8	6	3	3	3	4

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	0	0	0	0	0	0	0	0	+	+	.	na
France (Bulletin)	2	2	0	0	0	0	0	0	0	0	0.125	na
France (ICES)	1	0	0	1	+	+	+	0	+	+	.	.
UK (E,W &N.I.)	0	47	0	0	0	0	0	0	0	0	0.042	0.0009
Total	3	49	0	1	0	0	0	0	0	0	0.167	0.0009

Table 18.6a Demersal Elasmobranchs in the Celtic Seas. Catch efficiency by species and vessel (marketable catch only), and catch composition by vessel.

	Catch efficiency (kg/fish/fishing hour)				Catch composition (%)			
Species	Vessel 1	Vessel 2	Vessel 3	Vessel 4	Vessel 1	Vessel 2	Vessel 3	Vessel 4
Rajidae	12.6	23.5	15.4	26	32.9%	45.1%	32.4%	36.3%
Dogfish	2.7	3.2	3.4	3.7	7.1%	6.1%	7.2%	5.2%
Plaice	6.1	5.8	6.7	11.2	15.9%	11.9%	14%	15.6%
Sole	3.2	7	5.2	6.5	8.2%	13.4%	11%	9.1%
Lemon Sole	2.1	0.5	1.3	1.2	5.6%	1%	2.6%	1.7%
Anglerfish	1.1	0.1	1.4	1.8	2.9%	0.2%	3%	2.5%
Other Species	10.5	11.5	14.6	21.2	27.4%	22.2%	29.8%	29.6

Table 18.6b Demersal Elasmobranchs in the Celtic Seas. Catch composition by ICES Area for one outrigger vessel (35m/1200hp).

	Catch Composition (%)									
Species	IVb	IVc	VIIa	VIIb	VIId	VIIe	VIIf	VIIg	VIIJ	Total
Rajidae	0%	13.6%	37.8%	29.8%	59.7%	0%	50.2%	45%	0%	36.3%
Plaice	44.5%	6%	20.8%	0%	3.2%	32.3%	14%	6.7%	0%	15.6%
Sole	1.1%	22%	16.9%	0%	3.1%	8.4%	13.5%	7.5%	0%	9.1%
Norway Lobster	38.6%	0%	0%	0%	0%	0%	0%	0.3%	0%	6.2%
Dogfish	0%	12%	4.2%	3.9%	0.7%	13.1%	1.3%	7.7%	20.7%	5.2%
Anglerfish	0%	0.1%	3.3%	17%	0%	1.4%	0.4%	3.8%	32.6%	2.5%
Lemon Sole	0.1%	1.5%	0.3%	14.9%	0.3%	0.7%	1.3%	2.6%	10.9%	1.7%
Turbot	2.8%	1.7%	1.7%	0%	0.5%	0.3%	1.4%	1.2%	0%	1.4%
Others	12.9%	43.1%	15%	34.4%	32.5%	43.8%	18.9%	25.2%	35.8%	22%

Table 18.7 Demersal elasmobranchs in the Celtic Seas. Summary details of western IBTS surveys in Celtic Seas ecoregion.

Country	UK (Scot)	France	Spain (Porcupine)	Ireland	UK (E & W)
Institute	MLA	IFREMER	IEO	MI	Cefas
Survey Area	VI, VIIa	VIIf-j, VIII	Porcupine	VIa, VII	VIIa, e-h
Depth range (m)	20–200	30–400	180–800	15–200	15–200
Initiated (as per quarter)	1992	1997	2001	2003	2003
Quarter	4	4	3 and 4	4	4
Research vessel	Scotia	Thalassa	Vizconde de Eza	Celtic Explorer	Endeavour
Gear Type	GOV 36/47	GOV 36/47	Porcupine BACA 40/52	GOV 36/47	GOV 36/47 (fine ground)
					GOV 35/45 (Rock-hopper)
Exocet Kite	Yes	No	No	No	No
Groundgear	Bobbins	Rubber disks and Chains Rubber and metal disks	Synthetic wrapped wire core double coat	Rubber disks + chain (type A + D)	Groundgear A (fine ground); rubber disks + hoppers (12–16″)

Table 18.8 Demersal elasmobranchs in the Celtic Seas. Proportion of skates in fishery-independent surveys in the Celtic Sea (Portuguese High Headline Trawl, all stations north of 48ºN, 1984–2002).

Species	Numbers	Biomass
L. naevus	0.62	0.43
R. clavata	0.13	0.22
L. fullonica	0.10	0.10
R. montagui	0.09	0.08
D. batis	0.03	0.10
R. microocellata	0.02	0.04
R. brachyura	0.01	0.02
D. oxyrhinchus	+	0.01
L. circularis	+	+
D. nidarosiensis	+	+
R. undulata	+	+

Table 18.9 Demersal elasmobranchs in the Celtic Seas. Proportion of skates (by numbers) in fishery-independent surveys in the Celtic Seas (CEFAS 4m beam trawl surveys, 1988–2005, all stations).

SPECIES	VIIA	VIIF	VIIG	VIIE
R. brachyura	0.05	0.06	0.02	0.05
L. naevus	0.16	0.01	0.13	0.01
R. microocellata	+	0.30	0.14	0.03
R. montagui	0.30	0.19	0.40	0.39
R. clavata	0.48	0.45	0.32	0.48
R. undulata	+	-	-	0.04
L. circularis *	-	+	-	-
L. fullonica	-	-	+	-

*** The validity of the reported specimen from this area is questionable**

Table 18.10 Demersal elasmobranchs in the Celtic Seas. Maturity of male and female skate species from (a) west of Ireland (2005) and (b) Irish Sea (2006) (Source: Irish Biological Survey, 2005–2006).

		FEMALES						MALES			
		MATURITY						MATURITY			
	Species	1	2	3	4	5	6	1	2	3	4
(a) West of Ireland	*R. brachyura*	-	1	1	1	-	-	1	2		1
	L. naevus	16	-	-	-	-	-	11	3	2	
	R. montagui	10		2	1	-	-	-	2		1
	R. clavata	11	8	4	1	-	-	9	3	3	5
	Total	37	9	7	3	-	-	21	10	5	7
(b) Irish Sea	*R. brachyura*	6	2	2	-	-	-	5	1	8	1
	L. naevus	17	6	1	2	-	-	12	2	3	1
	R. montagui	44	17	6	-	-	1	28	24	15	16
	R. clavata	10	2	2	-	-	-	9	3	2	1
	Total	77	27	11	2	-	1	54	30	28	19

Table 18.11 Demersal elasmobranchs in the Celtic Seas. Technical interactions.

Stock interaction table	Anglerfish budegassa VIIb-k, VIIIabd	Anglerfish piscatorius VIIb-k, VIIIabd	Cod VIIe-k	Haddock VIIb-k	Hake Northern	Herring Celtic Sea and Division VIIj	Herring VIa(S) and VIIbc	Horse Mackerel Western	Mackerel North East Atlantic	Megrim VII	Nephrops Area L: VIIbcjk	Nephrops Area M: VIIfgh+VIIa	Nephrops VIIIa,b	Plaice VIIbc	Plaice VIIe	Plaice VIIfg	Plaice VIIhjk	Sole VIIbc	Sole VIIe	Sole VIIfg	Sole VIIhjk	Sprat VIIde	Whiting VIIe-k	Seabass	Skates and rays	Pelagic and migratory sharks	Demersal sharks
Anglerfish budegassa VIIb-k, VIIIabd		H	L	L	M	0	0	0	0	M	M	L	M	L	L	L	L	L	L	L	L		L		H	L	H
Anglerfish piscatorius VIIb-k, VIIIabd	T		L	L	M	0	0	0	0	M	M	M	M	L	L	L	L	L	L	L	L		L		H	L	H
Cod VIIe-k	T	T		H	L	0	0	0	0	L	L	M	0	0	L	M	L	0	L	L	L	0	H/M		H	L	H
Haddock VIIb-k	T	T	T		L	0	0	0	0	L	M	M	0	L	L	L	L	L	L	L	L	0	H	0	H	L	H
Hake Northern	T	T	T			0	0	0	0	M	M	L	M	L		0	L	L		0	L		L		H	L	H
Herring Celtic Sea and Division VIIj	N	N	N	N	N		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	I	0
Herring VIa(S) and VIIbc	N	N	N	N	N	N		0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	L	0
Horse Mackerel Western	N	N	N	N	N	N	N		H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	L	0
Mackerel North East Atlantic	N	N	N	N	N	N	N			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	L	0
Megrim VII	T, BT	T, BT	T		T	N	N	N	N		H	M	M	L			L	L		L	L		L		H	0	H
Nephrops Area L: VIIbcjk	NT	NT	NT	NT	NT	N	N	N	N	NT		0	0	L	0	0	L	L	0	0	L	0	M		M	0	M
Nephrops Area M: VIIfgh+VIIa	NT	NT	NT	NT	NT	N	N	N	N	NT	N		0	0	0	0	L	0	0	L	L	0	M		M	0	M
Nephrops VIIIa,b	NT	NT	N	N	NT	N	N	N	N	NT	N	N		0	0	0	0	0	0	0	0	0	0		L	0	M
Plaice VIIbc			N			N	N	N	N		NT	N	N		0	0	0	L	0	0	0	0	L	0	H	0	M
Plaice VIIe	OT, BT	OT, BT	OT, BT	N		N	N	N	N		N	N	N	N		0	0	0	H	0	0	0	L		H	0	M
Plaice VIIfg	OT, BT	OT, BT	OT, BT	OT, BT	N	N	N	N	N		N	N	N	N	N		0	0	0	H	0	0	L		H	0	M
Plaice VIIhjk			BT, OT			N	N	N	N		NT	N	N	N	N	N		0	0	0	L	0	L	0	H	0	M
Sole VIIbc			N			N	N	N	N		N	N	N		N	N	N		0	0	0	0	L	0	H	0	M
Sole VIIe	BT, OT	BT, OT	BT, OT	N		N	N	N	N		N	N	N	N	BT, OT	N	N	N		0	0	0	L		H	0	M
Sole VIIfg	BT, OT	BT, OT	BT, OT	BT, OT	N	N	N	N	N	BT	N	NT	N	N	N	BT, OT	N	N	N		0	0	L		H	0	M
Sole VIIhjk			BT, OT			N	N	N	N		N	N	N	N	N	N	T, BT	N	N	N		0	L	0	H	0	M
Sprat VIIde	N	N	N	N				N	N		N	N	N	N	N	N	N	N	N	N	N		0				
Whiting VIIe-k	T	T	T	T		N	N	N	N		NT	NT	N	N	N	BT, OT		N	N	BT, OT				0	H	L	H
Seabass						N	N	N	N														0		L	L	L
Skates and rays	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	N	N	N	BT, OT	NT	NT	NT	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	BT,OT	GN		L	H
Pelagic and migratory sharks	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	N	N	N	BT, OT				BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	BT, OT	BT, OT	N	BT,OT	T, GN	GN, BT		0
Demersal sharks	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	N	N	N	BT, OT	NT	NT	NT	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	BT,OT	GN	BT,OT	N	

H; the stocks are taken together in most fisheries where they are taken and their fisheries linkage is therefore high; M: the stocks are taken together in some but not all important fisheries and their fisheries linkage is therefore medium; L: the stocks

T: Trawl; BT: Beam trawl; OT: Otter trawl; NT: Nephrops trawl; GN: Gillnet; N: none

Figure 18.1a Demersal elasmobranchs in the Celtic Seas. Total landings (tonnes) of *Rajidae* in the Celtic Seas (ICES Subareas VI and VII (including VIId)), from 1903–2006 (Source: ICES).

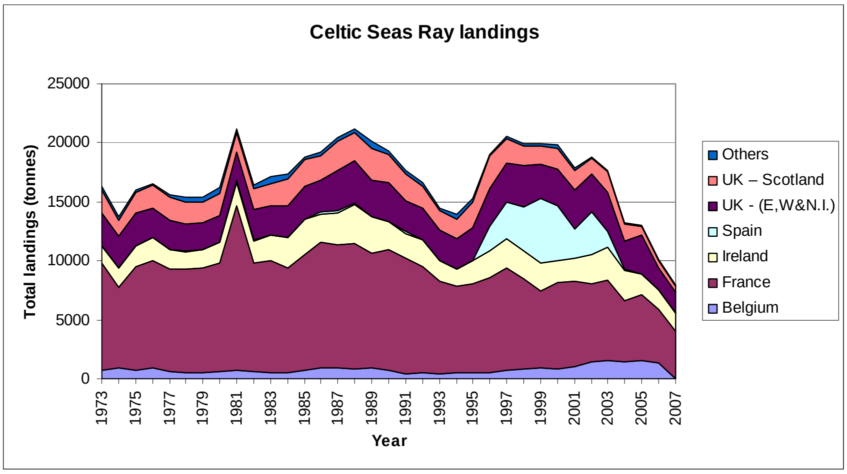


Figure 18.1b Demersal elasmobranchs in the Celtic Seas. Total landings (tonnes) of *Rajidae* by nation in the Celtic Seas from 1973–2006 (Source: ICES).

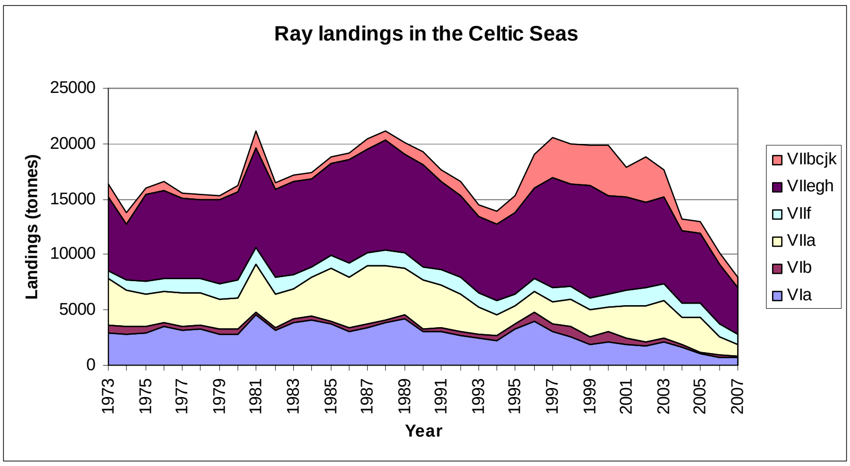


Figure 18.1c Demersal elasmobranchs in the Celtic Seas. Total landings (tonnes) of *Rajidae* by ICES Division in the Celtic Seas from 1973–2006 (Source: ICES).

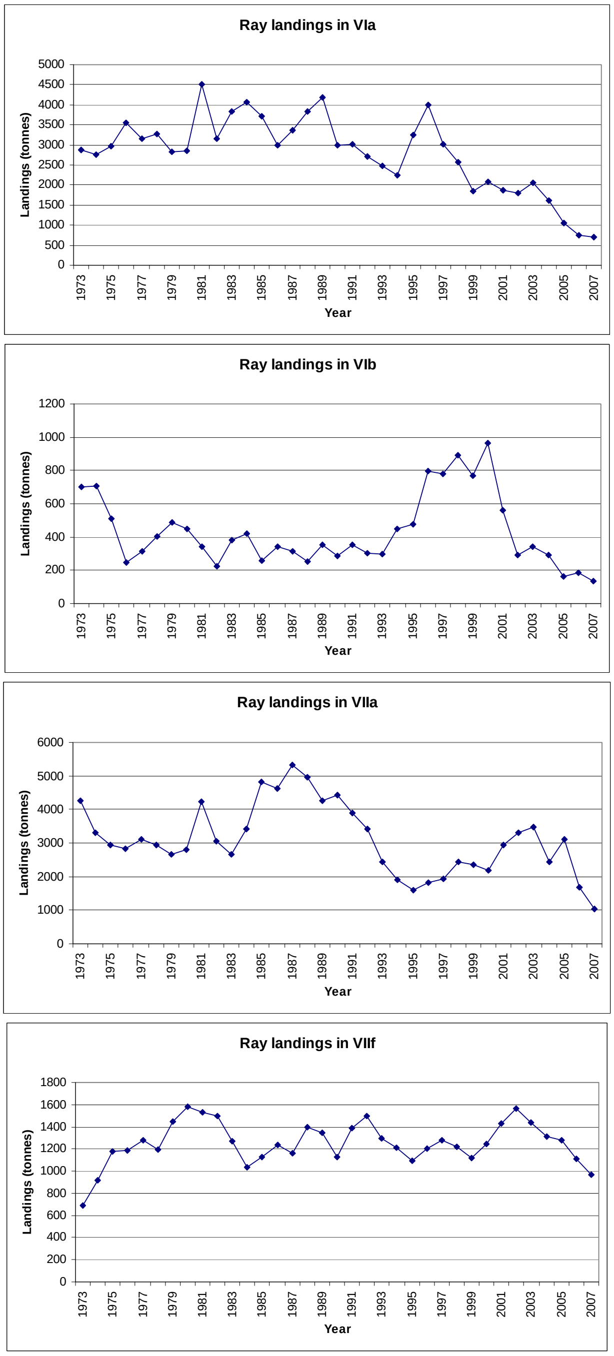
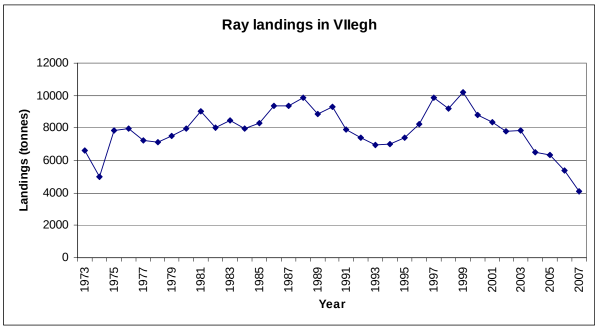


Figure 18.2a–18.2d Demersal elasmobranchs in the Celtic Seas. Landings (tonnes) of *Rajidae* by ICES Division in the Celtic Seas from 1973–2006 (Source: ICES).



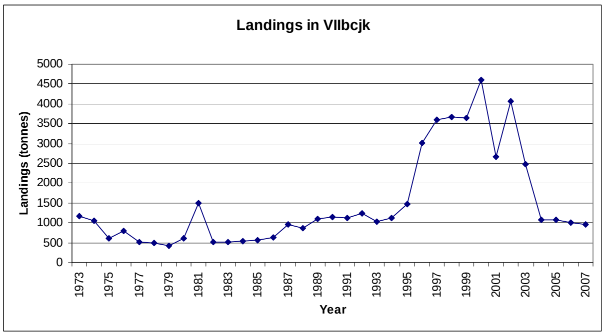
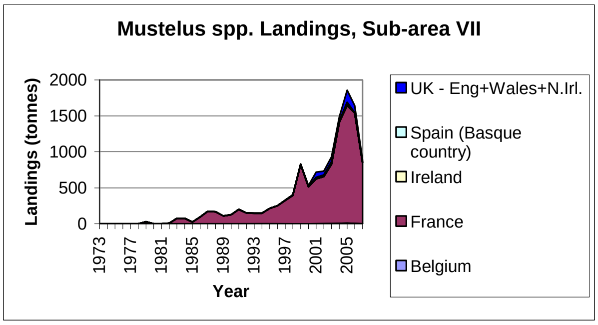


Figure 18.2e–18.2f Demersal elasmobranchs in the Celtic Seas. Landings (tonnes) of *Rajidae* by ICES Division in the Celtic Seas from 1973–2006 (Source: ICES).



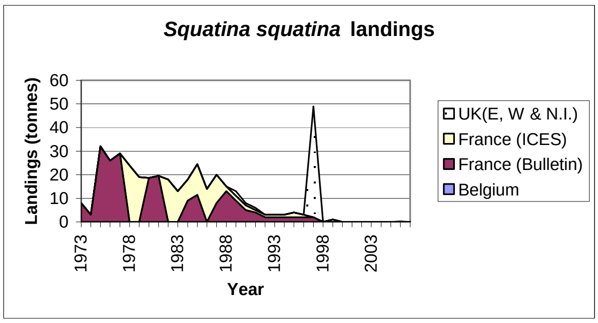


Figure 18.3 Demersal elasmobranchs in the Celtic Seas. Total landings of *Musetlus* spp. and *Squatina squatina* (Source: ICES and Bulletin de Statistiques des Peches Maritimes).

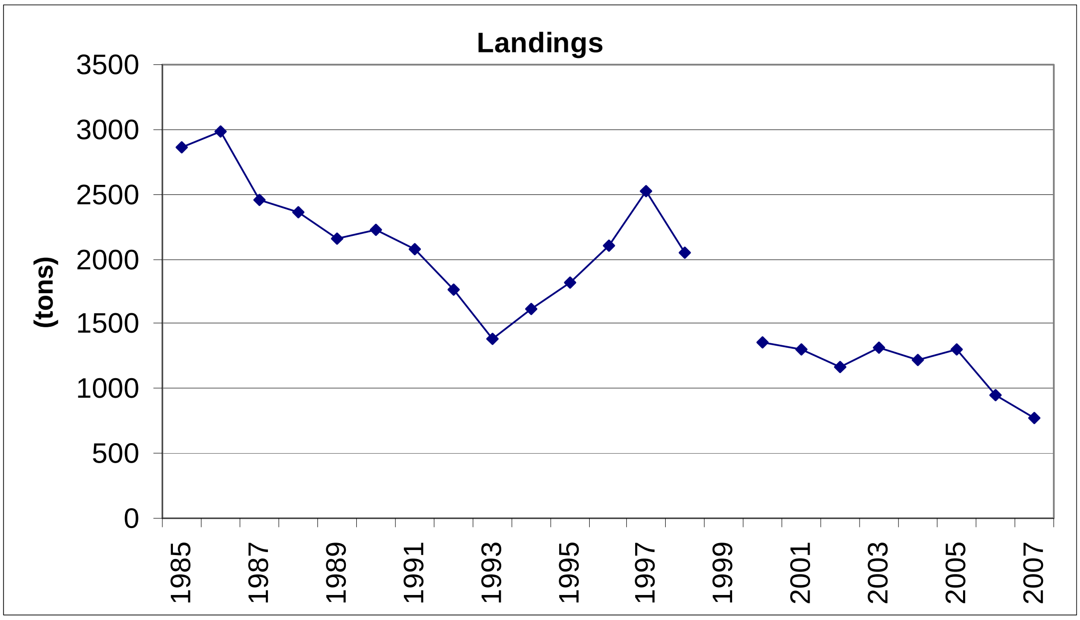


Figure 18.4a. Demersal elasmobranchs in the Celtic Seas. Landings of *Leucoraja naevus* by French bottom trawlers targeting benthic species (anglerfish, megrim and rays) in the Celtic Sea.

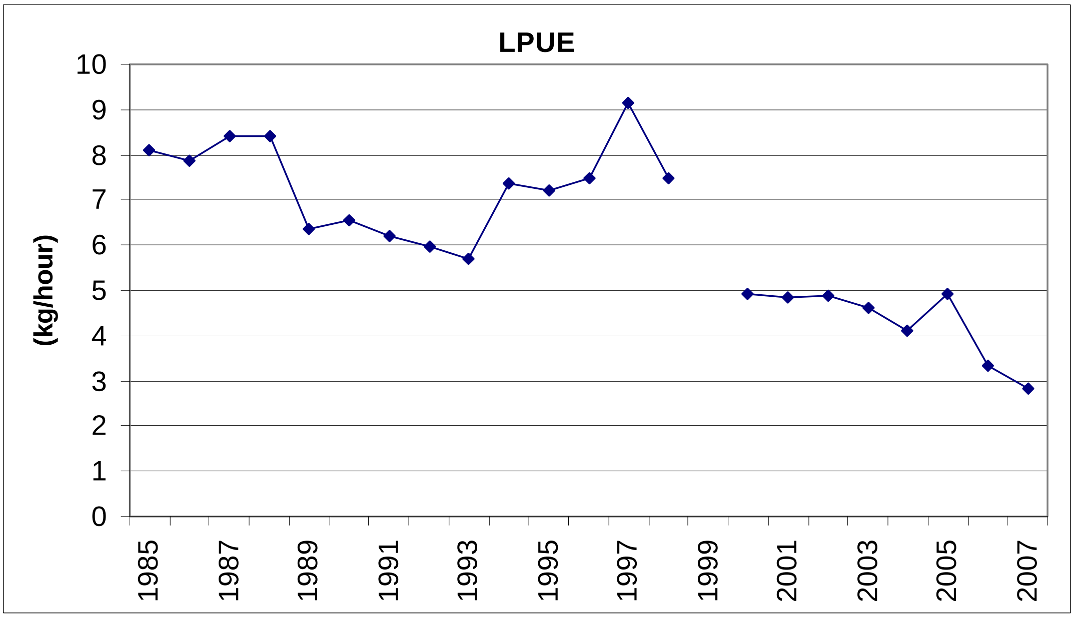
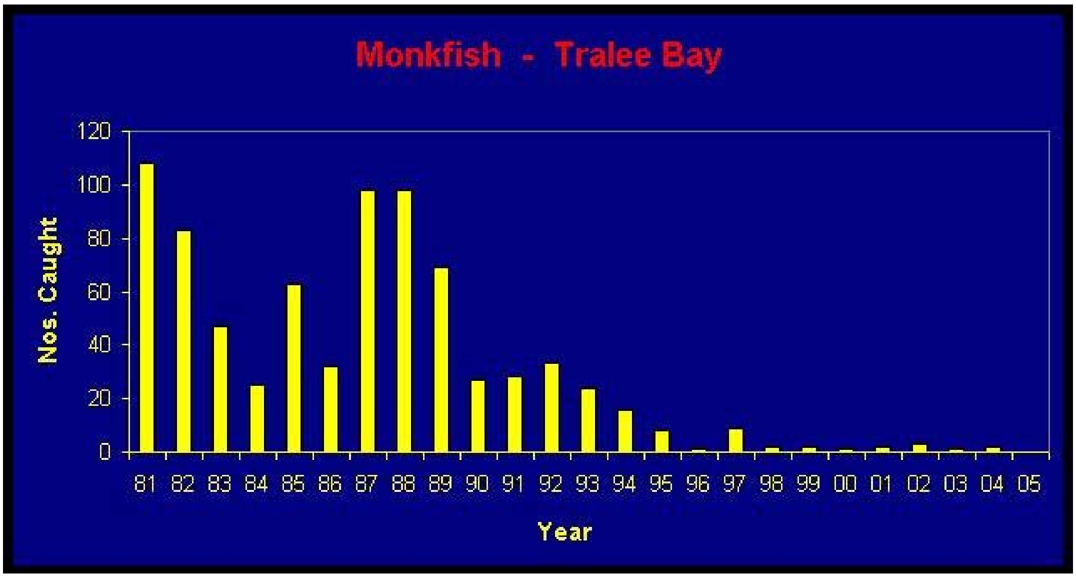


Figure 18.4b Demersal elasmobranchs in the Celtic Seas. Lpue of *Leucoraja naevus* in the Celtic Sea, from French trawlers targeting benthic species (anglerfish, megrim and rays). Data from 2000 onwards are from logbooks only.



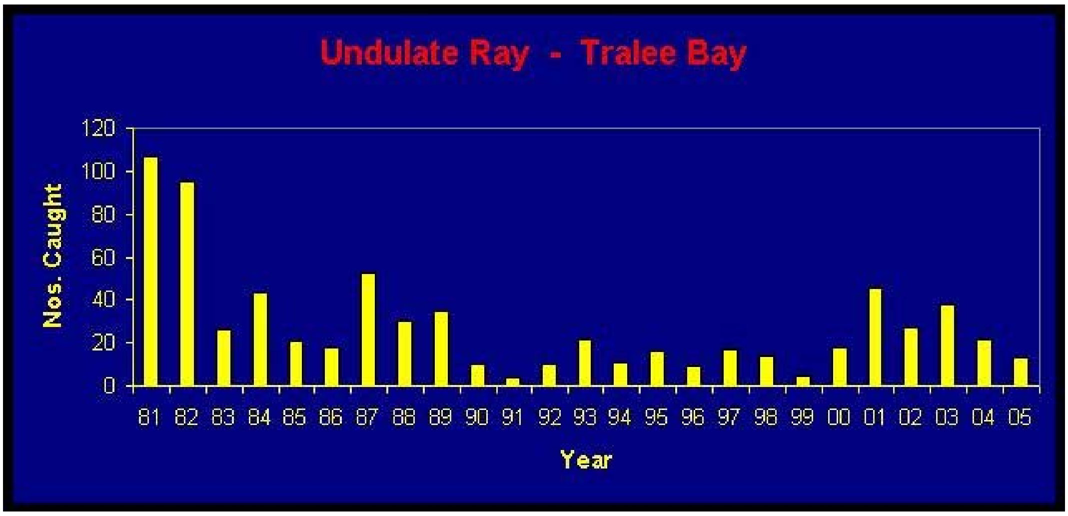


Figure 18.5 Demersal Elasmobranchs in the Celtic Seas. Angling effort of two charter boats in Tralee Bay 1981–2005 of monkfish (angel shark *Squatina squatina)* and undulate ray *R. undulata*. Source: Irish Central Fisheries Board.

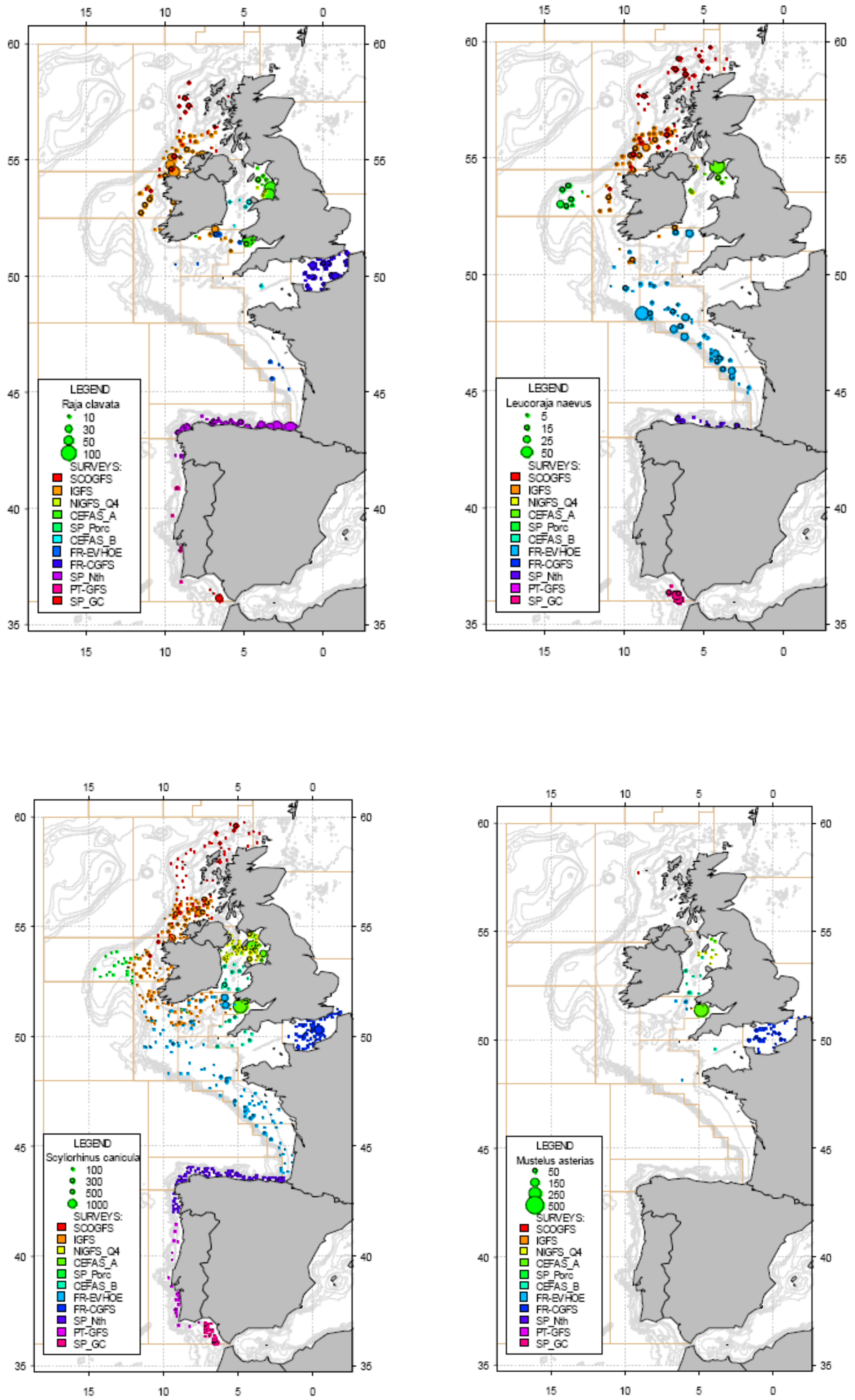


Figure 18.6 Demersal elasmobranchs in the Celtic Seas. Catches, in numbers per hour, of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, lesser-spotted dogfish *Scyliorhinus canicula* and starry smooth hound *Mustelus asterias* in Q4 IBTS surveys in the Western and Southern Areas in 2006. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey (Source: ICES, 2007).

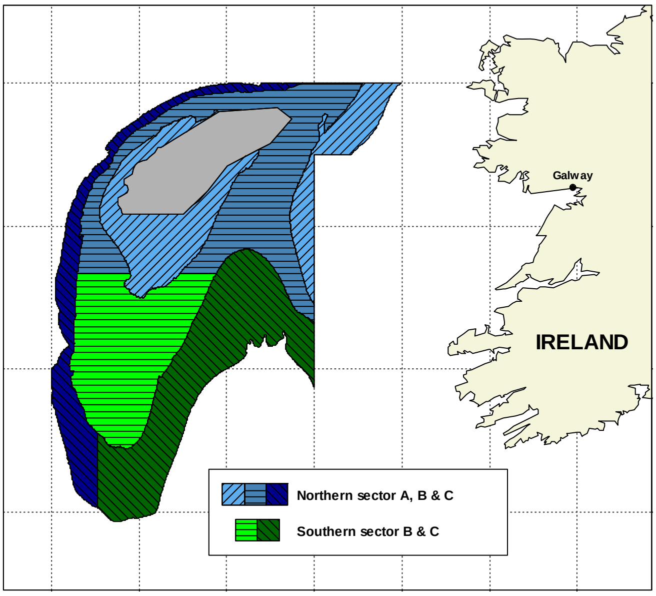


Figure18.7 Demersal Elasmobranchs in the Celtic Seas. Area covered and sampling design of Spanish Groundfish Survey in Porcupine bank. Depth strata are 190–300 m, 301–450 m and 450–800 m. The grey area in the middle of the bank corresponds to a non-trawlable rocky mound not sampled in the survey.

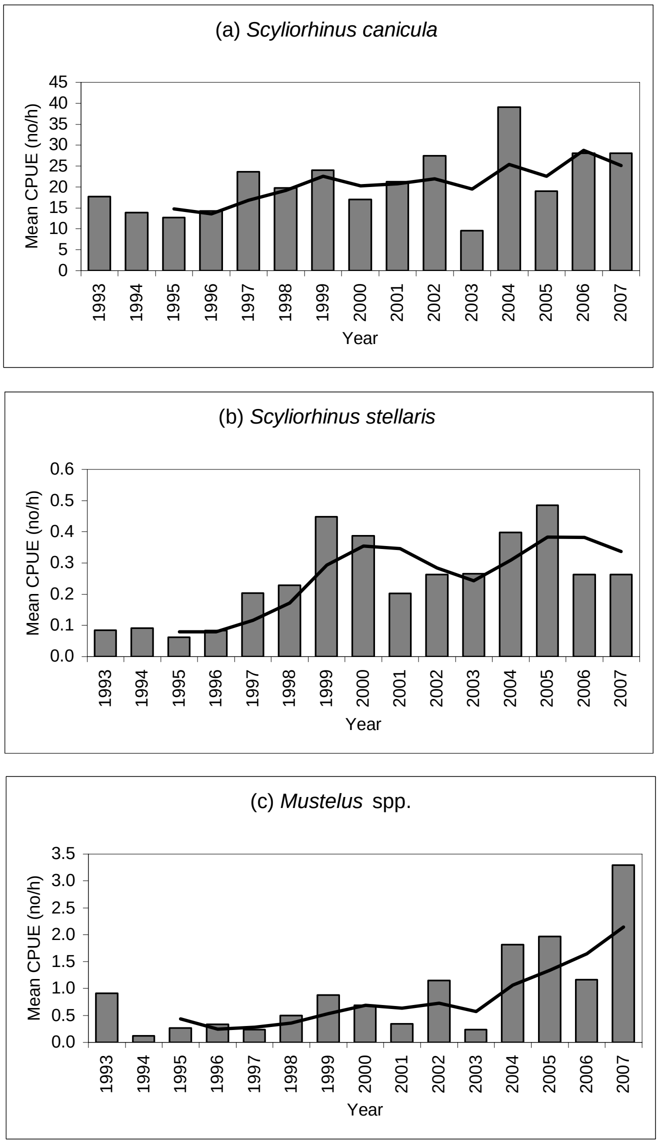


Figure 18.8. Demersal elasmobranchs in the Celtic Seas. Mean catch rates of (a) lesser-spotted dogfish, (b) greater-spotted dogfish and (c) smoothhounds from the UK 4m-beam trawl survey in the Irish Sea and Bristol Channel (1993–2007). Smoothed line is three-year moving average.

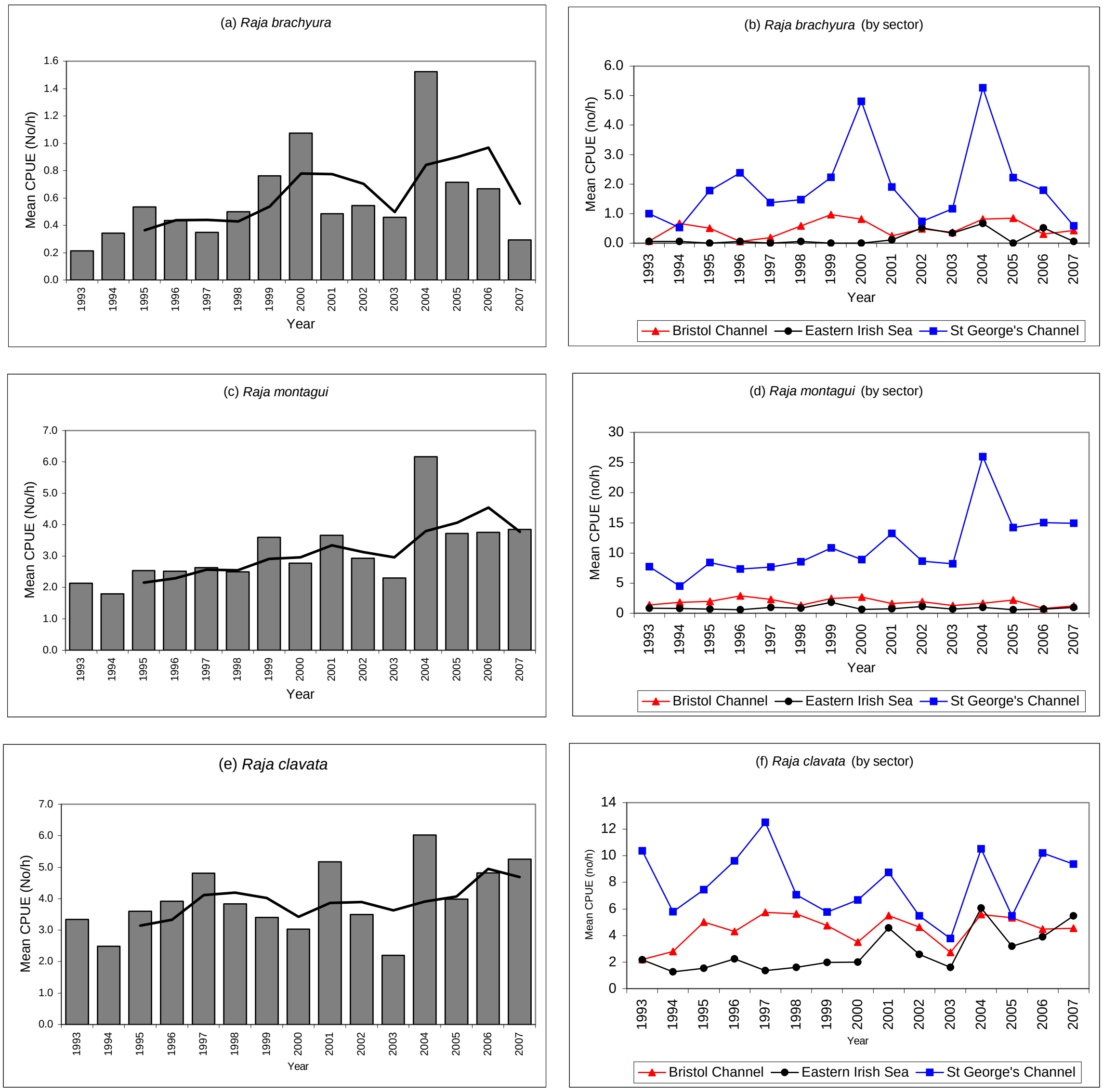
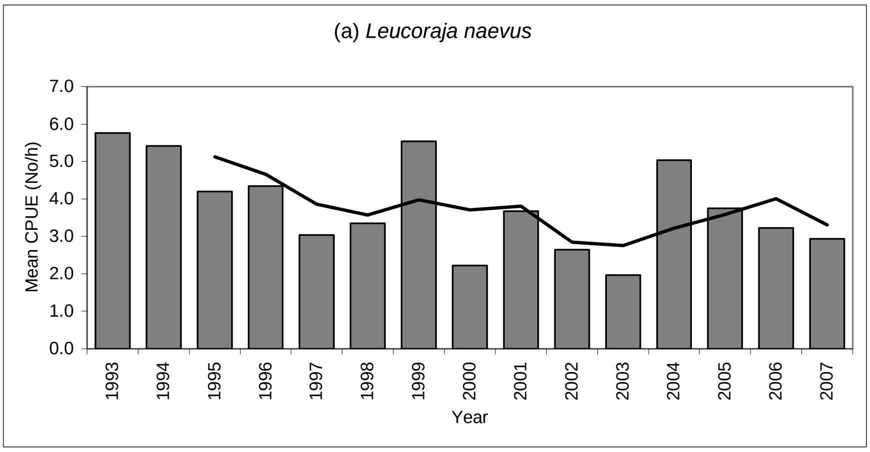


Figure 18.9 Demersal elasmobranchs in the Celtic Seas. Mean catch rates of (a–b) blonde ray, (c–d) spotted ray and (e–f) thornback ray from the UK 4m-beam trawl survey in the Irish Sea and Bristol Channel (1993–2007). Smoothed line is three-year moving average. Right hand panel shows mean catch rates by sector.



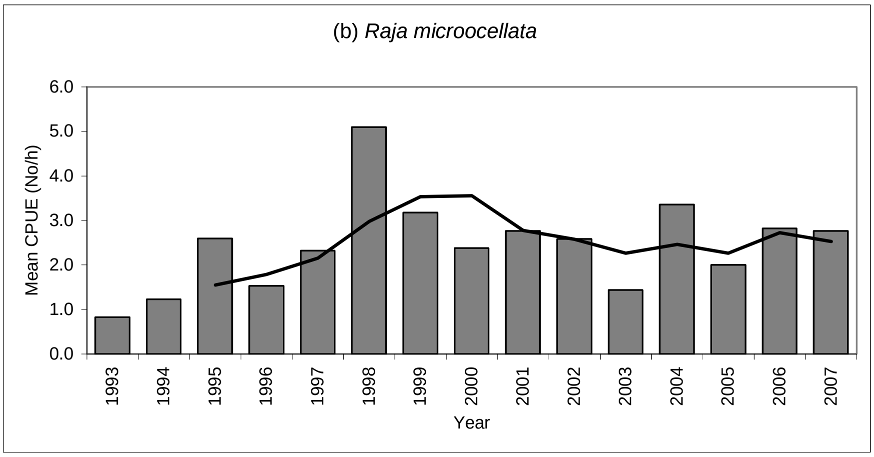


Figure 18.10 Demersal elasmobranchs in the Celtic Seas. Mean catch rates of (a) cuckoo ray (Central Irish Sea and St George's Channel) and (b) smalleyed ray (Bristol Channel) from the UK 4m-beam trawl survey in the Irish Sea and Bristol Channel (1993–2007). Smoothed line is three-year moving average.

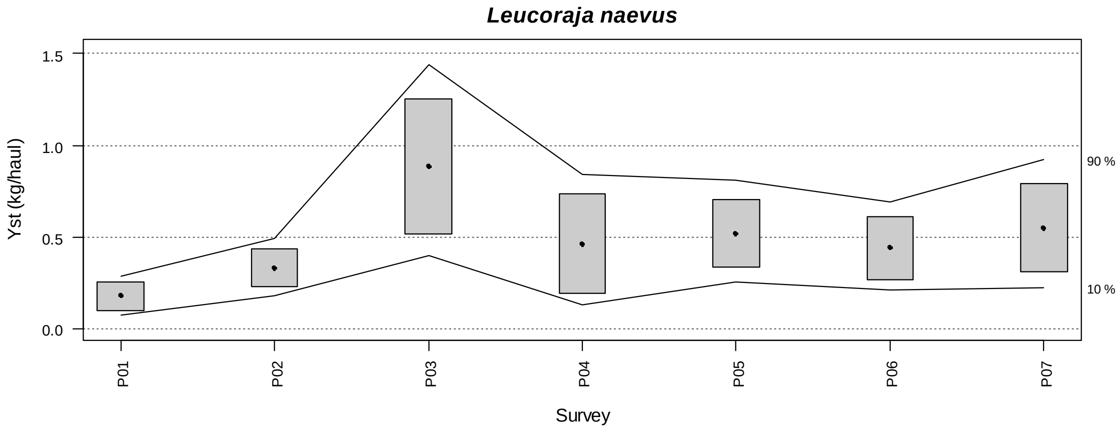


Figure 18.11a Demersal elasmobranchs in the Celtic Seas. Changes in cuckoo ray (*Leucoraja naevus)* biomass index during Porcupine Survey time-series (2001–2007). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

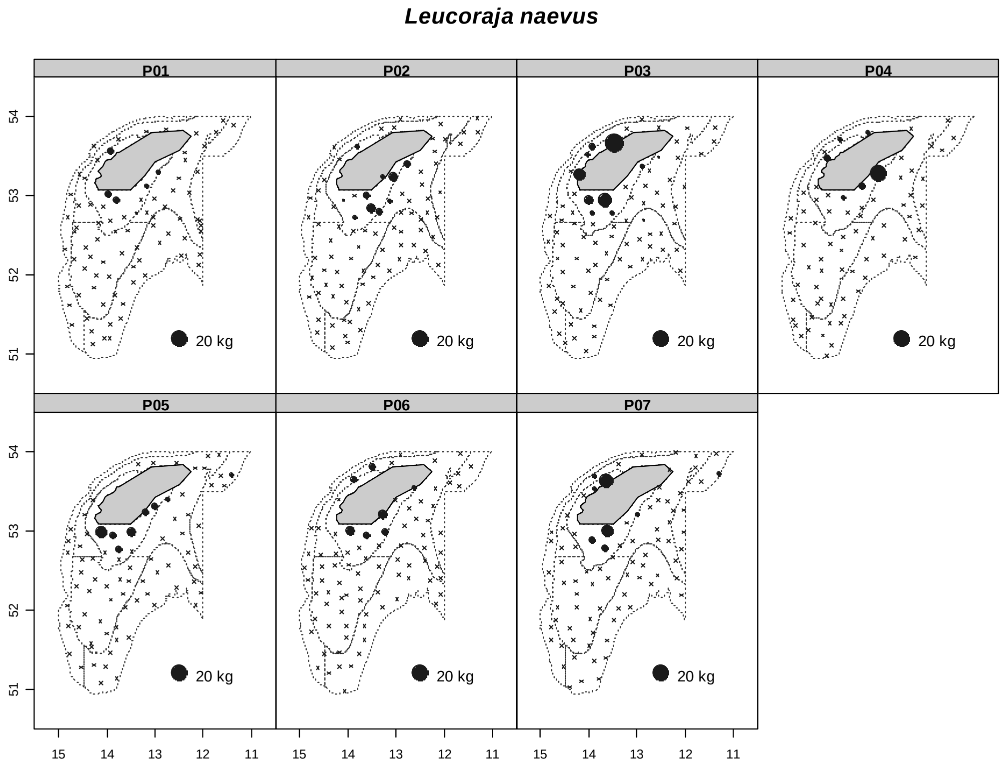


Figure18.11b Demersal elasmobranchs in the Celtic Seas. Geographic distribution of cuckoo ray (*L. naevus*) catches (kg/30 min haul) in Porcupine surveys (2001–2007).

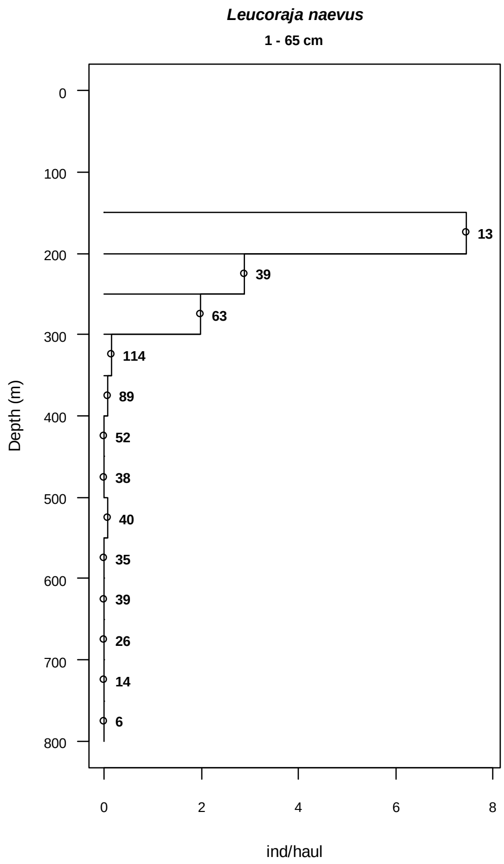


Figure 18.11c Demersal elasmobranchs in the Celtic Seas. Bathymetric distribution of cuckoo ray (*L. naevus*) catches (ind./30 min haul) by size range in Porcupine surveys as a whole. Numbers to the right of each bar correspond to the number of hauls per depth stratum.

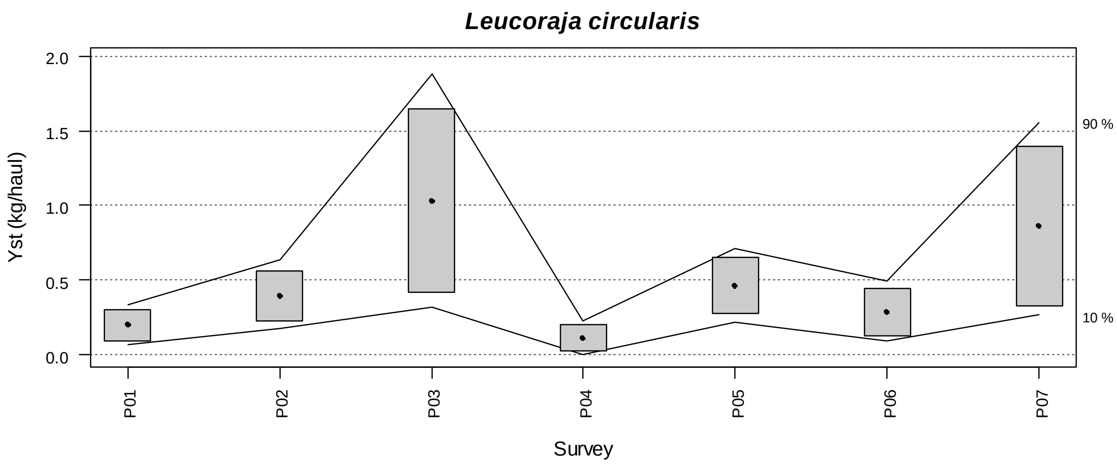


Figure18.12a Demersal elasmobranchs in the Celtic Seas. Changes in sandy ray (*Leucoraja circularis*) biomass index during Porcupine Survey time-series (2001–2007). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

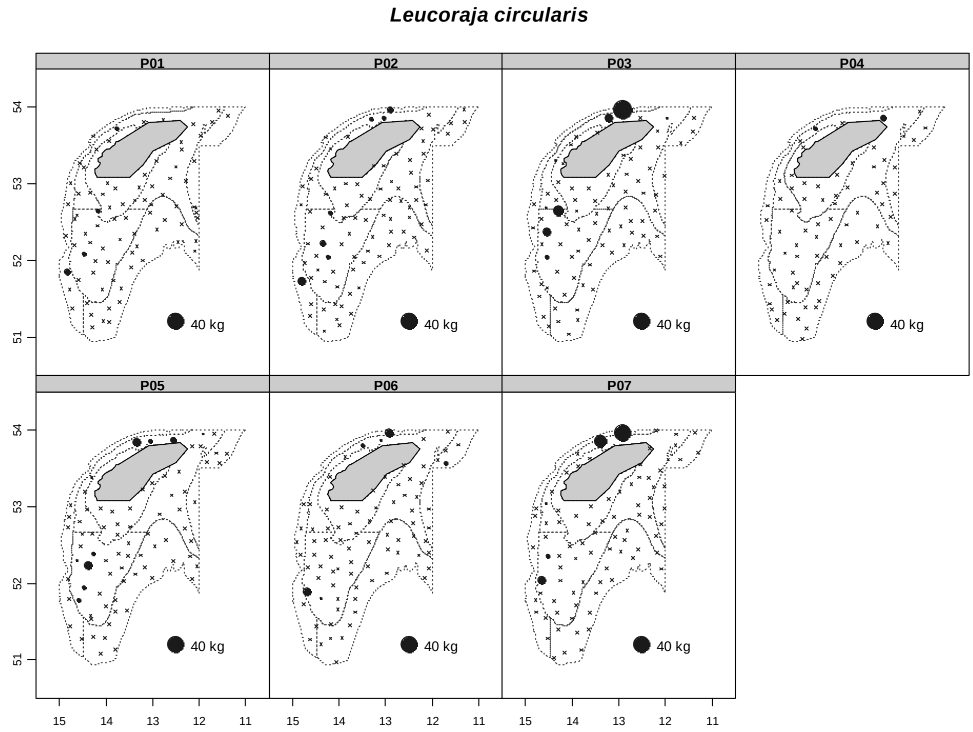


Figure 18.12b Demersal elasmobranchs in the Celtic Seas. Geographic distribution of sandy ray (*L. circularis*) catches (kg/30 min haul) in Porcupine surveys (2001–2007).

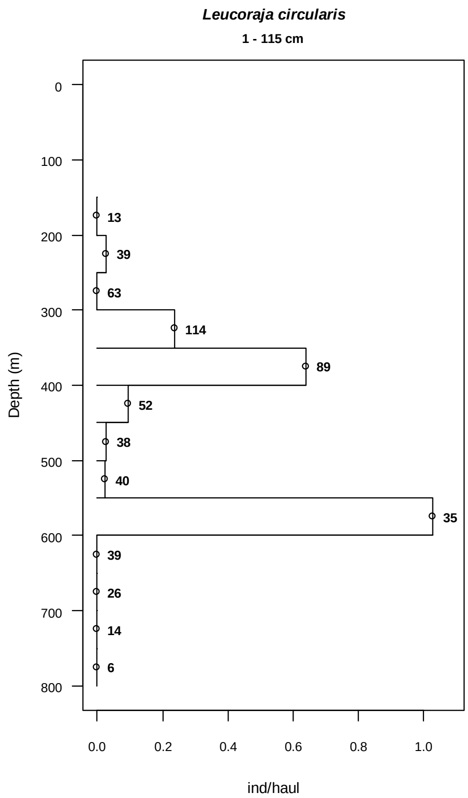


Figure 18.12c Demersal elasmobranchs in the Celtic Seas. athymetric distribution of sandy ray (*L. circularis*) catches (ind./30 min haul) by size range in Porcupine surveys as a whole. Numbers to the right of each bar correspond to the number of hauls per depth stratum.

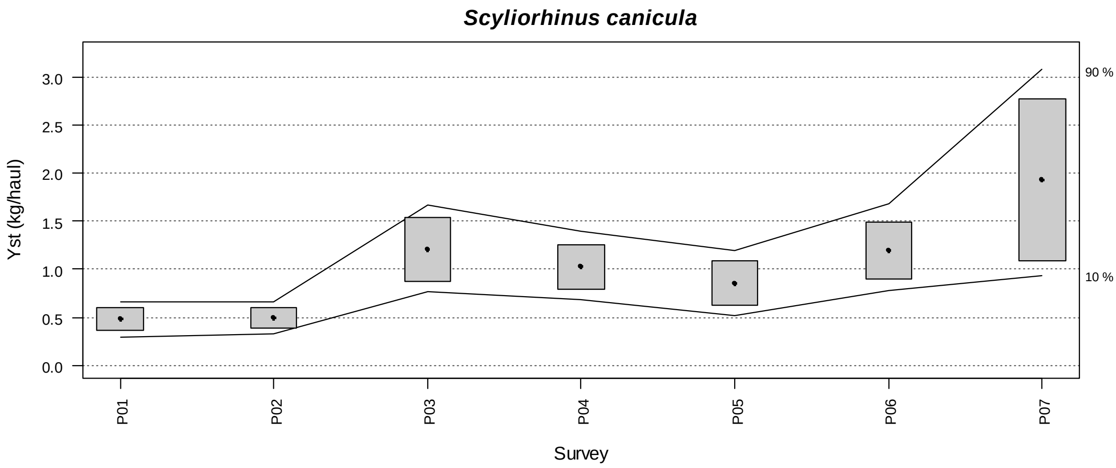


Figure 18.13a Demersal elasmobranchs in the Celtic Seas. Changes in lesser-spotted dogfish (Scyliorhinus canicula) biomass index during Porcupine Survey time-series (2001–2007). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

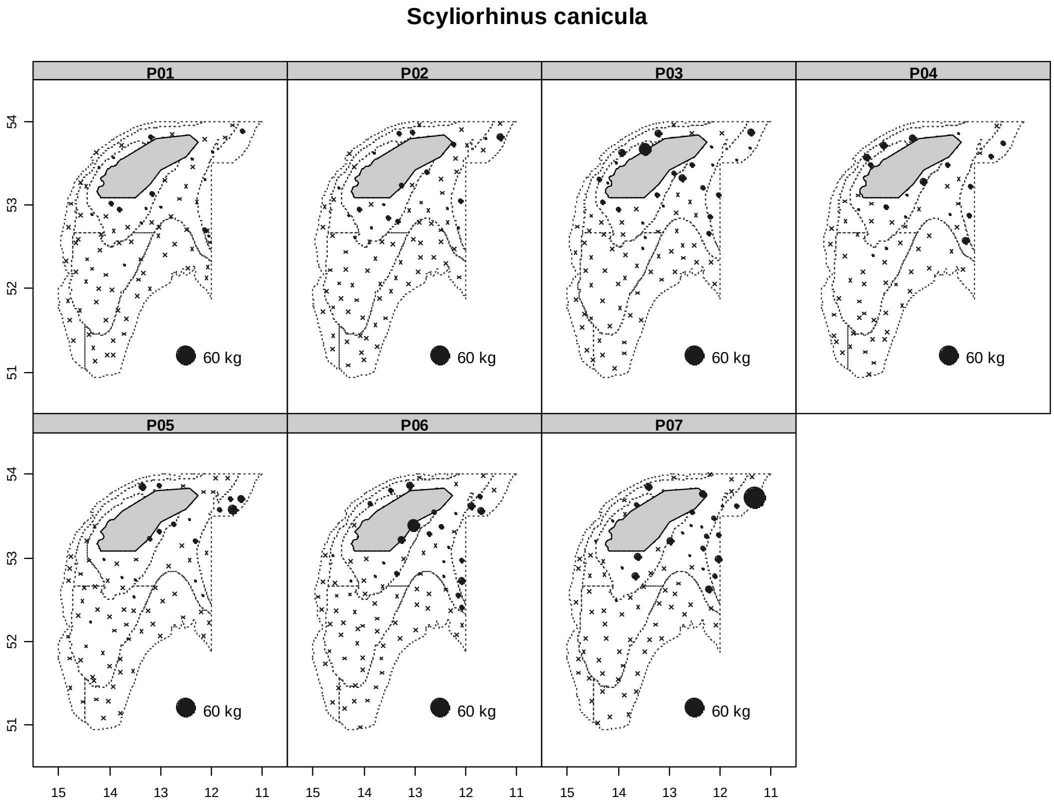


Figure 18.13b Demersal elasmobranchs in the Celtic Seas. Geographic distribution of lesser spotted dogfish (*S. canicula*) catches (kg/30 min haul) in Porcupine surveys (2001–2007).

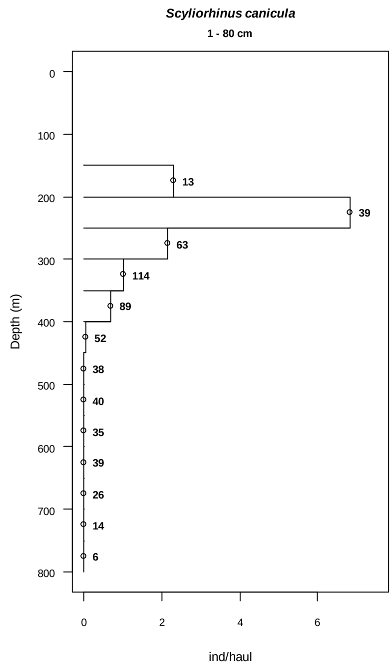


Figure 18.13c Demersal elasmobranchs in the Celtic Seas. Bathymetric distribution of lesser spotted dogfish (*S. canicula*) catches (ind./30 min haul) by size range in Porcupine surveys as a whole. Numbers to the right of each bar correspond to the number of hauls per depth stratum.

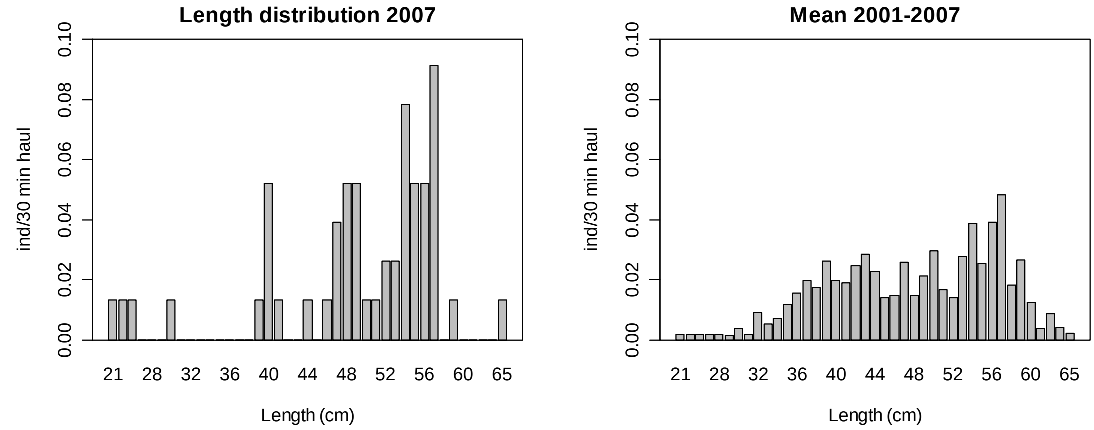


Figure18.14 Demersal elasmobranchs in the Celtic Seas. Stratified length distributions of cuckoo ray (*L. naevus*) in 2007 in Porcupine survey, and Mean values during Porcupine Survey time-series (2001–2007).

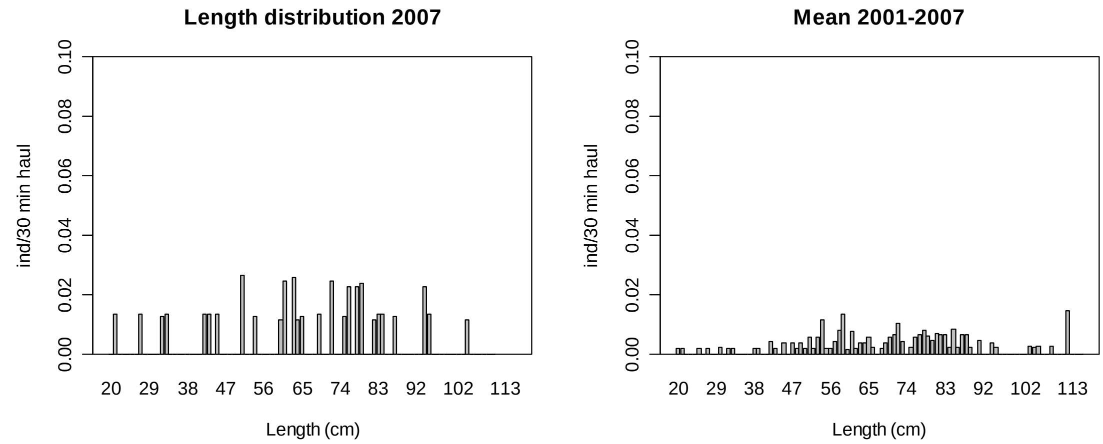


Figure 18.14b Demersal elasmobranchs in the Celtic Seas. Stratified length distributions of sandy ray (*L. circularis*) in 2007 in Porcupine survey, and Mean values during Porcupine Survey time-series (2001–2007).

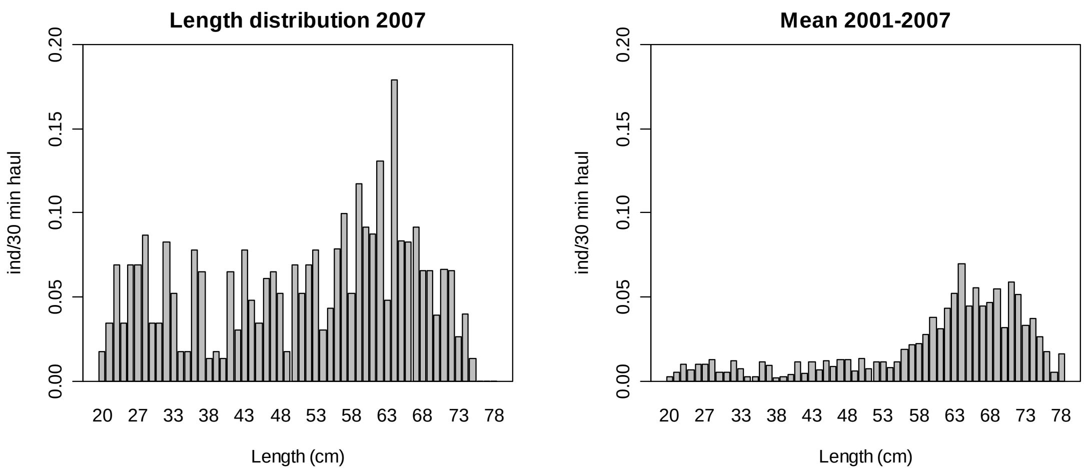


Figure 18.14c Demersal elasmobranchs in the Celtic Seas. Stratified length distributions of lesser spotted dogfish (*S. canicula*) in 2007 in Porcupine survey, and Mean values during Porcupine Survey time-series (2001–2007).

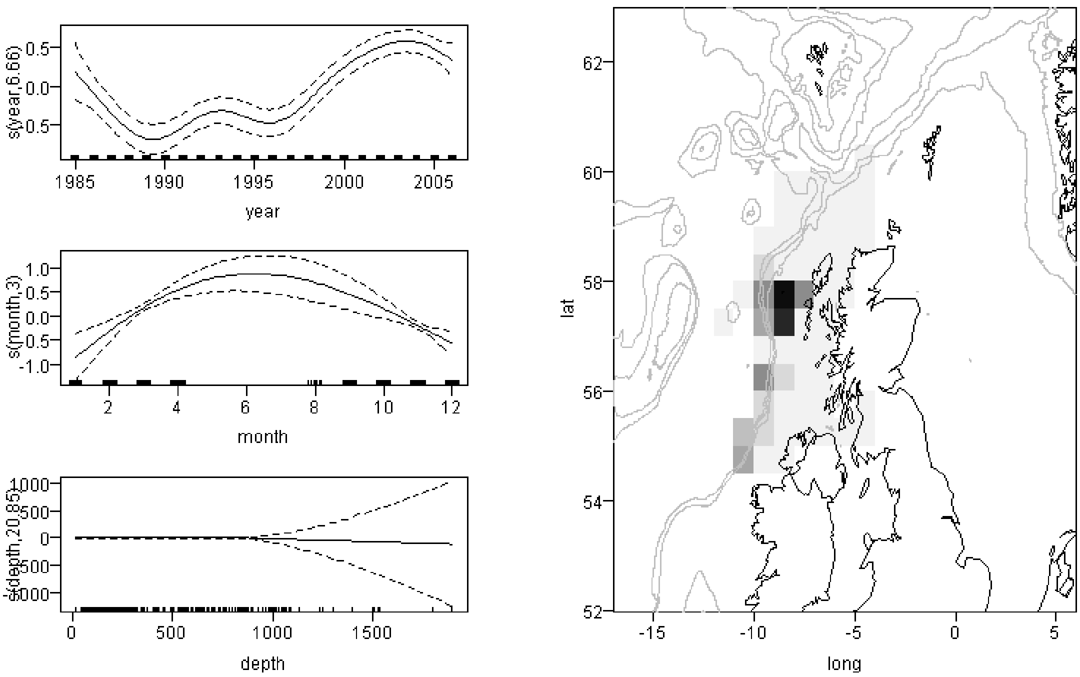


Figure 18.5a Demersal Elasmobranchs in the Celtic Seas. Thornback ray in Division VIa. Estimated effects (year, month, depth and statistical rectangle) from the GAM analysis of Scottish survey catch rate data (log scale). Models are for N/h.

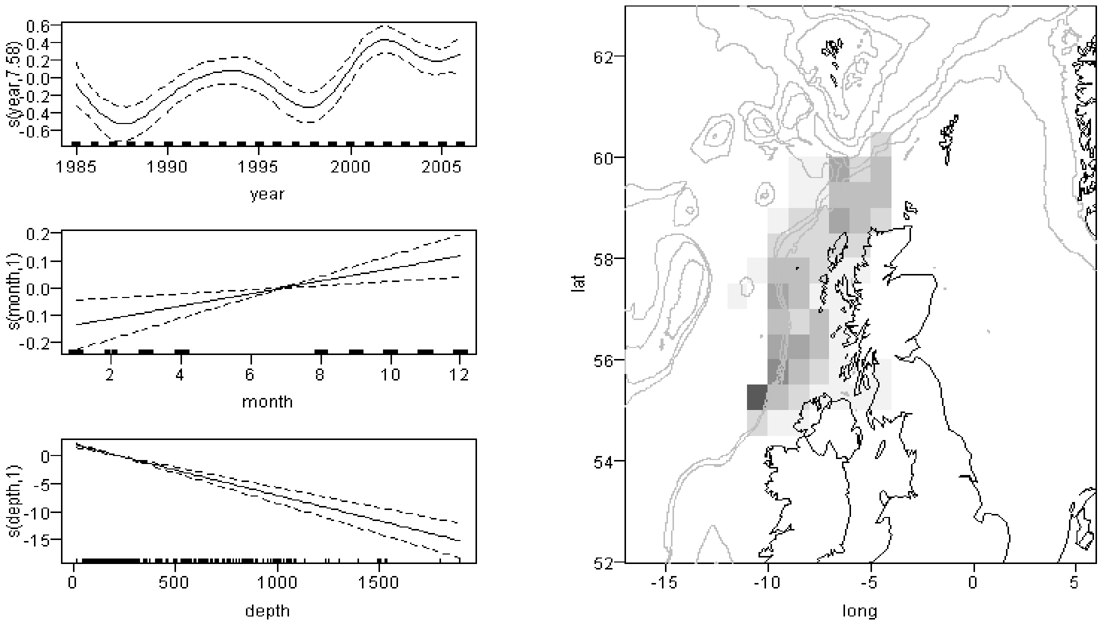


Figure 18.15b Demersal Elasmobranchs in the Celtic Seas. Cuckoo ray in Division VIa. Estimated effects (year, month, depth and statistical rectangle) from the GAM analysis of Scottish survey data (log scale). Models are of N/h.

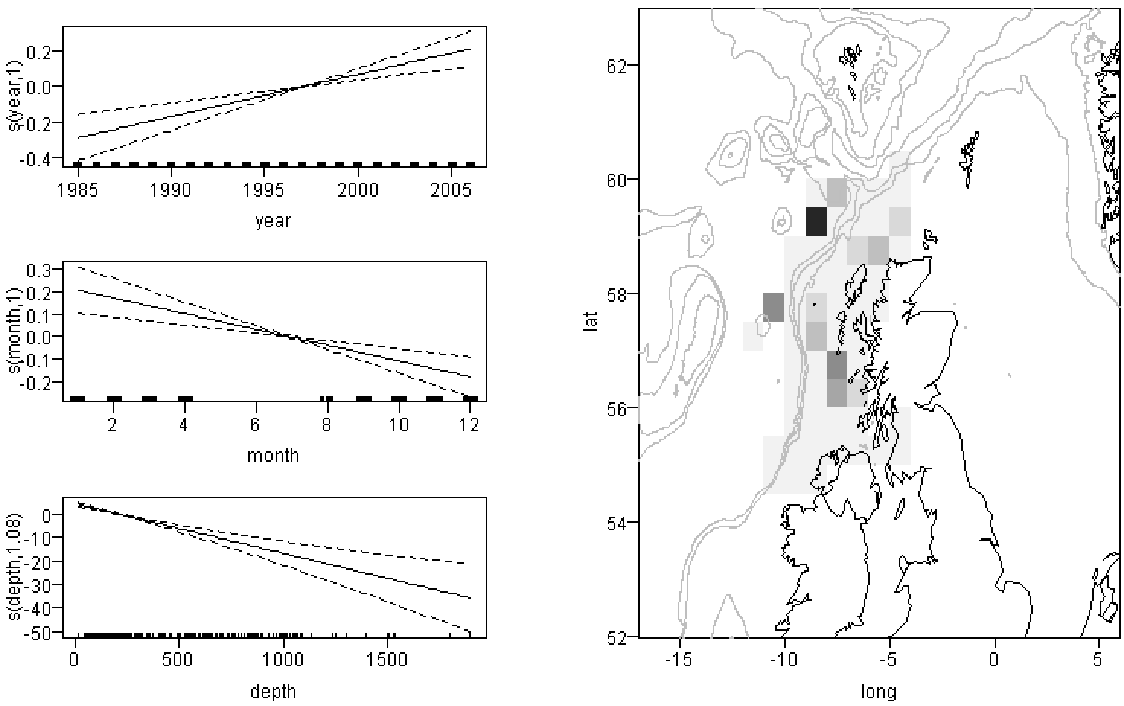


Figure 18.15c Demersal Elasmobranchs in the Celtic Seas. Spotted ray in Division VIa. Estimated effects (year, month, depth and statistical rectangle) from the GAM analysis of Scottish survey data (log scale). Models are for N/h.

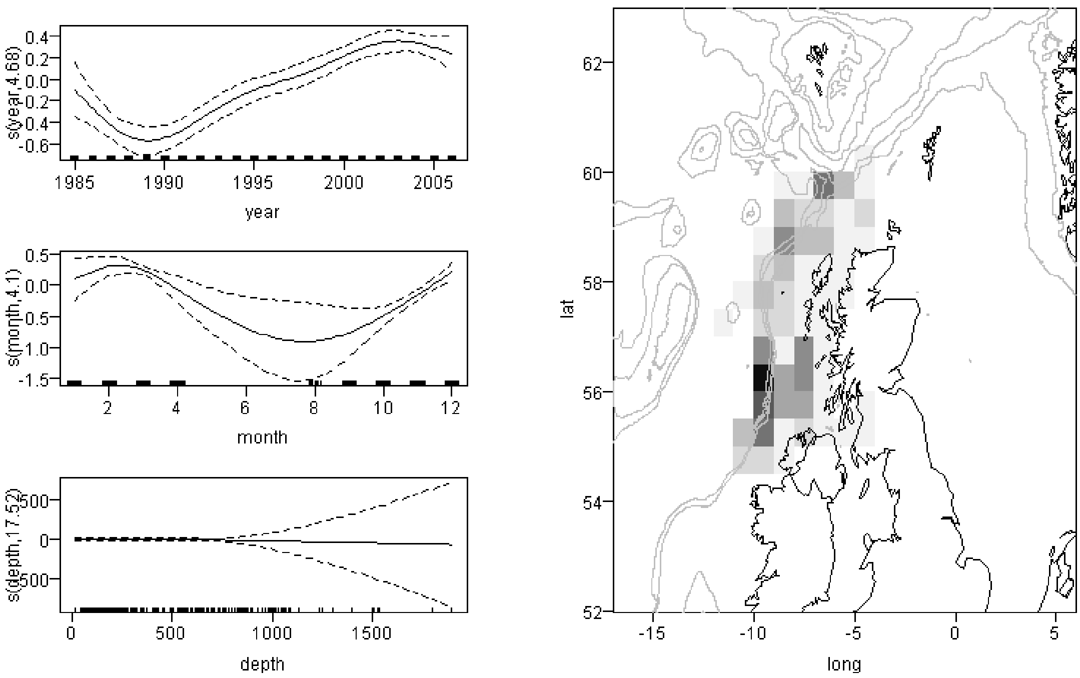


Figure 18.15d Demersal Elasmobranchs in the Celtic Seas. Lesser spotted dogfish in Division VIa. Estimated effects (year, month, depth and statistical rectangle) from the GAM analysis of Scottish survey data. (N/h).

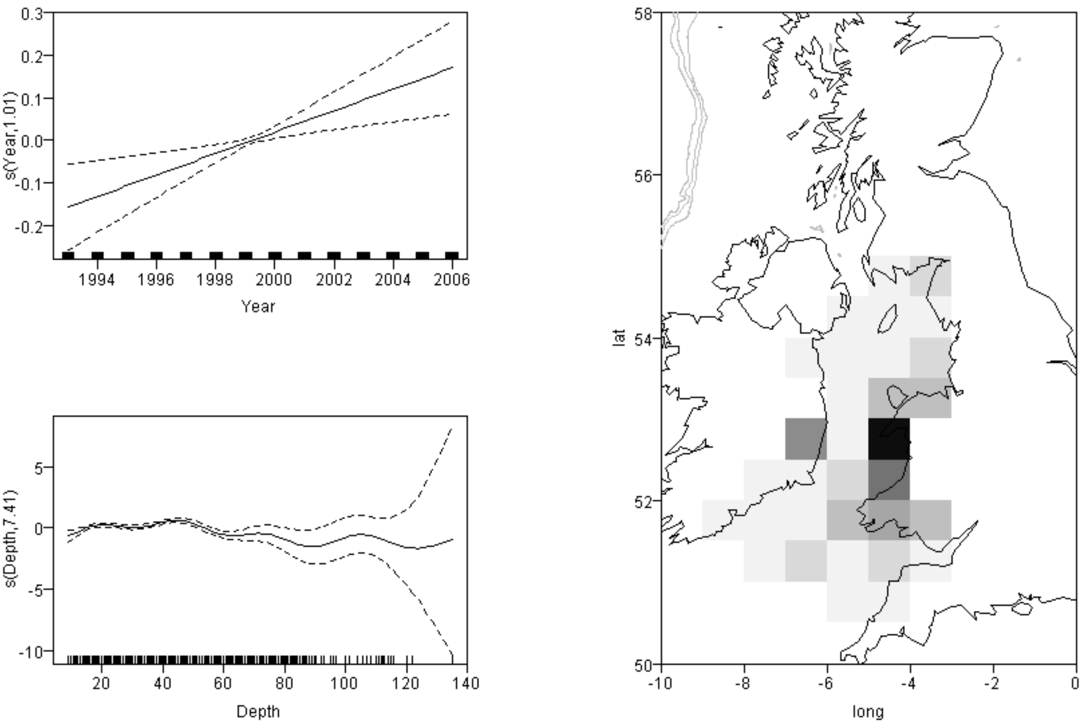


Figure 18.16a Demersal Elasmobranchs in the Celtic Seas. Thornback ray in Divisions VIIa and VIIf. Estimated effects (year, depth and statistical rectangle) from the GAM analysis of UK (E & W) beam trawl survey data (log scale). Model of N/h.

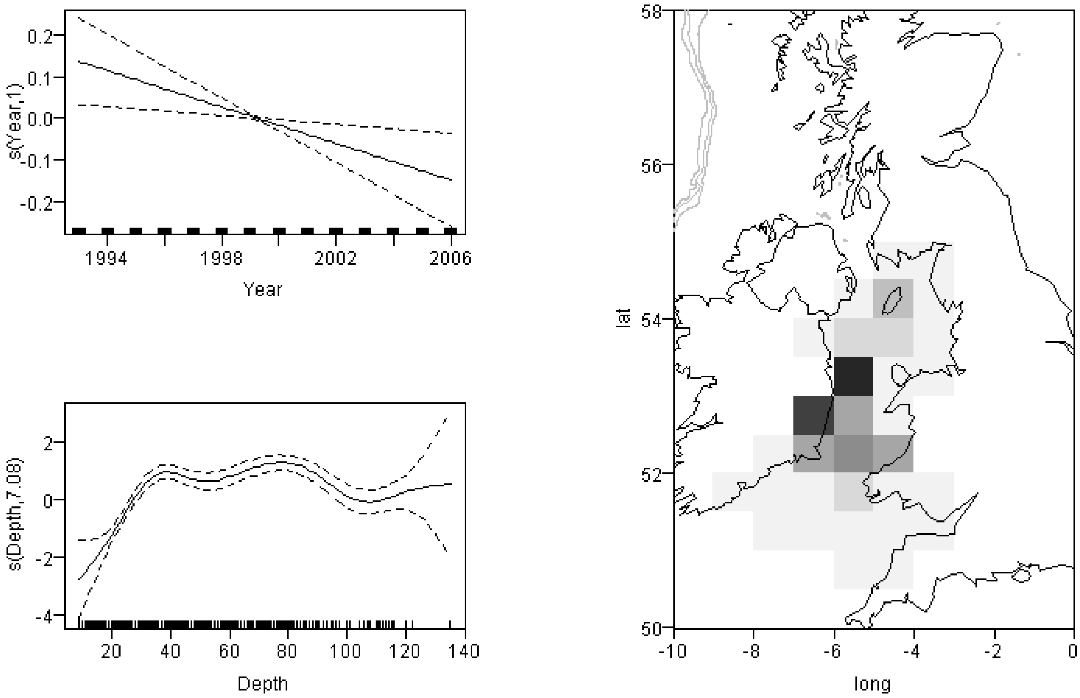


Figure 18.16b Demersal Elasmobranchs in the Celtic Seas. Cuckoo ray in Division VIIa and VIIf. Estimated effects (year, depth and statistical rectangle) from the GAM analysis of UK (E & W) beam trawl survey data (log scale). Model of N/h.

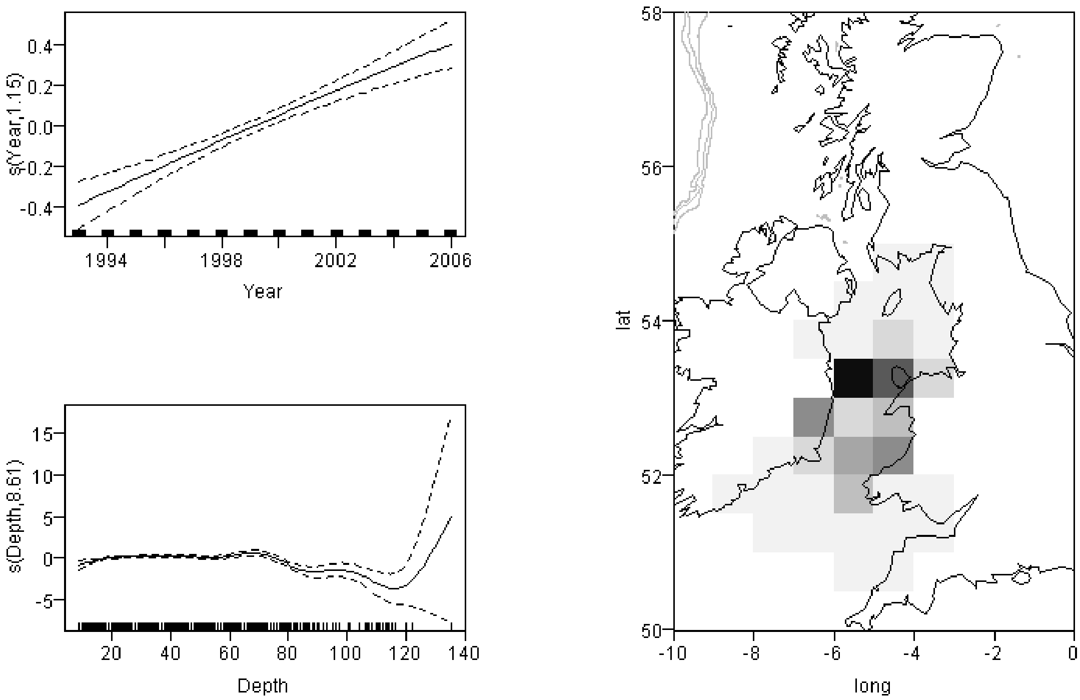


Figure 18.16c Demersal Elasmobranchs in the Celtic Seas. Spotted ray in Division VIIa and VIIf. Estimated effects (year, depth and statistical rectangle) from the GAM analysis of UK (E & W) beam trawl survey data (log scale). Model of N/h.

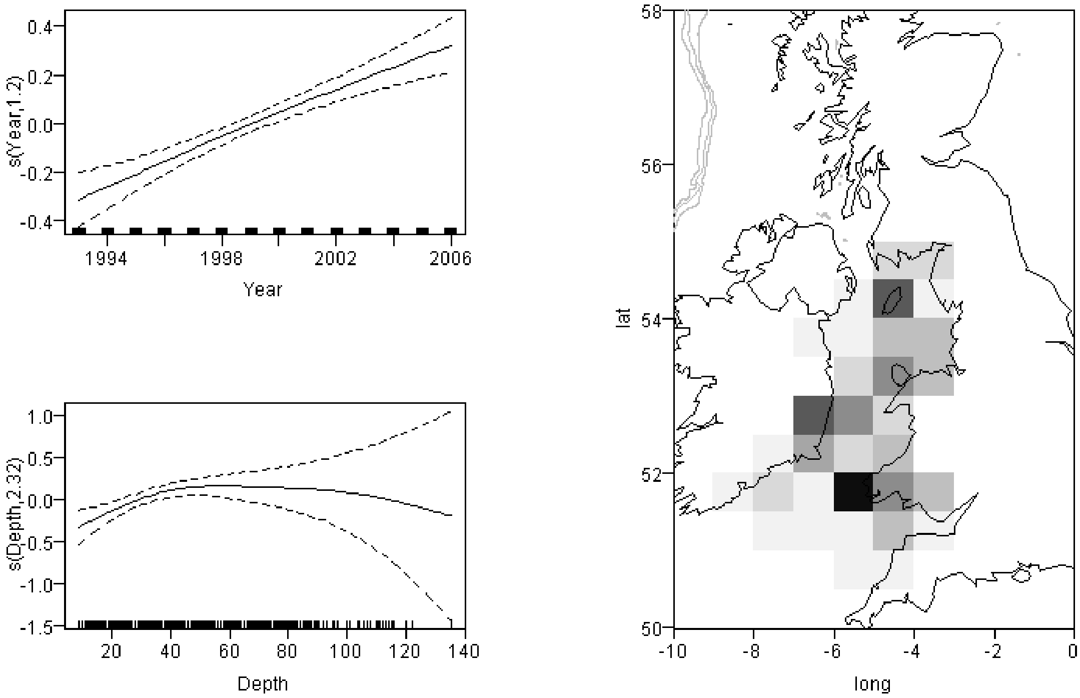


Figure 18.16d Demersal Elasmobranchs in the Celtic Seas. Lesser spotted dogfish in Division VIIa and VIIf. Estimated effects (year, depth and statistical rectangle) from the GAM analysis of UK (E & W) beam trawl survey data (log scale). Model of N/h.

19 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters (ICES Subarea VIII and Division IXa)

19.1 Eco-region and stock boundaries

The Cantabrian Sea (ICES VIIIc Division) is the southern part of the Bay of Biscay (ICES Divisions VIIIa, b, d). In contrast to the more northerly Bay of Biscay, which has a wider continental shelf with flat and soft bottoms more suitable for trawlers, the Cantabrian Sea has a narrow continental shelf with some remarkable bathymetric features (canyons, marginal shelves, etc.). In Portugal, the trawler fleet operates along the Portuguese continental coast (Division IXa), targeting a wide number of teleosts and crustaceans. Associated with these, several species of skate are also landed, mainly in the ports of Matosinhos, Peniche and Portimão.

No management stocks are defined for any of the three main demersal species landed either from the Bay of Biscay or Iberian waters. The geographical distribution of these species is fairly well known, but their stock structure is still unknown. Trying to describe the distribution of each species and to identify self-containing stocks the WGEF decided to consider the following stock units for demersal elasmobranch species in Bay of Biscay and Iberian Waters: Divisions VIIIa, b, VIIIc, VIIId and IX. The three species considered as the more valuable to assess are:

Lesser-spotted dogfish *Scyliorhinus canicula*: Populations would best be assessed as local populations, as a consequence of the availability of fisheries statistics and biological data, assessing this species within the ICES Divisions mentioned above.

Thornback ray *Raja clavata*: As biological and fisheries data are most accurate and comprehensive for the Celtic Sea (VIIe-k), Bay of Biscay region (VIII) and Portuguese Iberian waters (IXa), the same areas should be used in preliminary assessments of this species.

Cuckoo ray *Leucoraja naevus*: As biological and fisheries data are most accurate and comprehensive for the Celtic Sea (VIIe-k) and Bay of Biscay Bay (VIII), the same areas should be used as preliminary assessment areas for this species.

Other skates species in the area include blonde ray *Raja brachyura,* smalleyed ray *R. microocellata,* brown ray *R. miraletus,* spotted ray *Raja montagui,* undulate ray *R. undulata,* shagreen ray *Leucoraja fullonica,* common skate *Dipturus batis,* long-nose skated *D. oxyrinchus* and white skate *Rostroraja alba.* In terms of demersal sharks, spurdog (Section 2) and tope (section 10), blackmouth catshark *Galeus melastomus,* smoothhounds (*Mustelus asterias* and *M. mustelus*) and angel shark *Squatina squatina* also occur. The biology and stock structure for many of these species is less well known.

19.2 The fishery

19.2.1 History of the fishery

In order to facilitate the reading of this section the structure of text includes separate fishery descriptions for the three main countries involved in the area (Spain, Portugal (mainland) and France).

Spain

The Spanish demersal fishery along the Cantabrian Sea and Bay of Biscay takes many species of skates with a wide variety of gears, but most of the landings come from the bycatch of fisheries targeting other demersal species such as hake, anglerfish and megrim. Although a wide number of skates and demersal sharks can be found in the landings, historically the most commercial elasmobranchs are two species of skate (*L. naevus* and *R. clavata*) and lesser-spotted dogfish. The fact that some elasmobranchs have a low commercial value and are taken as a bycatch means that traditionally these species were landed together in the same category.

Mainland Portugal

Off mainland Portugal (IXa), lesser-spotted dogfish is caught mainly by coastal trawlers and by the artisanal fishing fleet. This species, along with greater-spotted dogfish *S. stellaris,* are landed in the major ports of Division IXa under the generic name of *Scyliorhinus* spp. Although it is believed that *S. canicula* is the dominant species in the landings, the composition of this mixture is not known.

Skates and rays are captured mainly by the artisanal polyvalent fleet, which primarily uses trammelnets. The artisanal fleet also use different types of fishing gear, such as longline and gillnet, and account for the highest landing records (75% of the annual skate and ray landings). The mixed nature of the fisheries catching skates and rays pose serious problems on the estimation of important fishery parameters.

French skate fisheries

Skates are a traditionally food resource in France, and France has had directed fisheries for skates since the 1800s. Since the 1960s, skates have been taken primarily as bycatch of bottom-trawl fisheries operating in the northern part Bay of Biscay, the southern Celtic Sea and English Channel. *Raja clavata* was often the target of directed seasonal fisheries in the past, and was the dominant skate in the French landings, but in the 1980s *L. naevus* replaced *R. clavata* as the dominant skate. The landings of both have declined since 1986. Landings of *L. naevus* declined from about 6000 t in 1986 to 1605 t in 2007, and that of *R. clavata* from about 3000 t in 1986 to 371 t in 2007 (noting that 2007 data are preliminary data).

Other skates are also landed include sandy ray *Leucoraja circularis*, *L. fullonica*, smalleyed ray *Raja microocellata, D. batis* and *D. oxyrinchus. Rostroraja alba* is now rarely caught.

19.2.2 The fishery in 2007

No new information.

19.2.3 ICES advice applicable

ICES has never provided advice for the demersal elasmobranchs in the Bay of Biscay and Iberian Waters (ICES Subarea VIII and Division IXa).

19.2.4 Management applicable

No new information.

19.3 Catch data

19.3.1 Landings

Skate and rays landings for the period 1996–2006 are given in Table 19.1a–e. Historically the main countries reporting international landings since 1973 in Subarea VIII are France, Spain and Portugal.

Historically French and Spanish (Basque Country) skate and rays landings come mainly from Divisions VIIIa, b although Spanish landings are more important in Division VIIIc. Landings of skates since 1973 display no clear pattern, although there was a remarkable peak in landings in the earlier years (1973–1974) and from 1982–1991. The reduction in observed landings from 1992–1995 coincides with a misreporting period of Spanish landings, but from 1996–2006 the annual landings seem to have stabilized at 4000–5000 t (Figure 19.1). After a revision of historical data, important changes can be found in the French landings of skates since 1996. It is noticeable that the French landings of skates in Subarea VIII in 2007 are 53% less than in 2006 and the lowest ones since 1973 (Table 19.1). Further analyses of these data are required next year, as 2007 data are provisional and not all nations have reported landings.

The annual landings of skates and rays by Portugal in Subarea IXa remain stable since 1996, at around 1500 t. Some other countries, such as Belgium, Netherlands and UK, have minor skate landings in these areas.

Landings of lesser-spotted dogfish reported to the WG are demonstrated in Table 19.2. As for skates, French and Spanish (Basque Country) landings of lesser-spotted dogfish come mainly from Divisions VIIIa, b. Spanish landings of lesser-spotted dogfish for 2007 were not available for the Working Group (Table 19.2c). Until 2004, all the Portuguese landings of this species (around 600–700 $t.y^{-1}$) were from Division IXa, but an important reduction of this country’s landings can be observed since 2005. The total historical landings of lesser-spotted dogfish in Biscay and Iberian waters have been quite stable since 1996, at about 1500 $t.y^{-1}$ and a peak between 1997 and 1999 (Table 19.2; Figure 19.2). Until the missing data of 2007 is available is not possible to extend the trend analysis to this year.

The information about the historical landing series of other elasmobranch species such as smoothhounds and angel shark are poor. Of these species, only smoothhounds are landed in significant quantities in Subarea VIII, mainly by the French and Spanish fleets from 2000–2007 (on average 375 $t.y^{-1}$ for both countries combined). There has been a noticeable increase in landings of *Mustelus* spp. in French landings in Division VIII since the mid-1990s (Tables 19.3a, b, c). In Division IXa a slight increase of landings of smoothhounds by the Portuguese fleet is observed in 2007, reaching 45 t.

Angel shark landings in Subarea VIII have always been very low, and after the revision of French data the historical series, no significant landings can be found in this area (Table 19.4). In Subarea IX, 66 t of this species were reported in 2002 by the Spanish fleet and no recent data are available.

New species-specific landings for Subarea VIII and Division IXa have been provided in 2007 by some countries (France, Basque Country (Spain) and Portugal). According to these data (Table 19.5) the most important species landed in last years in decreasing order are *L. naevus, R. clavata, R. brachyura, R. undulata, R. montagui, R. microcellata* and *L. circularis*.

19.3.2 Discards

Updated information of demersal elasmobranch discards were presented in a Working Document by Diez *et al*., 2006 and demonstrated in this section. The discards were estimated by observers on board “baka” trawlers and Very High Vertical Open Pair Trawler (VHVOP) operating in Area VIII. A subsample of every catch was taken in each haul. The species in the subsample were identified and weighted and the partial weight of each species was raised to the total catch of the haul and trip. For each fleet the average of biomass discarded by trip was raised to the total annual trips.

Baka trawler fleet

The most important species discarded for this fleet was lesser-spotted dogfish. Maximum discard estimates (654.4 t) were reached in 2004, and in 2005 and 2006 the discards of this species decreased strongly. Blackmouth catshark was only discarded in significant amounts in 2004 (226.8 t). Small individuals of *L. naevus* and *R. clavata* are usually discarded by the Baka trawler fleet, although the general trend is a decrease since 2004 (Table 19.6a).

VHVOP fleet

The elasmobranch catches and landings of VHVOP operating in Division VIIIc are historically scarce. The information available indicates that *L. naevus* was discarded only in Division VIIIa, b, d in 2003. No discards or catches were recorded in 2004 and 2005 respectively.

Lesser-spotted dogfish in Division VIIIa, b, d is usually retained and, as for "baka" trawler fleet, only smaller specimens are discarded (Table 19.6b).

19.3.3 Quality of the catch data

It is important to highlight, in the analysis of landings in 2007, that some countries have not had available the information of landings on time for the WG or they have been considered as preliminary data. Because of this, the landings recorded in 2007 in all Iberian waters (and especially in Subarea VIII) are much lower than those of previous years. Commercial landings of skates are not reported on a species-specific basis (although there is market sampling to collect species composition data).

19.4 Commercial catch compositions

19.4.1 Species and size composition

No new commercial information was presented.

The size compositions of *S. canicula*, *R. clavata* and *L. naevus* from the Spanish IEO Q4-IBTS survey in the Cantabrian Sea and Galician waters is presented in this Section (see Figures 19.2a, 19.2b, and 19.2c). See Section 19.6.1 for a description of the survey series.

19.4.2 Quality of the catch data

Despite last years advances in the quality of the sampling, there is difficulty in getting reliable information about species composition of skate landings in Divisions IXa and VIII in recent years. To solve this problem the estimates of specific composition of landings rays of some countries (Portugal and Spain (Basque Country)) are based in the proportions of each species obtained by means of specific sampling carried out in previous years (see foot note in Table 19.5).

19.5 Commercial catch-effort data

An update of nominal lpue data of the Basque Country's baka trawler fleet operating in Divisions VIIIa, b, d has been presented this year.

The lpue data are referred to the main elasmobranch species landed by the fleets: lesser-spotted dogfish, rajids (mainly *L. naevus* and *R. clavata*) and spurdog.

Effort for each fleet was obtained from the information provided yearly by the logbooks filled out by the skippers of most of the ships landing in Ondarroa (ON) port. Effective fishing effort for each fleet was calculated using the following formula:

Effort = fishing days = trips * (mean days/trip)

On average, landings of lesser-spotted dogfish from this fleet have been 249 $t.y^{-1}$, and the highest lpue (157 kg/day) was recorded in 2002. This has since decreased and was 91 kg/day in 2007.

The highest lpue values for rajid skates was reached in 1998 (199 kg/day), but since this year a continuous decrease has been observed. Landings of spurdog in VIIIa, b, and d have been historically very scarce, that is why the lpue of this species are very low and in 2007, the lowest of the series only 0.3 kg/day were reached.

A historical series of cuckoo ray lpue from French bottom trawlers targeting anglerfish, megrim and skates in the Bay of Biscay was also presented to the Working Group. It is observed a continuous decline in the lpue and landings of this species from 1985–1992, which is in agreement with the trend observed in Basque trawler fleet operating in the same area, and a gradual decline in lpue from 2002–2007 (Figure 19.3).

19.6 Fishery-independent surveys

Updated information from the Spanish IEO Q4-IBTS survey in the Cantabrian Sea and Galician waters is presented in this section.

19.6.1 Surveys of the Cantabrian Sea

Spanish IEO Q4-IBTS survey in the Cantabrian Sea and Galician waters has covered this area annually since 1983 (except in 1987), obtaining abundance indices and length distributions for the main commercial species. Survey design (Figure 19.4) is random stratified with number of hauls allocated proportionally to strata area, and it includes five geographical sectors and three depth strata which were changed in 1997 after studies of fish community distributions. It covers depths of 70–500 m, with special hauls in shallower and deeper grounds. The gear used is a "baca" trawl 44/60 (ICES, 2002b) with an inner 20 mm liner covering the codend, 2 m vertical opening, ca. 19 m horizontal opening and ca. 105 m door spread.

Lesser-spotted dogfish abundance levels in Division VIIIc remained stable in the time-series, but increased strongly since 2006 in Division IXa (Figure 19.5). *R. clavata* in Division VIIIc demonstrates an increasing trend since 1995, with peaks in 2000, 2001 and 2006, and no clear trends can be observed in Division VIIIc (Figure 19.6). Although the abundance of *L. naevus* has been variable it demonstrates an increasing trend from 1997 to 2001 and from 2003 to 2005 (Figure 19.7).

The geographic distribution of these three species along the Cantabrian Sea (Division VIIIc) is shown in Figures 19.8a, 19.8b, and 19.8c. Although they are widely distributed in the study area, they seem to be more abundant in the mid-east part of the VIIIc, especially for lesser-spotted dogfish.

19.7 Life-history information

No new information is available for the WGEF 2008.

The tagging programme carried out since 1993 by the IEO in the Cantabrian Sea is still active, but there is not new information about the recapture rates since 2006.

19.8 Exploratory assessment models

19.8.1 Previous assessments

No new information is available for the WGEF 2008.

19.8.2 Exploratory analyses

No new assessments were conducted during this WG, although preliminary analyses of survey data (see above) and catch rates were undertaken.

Updated information of trawler fleet confirmed that the lpue for *S. canicula* in Divisions VIIIa, b, d have been increasing from 1994 to 2006. However a slight decrease in lpue is observed in 2007. This information suggests that in recent years the population of *S. canicula* in Subarea VIII may be increasing, or at least is in a stable condition, as also indicated by bottom-trawl survey indices.

On the other hand, the information from Subarea IXa indicates a slight decrease of landings since 1998, although this reduction is more noticeable since 2004. The year 2007 cannot be incorporated to the analysis because some countries were not able to provide landings data in time for the meeting. Although in this area, lesser-spotted dogfish is essentially a bycatch from other fisheries, so the decrease on landings registered during the last two years could be related to changes in the effort distribution targeting different species, and to better discrimination of the species at Portuguese landing ports.

In VIIIc, although landings reported do not demonstrate clear trends, results obtained from surveys carried out in this area indicate an increase of *R. clavata* biomass since 1996. Less clear is the situation of *L. naevus*, demonstrating continuous peaks in the biomass index since 1988, although an overall view of historical series of biomass index seems to indicate a continuous, but slight, increase of abundance.

Data on skates and rays from surveys in Subarea IXa were available (Bordalo-Machado and Figueiredo, 2006), but they proved to be inadequate for abundance estimation. According to the landings data, the situation of skate stocks in the area seems to be stable until 2006, ranging between 1300–2000 t since 1996, with an average of 1666 $t.y^{-1}$.

The state of other elasmobranchs stocks (smoothhounds and angel shark) is less clear as a consequence of the relative low amount of landings reported, the short length and the gaps in the historical series, and the difficulties in separating the two species of smoothhound. Taking all these aspects into consideration, the available landing data of smoothhounds (*Mustelus* spp.) demonstrated that landings in Subarea VIII have been increased steadily since 1996, from 151 t to 397 t. In Subarea IX, *Mustelus* spp landings have been stable since the maximum recorded in 1999.

However, in order to clarify these considerations, better information on species composition of landings (especially for skates and rays) in Subarea VIII is necessary.

19.9 Quality of assessments

No stock assessments have been conducted. More information on the stock identity is required. The absence of species-specific landings for skates is problematic, although estimates of species composition are available for recent years.

19.10 Reference points

No reference points have been proposed for the stocks in this ecoregion.

19.11 Management considerations

According to the historical series on landings and the information available from the surveys, Lesser-spotted dogfish and rays (*L. naevus* and *R. clavata*) stocks in divisions VIIIc and IXa seem to be stable or slightly increasing in abundance. Skates in ICES Subarea VIII seem to be decreasing in abundance, according to the landings time-series and lpue.

The situation and structure of the stocks of other elasmobranch species less frequent in the landings (e.g. *Squatina squatina*) remains unknown.

Technical interactions of fisheries in the ecoregion are demonstrated in Tables 19.8a and 19.8b.

19.12 References

Bordalo-Machado, P. and Figueiredo, I. 2006. Skates and Rays in the Portuguese continental coast-Preliminary results from 26 years of IPIMAR demersal surveys. Working Document presented at the 2006 WGEF.

Diez, G., Iriondo, A., Ruiz, J., Quincoces, I., González, I., Santurtun, M. and Artetxe, I. 2006. Lesser-spotted dogfish, rays and spurdog Landings per Unit Effort and preliminary discards data of Basque fleets operating in Subareas VI, VII and VIII in the period 1994–2005. Working Document presented at the 2006 WGEF.

Table 19.1 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Nominal landings (tonnes) of skates and rays by Division and country (Source: ICES).

TABLE 19.1A	TOTAL LANDINGS (T) OF *RAJIDAE* IN AREA VIIIAB											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007**
Belgium	12	6	11	11	6	11	14	11	8	12	14	
France	1535	1733	1503	437	949	876	895	880	1044	1256	890	691
Netherlands						1						
Spain	872	906	724	677	146	76	323	27	20	9	12	
Spain (Basque Country)	*	*	*	*	297	337	*	252	242	278	218	199
UK (E&W)	22	76	13	7	2	3	4	4		8	40	0
UK (Scotland)										1		3
Total of submitted data	2442	2721	2251	1132	1399	1303	1236	1174	1314	1565	1175	893

*** Included in Spanish Landings.**

**** provisional data.**

TABLE 19.1B	TOTAL LANDINGS (T) OF *RAJIDAE* IN AREA VIIID											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007***
Belgium												
France	46	50	60	52	43	66	64	73	63	97	61	31
Spain	89	92	74	2	1	1	9	5	40	**	**	
Spain (Basque Country)	*	*	*	*	0	2	*	0	1	0	1	2
UK (E&W)											3	
UK (Scotland)												1
Total of submitted data	135	143	134	54	44	69	73	78	104	97	64	34

*** Included in Spanish Landings.**

**** Included in area VIIIab.**

***** provisional data.**

TABLE 19.1C	TOTAL LANDINGS (T) OF *RAJIDAE* IN AREA VIIIC											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007**
Belgium	.	.	.	.	.	.	.	.	.	.	.	
France	0	0	1	1	1	0	0	0	0	0	0	0
Netherlands	.	.	.	.	.	.	.	.	.	.	.	
Portugal	11	7	10	4	4	5	.	.	264	0	.	
Spain	0	321	345	226	424	978	352	1004	511	546	430	
Spain (Basque Country)	*	*	*	*	5	16	*	21	21	20	14	9
UK (E&W_NI_+)												
UK (Scotland)	.	.	.	.	.	.	.	.	.	.	.	
Total of submitted data	11	328	356	231	434	999	352	1025	796	567	444	9

*** Included in Spanish Landings.**

TABLE 19.1D	TOTAL LANDINGS (T) OF *RAJIDAE* IN AREA IXA											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	**2007****
France	n.a.	n.a.	n.a.	n.a.	0	0	0	0	0	0	.	
Portugal	1534	1512	1485	1420	1528	1591	1521	1598	1614	1303	1544	1443
Spain	58	143	197	276	285	416	339	342	325,2	300	364	
Total of submitted data	1592	1655	1682	1696	1813	2007	1860	1940	1939	1602	1908	1443

**** provisional data.**

TABLE 19.1E	COMBINED LANDINGS (T) OF *RAJIDAE* IN BISCAY AND IBERIAN WATERS											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007**
Belgium	12	6	11	11	6	11	14	11	8	12	14	0
France	1581	1784	1564	490	993	942	959	952	1107	1353	951	722
Netherlands	.	.	.	.	.	1	.	.	.	.	.	
Portugal	1545	1519	1495	1424	1532	1596	1521	1598	1878	1303	1602	1443
Spain	1019	1462	1340	1181	855	1471	1022	1378	895	855	806	
Spain (Basque Country)	*	*	*	*	302	354	*	273	264	298	233	210
UK (E&W_NI_+)	22	76	13	7	2	3	4	4	0	8	43	0
UK (Scotland)	.	.	.	.	.	.	.	.	.	1	.	4
Total of submitted data	4179	4846	4423	3113	3690	4378	3521	4216	4153	3831	3649	2379

**** provisional data.**

Table 19.2 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Nominal landings (tonnes) of Lesser-spotted dogfish by Division and country (Source: ICES).

TABLE 19.2A LESSER-SPOTTED DOGFISH (*SCYLIORHINUS CANICULA*) LANDINGS (T) IN AREA VIIIAB												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	**2007***
Belgium	.	.	.	.	.	.	.	.	9	10	13	.
France	568	645	762	405	426	426	360	503	708	798	879	821
Spain	0	0	63	0	7	7	28	1	0	0	2	.
Spain (Basque Country)	223	270	336	254	247	277	353	318	254	335	318	247
UK (E&W)								2		3	0	
Total	791	915	1161	660	681	711	741	824	971	1147	1211	1068

*** provisional data.**

TABLE 19.2B LESSER-SPOTTED DOGFISH (*SCYLIORHINUS CANICULA*) LANDINGS (T) IN AREA VIIID												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007**
France	5	4	5	2	4	5	3	7	7	10	5	4
Spain	0	0	97	0	78	0	0	0	0	*	*	.
Spain (Basque Country)	0	0	0	0	0	0	1	0	1	0	2	2
Total	5	4	103	2	83	5	4	7	7	10	7	6

*** Included in area VIIIab.**

**** provisional data.**

TABLE 19.2C LESSER-SPOTTED DOGFISH (*SCYLIORHINUS CANICULA*) LANDINGS (T) IN AREA VIIIC												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
France	0	0	1	1	1	4	3	4	5	1	0	1
Spain	417	458	375,6	448	167	188	65	114	88	143	168	.
Spain (Basque Country)	11	8	8	9	5	10	52	65	63	66	73	59
Total	428	466	385	458	173	201	120	183	157	211	241	60

*** provisional data.**

TABLE 19.2D LESSER-SPOTTED DOGFISH (*SCYLIORHINUS CANICULA*) LANDINGS (T) IN AREA IXA												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Spain	3	6	19	34	30	39	39	69	86	88	92	
Portugal	667	691	689	882	757	734	673	658	677	385	185	152
Total	670	697	708	916	787	773	711,8	727	763	472	276	152

*** provisional data.**

TABLE 19.2E COMBINED LANDINGS (T) OF LESSER-SPOTTED DOGFISH (*SCYLIORHINUS CANICULA*) IN BISCAY AND IBERIAN WATERS												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Belgium	.	.	.	.	.	.	.	.	9	10	13	.
France	573	648	768	408	431	435	366	513	720	809	884	826
Spain	420	464	555	482	283	234	132	184	174	231	262	
Spain (Basque Country)	234	278	344	263	253	287	405	384	318	401	392	308
UK (E&W)	.	.	.	.	.	.	.	2	.	3		
Portugal	667	691	689	882	757	734	673	658	677	385	185	152
Total	1894	2081	2356	2036	1723	1690	1576	1741	1898	1839	1735	1286

*** provisional data.**

Table 19.3 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Nominal landings (tonnes) of Smooth hounds by Subarea and country (Source: ICES).

TABLE 19.3A-SMOOTH HOUNDS UNIDENT. (*MUSTELUS* SPP.)-ICES AREA VIII												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Belgium	.	.	.	.	.	.	.	.	+	0,1	0,1	.
France	96,6	115	158	47,8	142	149	188	321	407	394	437	354
Portugal	.	.	.	.	+	.	.	.	1	.	.	
Spain (Basque Country)	53	56	57	46	61	58	85	58	56	54	62	45
Total	150	170	214	94	202	207	273	379	464	448	500	399

*** provisional data.**

TABLE 19.3B-SMOOTH HOUND (*MUSTELUS MUSTELUS*)-ICES AREA IX												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Portugal	5	2	4	4	2	2	2	1	1	10	25	45
Total	5	2	4	4	2	2	2	1	1	10	25	45

*** provisional data.**

TABLE 19.3C. - SMOOTH HOUNDS UNIDENT. (*MUSTELUS* SPP.) - ICES AREA IX									
	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Portugal	72	39	41	43	50	35	24	11	11
Total	72	39	41	43	50	34	24	11	11

*** provisional data.**

Table 19.4 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Nominal landings (tonnes) of Angel shark by Subarea and country (Source: ICES).

TABLE 19.4 - ANGEL SHARK (*SQUATINA SQUATINA*) - ICES AREA VIII												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
France	0	0	0	0	0	0	0	0	0	0	0	0
UK (E&W_NI_+)	.	.	.	.	.	.	.	.	.	.	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0

*** provisional data.**

Table 19.5 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Species-specific landings (rays and skates in t) by country in Subareas VIII, and Division XIa, all gears combined. These data are included in the Tables 19.1a to 19.1c.

COUNTRY	YEAR	AREA	T. MARMORATA	D. BATIS	D. OXYRINCHUS	L. CIRCULARIS	L. FULLONICA	L. NAEVUS	R. CLAVATA	R. MICROOCELLATA	R. MONTAGUI	R. UNDULATA	D. PASTINACA	M. AQUILA	R. ASTERIAS	R. BRACHYURA	RAJA MIRALETUS	ROSTRORAJA ALBA	MISCELLANEOUS	RAJA SPP.
France	1999	VIII	24	1	0	17	0	319	75	0	46	0	0	2					0	
France	2000	VIII	9	5	1	55	3	749	68	0	53	1	1	0					1	
France	2001	VIII	3	4	0	47	7	637	37	1	62	2	1	0					1	
France	2002	VIII	5	13	16	51	5	614	39	1	47	0	0	0					0	
France	2003	VIII		4	1	44	4	654	49	2	58	0			0					
France	2004	VIII		4	0	46	4	749	97	0	67	0			0					201
France	2005	VIII		4	1	61	5	946	104	0	54	0			0					598
France	2006	VIII		4	2	36	4	668	139	0	61	0	2	1	0			0		607
France	2007	VIII		2	1	30	3	582	74		30		1							
Spain (Basque Country)	2000	VIII		6			4	250	39		2	0								
Spain (Basque Country)	2001	VIII		8	0		26	230	85		5				0					
Spain (Basque Country)	2002	VIII						243	54		18									
Spain (Basque Country)	2003	VIII					12	230	38		4	0								
Spain (Basque Country)*	2004	VIII		3	0	0	9	208	47	0	6	0	0	0	0					
Spain (Basque Country)*	2005	VIII		3	0	0	11	235	53	0	7	0	0	0	0					
Spain (Basque Country)*	2006	VIII		3	0		6	179	41		5	0			0					
Spain (Basque Country)*	2007	VIII		2	0		5	161	37		5	0			0					

Country	year	area	T. marmorata	D. batis	D. oxyrinchus	L. circularis	L. fullonica	L. naevus	R. clavata	R. microocellata	R. montagui	R. undulata	D. pastinaca	M. aquila	R. asterias	R. brachyura	Raja miraletus	Rostroraja alba	miscellaneous	Raja spp.
Portugal	2002	IXa						13	2											1505
Portugal	2003	IXa						18	351	78	56	126				578	2			
Portugal	2004	IXa						113	516	95	82	108				532	17	5		
Portugal**	2005	IXa						43	480	88	76	100				495	16	5		
Portugal**	2006	IXa						51	569	105	90	119				586	19	6		
Portugal***	2007	IXa						79	472	35	119	277				459			3	

*** 2004 and 2006 landings are based on the average species proportion of 2000–2003.**

**** Provisional data (except for *L. naevus*): 2005 and 2006 landings based in the species proportion of 2004.**

***** Provisional data.**

Table 19.6 Elasmobranch discard estimates of Baka Trawler and VHVOP fleets in Divisions VIIIa, b, d and VIIIc.

Baka trawler							
a)			2003			2004	
	ICES	discard average	(%) trips	total estimated	discard average	(%) trips	total estimated
Species	Divisions	by trip (kg)	sampled	discard(t)	by trip (kg)	sampled	discard (t)
Lesser-spotted dogfish	VIIIa,b,d	714	1.2	348.5	1511	0.9	654.4
Blackmouth catshark	VIIIa,b,d	0.4	1.2	0.2	524	0.9	226.8
Cuckoo ray	VIIIa,b,d	54	1.2	26.3	135	0.9	58.4
Thornback ray	VIIIa,b,d	4	1.2	1.9	N.A.	0.9	.
Rajidae	VIIIa,b,d	98	1.2	47.7	13	0.9	5.8
Spurdog	VIIIa,b,d	N.A.	1.2	.	N.A.	0.9	.
Tope shark, flake	VIIIa,b,d	N.A.	1.2	.	N.A.	0.9	.
Shark and rays	VIIIa,b,d	N.A.	1.2	.	N.A.	0.9	.
			2005			2006	
Lesser-spotted dogfish	VIIIa,b,d	544	2.4	274.7	329	1.9	173
Blackmouth catshark	VIIIa,b,d	11	2.4	5.5	1	1.9	0.6
Cuckoo ray	VIIIa,b,d	24	2.4	11.9	20	1.9	10
Thornback ray	VIIIa,b,d	0	2.4	0.0	0	1.9	0
Rajidae spp.	VIIIa,b,d	1	2.4	0.7	N.A.	1.9	.
Spurdog	VIIIa,b,d	0	2.4	0	2	1.9	1
Tope shark, flake	VIIIa,b,d	0	2.4	0	2	1.9	1
Shark and rays	VIIIa,b,d	N.A.	2.4	.	9	1.9	5

VHVOP							
b)			2003			2004	
	ICES	discard average	(%) trips	total estimated	discard average	(%) trips	total estimated
Species	Divisions	by trip (kg)	sampled	discard (t)	by trip (kg)	sampled	discard (t)
Lesser-spotted dogfish	VIIIa,b,d	8	1.5	3.3	5	1.9	1.8
	VIIIc	N.C.	.	.	N.C.	.	.
Cuckoo ray	VIIIa,b,d	10	1.5	4.1	0	1.9	0.0
			2005			2007	
Lesser-spotted dogfish	VIIIa,b,d	21	2.1	6.9	22	3.4	4.6
	VIIIc	24	2.4	7.8	N.A.		
Cuckoo ray	VIIIa,b,d	N.C.	.	.	N.A.		

N.A.: Not available data

N.C.: No catches in the sampling

Table 19.7 Landings (t), effective effort (fishing days = trips*(days/trip)) and lpue (landings in kg/day) of lesser-spotted dogfish, Rajidae and dogfish of Bakk trawler fleet landing in the Basque Country (Spain) ports in the period 1994–2007.

BAKA TRAWL-ON-VIIIA,B,D									
	Lesser-spotted dogfish			Rajidae			spurdog		
Year	Landings (t)	Effort (days)	lpue (kg/days)	Landings (t)	Effort (days)	lpue (kg/days)	Landings (t)	Effort (days)	lpue (kg/days)
1994	112	5619	20	179	5619	32	32	5619	6
1995	202	4474	45	505	4474	113	23	4474	5
1996	206	4378	47	471	4378	108	45	4378	10
1997	242	4286	56	549	4286	128	34	4286	8
1998	303	3002	101	598	3002	199	25	3002	8
1999	231	2337	99	362	2337	155	12	2337	5
2000	228	2227	102	272	2227	122	38	2227	17
2001	217	2118	103	292	2118	138	9	2118	4
2002	331	2107	157	265	2107	126	12	2107	5
2003	303	2296	132	219	2296	95	3	2296	1
2004	235	2159	109	177	2159	82	1	2159	0.5
2005	320	2263	141	233	2263	103	3	2263	2
2006	311	2398	130	185	2398	77	3	2398	1
2007	256	2805	91	194	2805	69	0.7	2805	0.3

Table 19.8a Demersal elasmobranchs in the Bay of Biscay and Iberian waters. Technical interactions in Biscay waters.

	Anchovy VIII	Anglerfish budegassa VIIb-k, VIIIabd	Anglerfish piscatorius VIIb-k, VIIIabd	Cod VIIe-k	Haddock VIIb-k	Hake Northern	Herring Celtic Sea and Division VIIj	Herring VIa(S) and VIIbc	Horse Mackerel Southern	Horse Mackerel Western	Mackerel North East Atlantic	Megrim VII, VIIIabd	Nephrops Area L: VIIbcjk	Nephrops Area M: VIIfgh+VIIa	Nephrops VIIIa,b	Nephrops VIIIc	Plaice VIIbc	Plaice VIIe	Plaice VIIfg	Plaice VIIhjk	Sardine VIIIc, IXa	Sole VIIbc	Sole VIIe	Sole VIIfg	Sole VIIhjk	Sole VIIIab	Sprat VIIde	Whiting VIIe-k	Seabass	Skates and rays	Pelagic and migratory sharks	Demersal sharks
Anchovy VIII		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	0	0	0		0
Anglerfish budegassa VIIb-k, VIIIabd	N		H	L	L	M	0	0	0	0	0	M	M	L	M		L	L	L	L	0	L	L	L	L	M		L		H		H
Anglerfish piscatorius VIIb-k, VIIIabd	N	T		L	L	M	0	0	0	0	0	M	M	M	M		L	L	L	L	0	L	L	L	L	M		L		H		H
Cod VIIe-k	N	T	T		H	L	0	0	0	0	0	L	L	M	0	0	0	L	M	L	0	0	L	L	L	0	0	H/M		H	L	H
Haddock VIIb-k	N	T	T	T		L	0	0	0	0	0	L	M	M	0	0	L	L	L	L	0	L	L	L	L	0	0	H	0	H	L	H
Hake Northern	N	T	T	T			0	0	0	0	0	M	M	L	M		L		0	L	0	L		0	L	L		L		H	L	H
Herring Celtic Sea and Division VIIj	N	N	N	N	N	N		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0
Herring VIa(S) and VIIbc	N	N	N	N	N	N	N		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0
Horse Mackerel Southern	N	N	N	N	N	N	N	N		0	H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
Horse Mackerel Western	N	N	N	N	N	N	N	N	N		H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
Mackerel North East Atlantic	N	N	N	N	N	N	N	N				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
Megrim VII, VIIIabd	N	T, BT	T, BT	T		T	N	N	N	N	N		H	M	M		L			L	0	L		L	L	0		L		H		H
Nephrops Area L: VIIbcjk	N	NT	NT	NT	NT	NT	N	N	N	N	N	NT		0	0	0	L	0	0	L	0	L	0	0	L	0	0	M		L		L
Nephrops Area M: VIIfgh+VIIa	N	NT	NT	NT	NT	NT	N	N	N	N	N	NT	N		0	0	0	0	0	L	0	0	0	L	L	0	0	M		L		L
Nephrops VIIIa,b	N	NT	NT	N	N	NT	N	N	N	N	N	NT	N	N		0	0	0	0	0	0	0	0	0	0	M	0	0		L		L
Nephrops VIIIc	N			N	N		N	N	N	N	N		N	N	N		L		0	0	0	L	0	0	0	0		0		L		L
Plaice VIIbc	N			N			N	N	N	N	N		NT	N	N			0	0	0	0	L	0	0	0	0	0	L	0	H		H
Plaice VIIe	N	OT, BT	OT, BT	OT, BT	N		N	N	N	N	N		N	N	N		N		0	0	0	0	H	0	0	0	0	L		H		H
Plaice VIIfg	N	OT, BT	OT, BT	OT, BT	OT, BT	N	N	N	N	N	N		N	N	N	N	N	N		0	0	0	0	H	0	0	0	L		H		H
Plaice VIIhjk	N			BT, OT			N	N	N	N	N		NT	N	N		N	N	N		0	0	0	0	L	0	0	L	0	H		H
Sardine VIIIc, IXa	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		0	0	0	0	0	0	0	0	0		0
Sole VIIbc	N			N			N	N	N	N	N		N	N	N			N	N	N	N		0	0	0	0	0	L	0	H		H
Sole VIIe	N	BT, OT	BT, OT	BT, OT	N		N	N	N	N	N		N	N	N	N	N	BT, OT	N	N	N	N		0	0	0	0	L		H		H
Sole VIIfg	N	BT, OT	BT, OT	BT, OT	BT, OT	N	N	N	N	N	N	BT	N	NT	N	N	N	N	BT, OT	N	N	N	N		0	0	0	L		H		H
Sole VIIhjk	N			BT, OT			N	N	N	N	N		N	N	N		N	N	N	T, BT	N	N	N	N		0	0	L	0	H		H
Sole VIIIab	N	BT	BT	N	N	BT	N	N	N	N	N	N	N	N	NT	N	N	N	N	N	N	N	N	N	N		0	0	0	H		H
Sprat VIIde	N	N	N	N	N				N	N	N		N	N	N		N	N	N	N	N	N	N	N	N	N		0				
Whiting VIIe-k	N	T	T	T	T		N	N	N	N	N		NT	NT	N		N	N	BT, OT		N	N	N	BT, OT		N			0	H		H
Seabass	N						N	N	N	N	N										N					N		0				
Skates and rays	N	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	N	N	N	N	BT, OT	NT	NT	NT	NT	BT, OT	BT, OT	BT, OT	BT, OT	N	BT, OT		BT, OT	BT, OT	BT	N	BT,OT				
Pelagic and migratory sharks	NA	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	N	N	N	N	BT, OT					BT, OT	BT, OT	BT, OT	BT, OT	N	BT, OT		BT, OT	BT, OT	BT	N	BT,OT				
Demersal sharks	N	BT, OT	BT, OT	BT, OT	BT, OT	BT, OT	N	N	N	N	N	BT, OT	NT	NT	NT	NT	BT, OT	BT, OT	BT, OT	BT, OT	N	BT, OT		BT, OT	BT, OT	BT	N	BT,OT				

H; the stocks are taken together in most fisheries where they are taken and their fisheries linkage is therefore high; M: the stocks are taken together in some but not all important fisheries and their fisheries linkage is therefore medium; L: the stocks are taken together in some fisheries but are mainly caught independently of each other and their fisheries linkage is therefore low; O: the stocks are never or only rarely caught together and they are thus not linked in the fisheries; na: information not available.

T: Trawl; BT: Beam trawl; OT: Otter trawl; NT: Nephrops trawl; N: none

Table 19.8b Demersal elasmobranchs in the Bay of Biscay and Iberian waters. Technical interactions in Iberian waters.

	Hake VIIIc,IXa	Anglerfish VIIIc, IXa	Megrim VIIIc, IXa	Nephrops Cantabrian FU 31	Nephrops N Galicia FU 25	Nephrops W Galicia, N Portugal FU 26-27	Nephrops SW, S Portugal FU 28-29	Nephrops Cadiz FU 30	Horse mackerel IXa	Blue whiting VIIIc, IXa	Black scabbardfish IXa	Red seabream IX, X
Hake VIIIc,IXa		H	H	L	H	H	H	H	H	M	L	L
Anglerfish VIIIc, IXa	PT/SP Trawl PT/SP Gillnet		H	L	H	H	H	0	M	L	0	L
Megrim VIIIc, IXa	PT Trawl, Gillnet	PT Trawl, Gillnet		L	L	L	H	0	M	L	O	L
Nephrops Cantabrian FU 31	SP Trawl	SP Trawl	SP Trawl		0	0	0	0	0	0	0	0
Nephrops N Galicia FU 25	SP Trawl	SP Trawl	SP Trawl	None		0	0	0	0	0	0	0
Nephrops W Galicia, N Portugal FU 26-27	SP Trawl PT Trawl	SP Trawl PT Trawl	SP Trawl PT Trawl	None	None		0	0	L	L	0	0
Nephrops SW, S Portugal FU 28-29	Crustacean PT Trawl	Crustacean PT Trawl	Crustacean PT Trawl	None	None	None		0	L	M	0	0
Nephrops Cadiz FU 30	SP Trawl	None	None	None	None	None	None		M	H	0	0
Horse mackerel IXa	PT Trawl/Artisanal SP Trawl-H/GOV-L	PT Trawl/Gillnet SP Trawl-H/GOV-L	PT Trawl/Gillnet SP Trawl-H/GOV-L	None	None	SP Trawl PT Trawl	Crustacean PT Trawl	SP Trawl		M	0	0
Blue whiting VIIIc, IXa	PT Trawl SP Trawl, Pair Trawl	Crustacean PT Trawl SP Trawl	Crustacean PT Trawl SP Trawl	SP Trawl-L	SP Trawl-L	SP Trawl-L	Crustacean PT Trawl	SP Trawl	PT Trawl, SP Trawl, Pair Trawl, GOV-L		0	0
Black scabbardfish IXa	PT Longline	None	None	None	None	None	None	None	None	None		0
Red seabream IX, X	PT Artisanal	PT Artisanal	PT Artisanal	None	None	None	None	None	PT Artisanal	None	None	

Table 19.8c Quantitative description of fishing gears and species interaction UK fleets in Subareas VIII and IX.

		2005	2006		2007	
Species	Gear	VIII	VIII	IX	VIII	IX
Alfonsino (Beryx)	Nets		3			
Bairds Smoothhead	Nets		14			
Birdbeak dogfish	Nets		0.2	4		
Bluemouth redfish	Nets		8		1	
Conger eels	Bottom trawl	1				
	Lines	76	72		53	
	Nets	1	2		1	
Deepwater red crab	Nets		22	283	7	56
	Pots			6	0	20
Dogfish (scyliorhinidae)	Bottom trawl	3				
Greater forkbeard	Bottom trawl	0.01				
	Lines	0.03				
Gulper shark	Nets		0.1	9		
Kitefin shark	Nets		0.1	4		
Leafscale gulper shark	Nets		2	3		
Ling	Bottom trawl	0.02				
	Lines	17	30		4	0
	Nets	1	15		6	0
Livers and oils	Lines					
	Nets		3	31		
	Pots			1		
Longnose velvet dogfish	Lines			13		
	Nets		17	82	0	1
Portuguese dogfish	Lines			1		
	Nets		1	17	2	0.106
Sea breams	Lines		0.1			
	Nets		0.03			
Unidentified sharks	Nets		1	1	1.334	

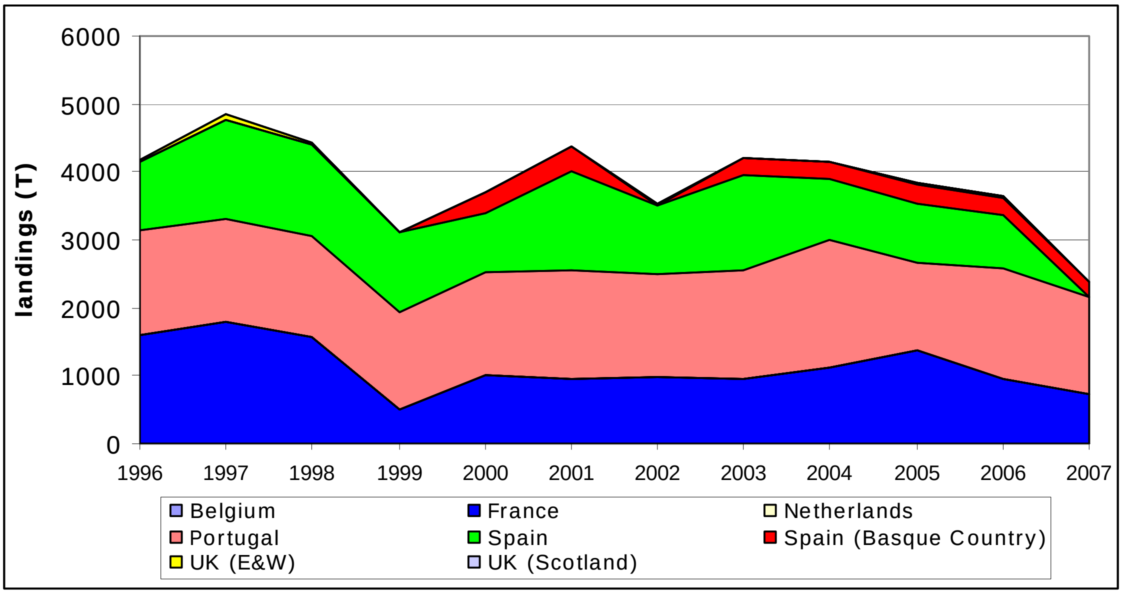


Figure 19.1 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Historical trend landings of Rajidae spp in Divisions VIIIab, VIIId, VIIIc and IXa.

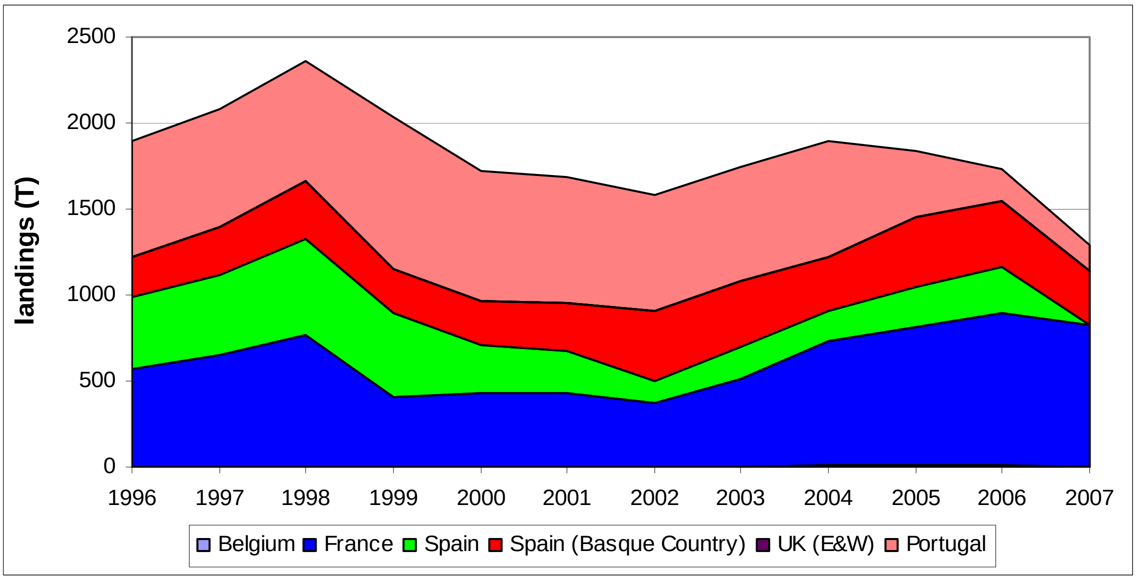


Figure 19.2 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Historical trend landings of Lesser-spotted dogfish Divisions VIIIab, VIIId, VIIIc and IXa.

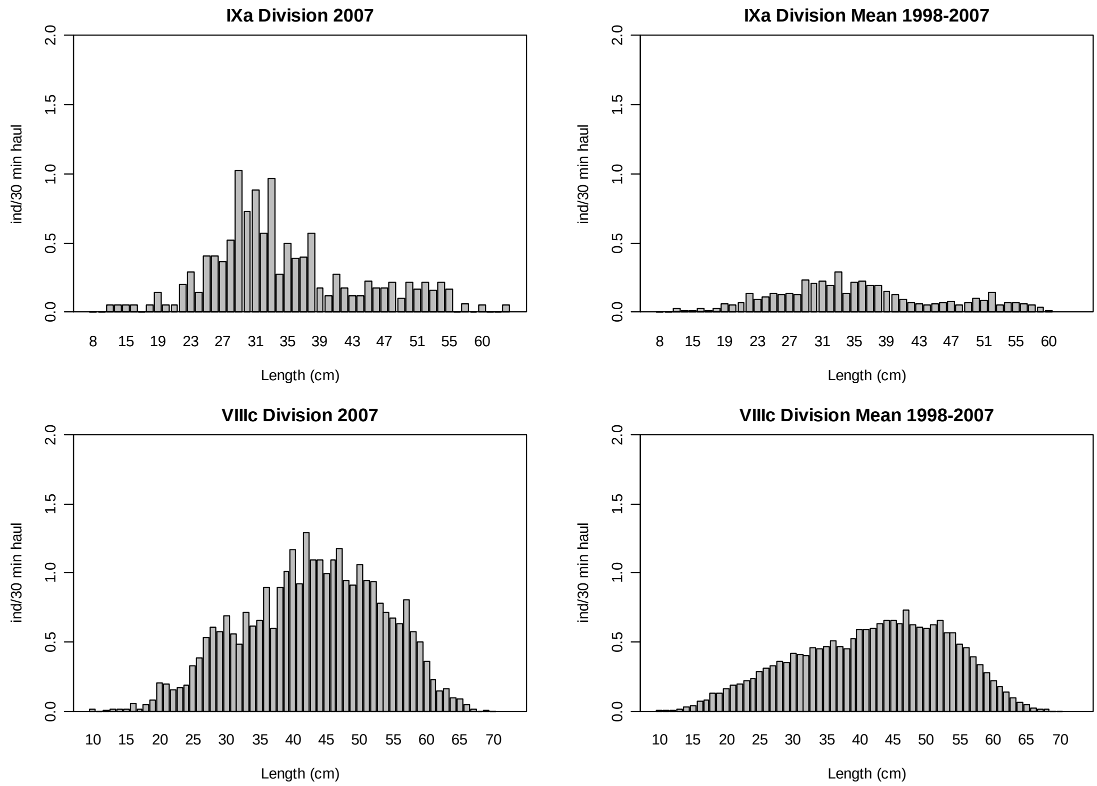


Figure 19.2a Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Stratified length distribution of lesser-spotted dogfish (*S. canicula*) on North Spanish Coast bottom-trawl surveys, in ICES Divisions IXa and VIIIc, for 2007 and mean values during the last decade (1998–2007).

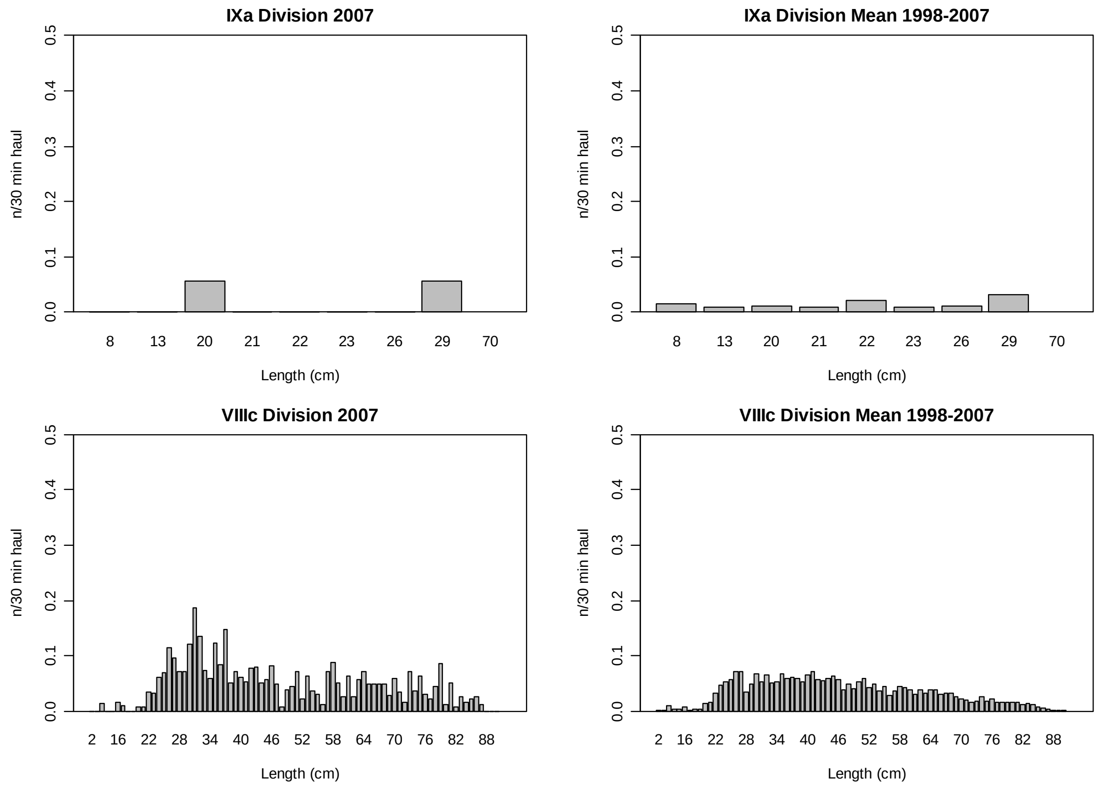


Figure 19.2b Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Stratified length distribution of Thornback ray (*R. clavata*) on North Spanish Coast bottom-trawl surveys, ICES Divisions IXa and VIIIc, for 2007 and mean values during the last decade (1998–2007).

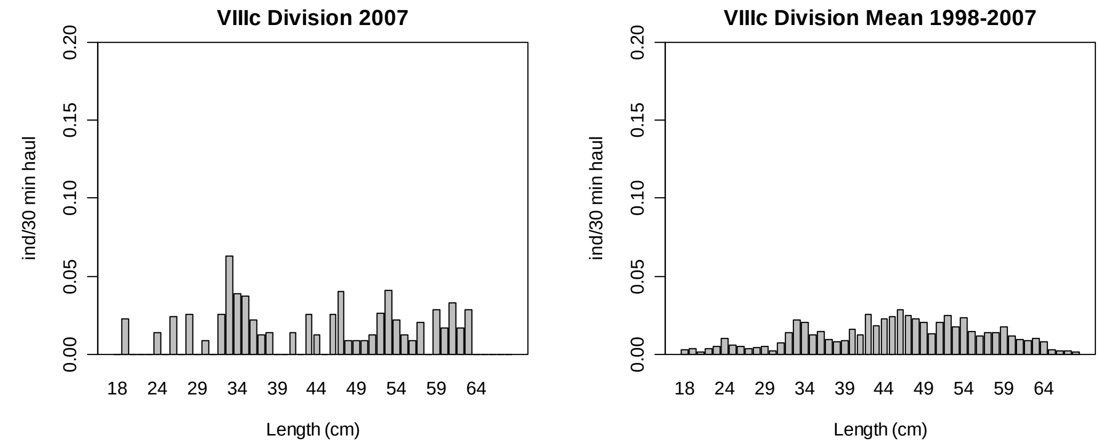


Figure 19.2c Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Stratified length distribution of Cuckoo ray (*L. naevus*) on North Spanish Coast bottom-trawl surveys, in ICES Divisions IXa and VIIIc, for 2007 and mean values during the last decade (1998–2007).

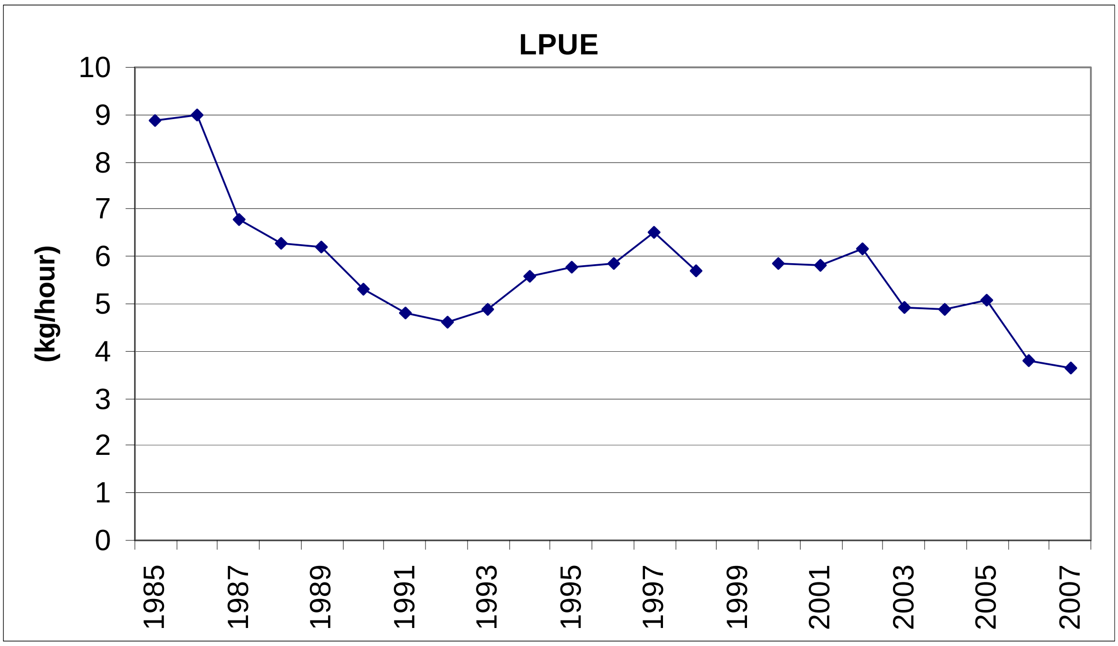


Figure 19.3 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Cuckoo ray lpue of French bottom trawlers targeting benthic species in Bay of Biscay.

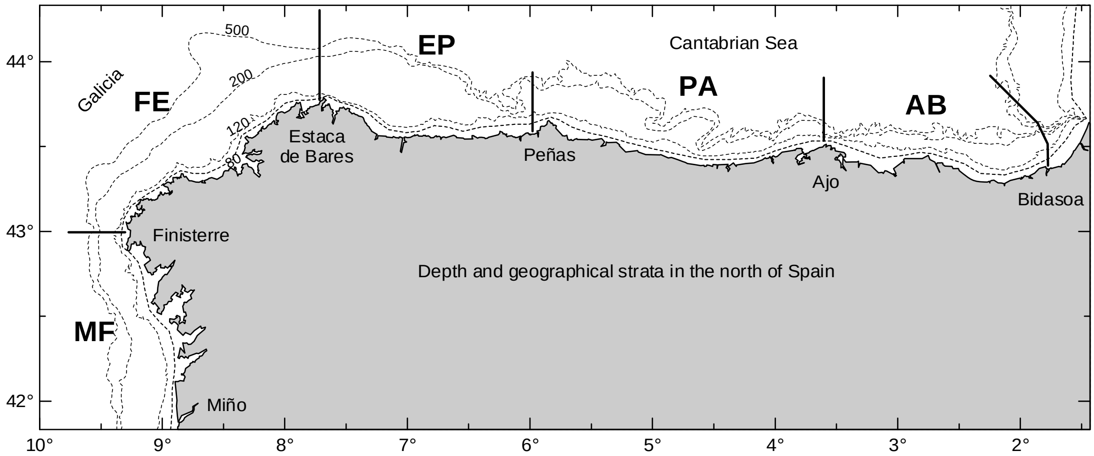


Figure 19.4 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Design of the IBTS North of Spanish Coast groundfish survey demonstrating geographical sectors and depth stratification.

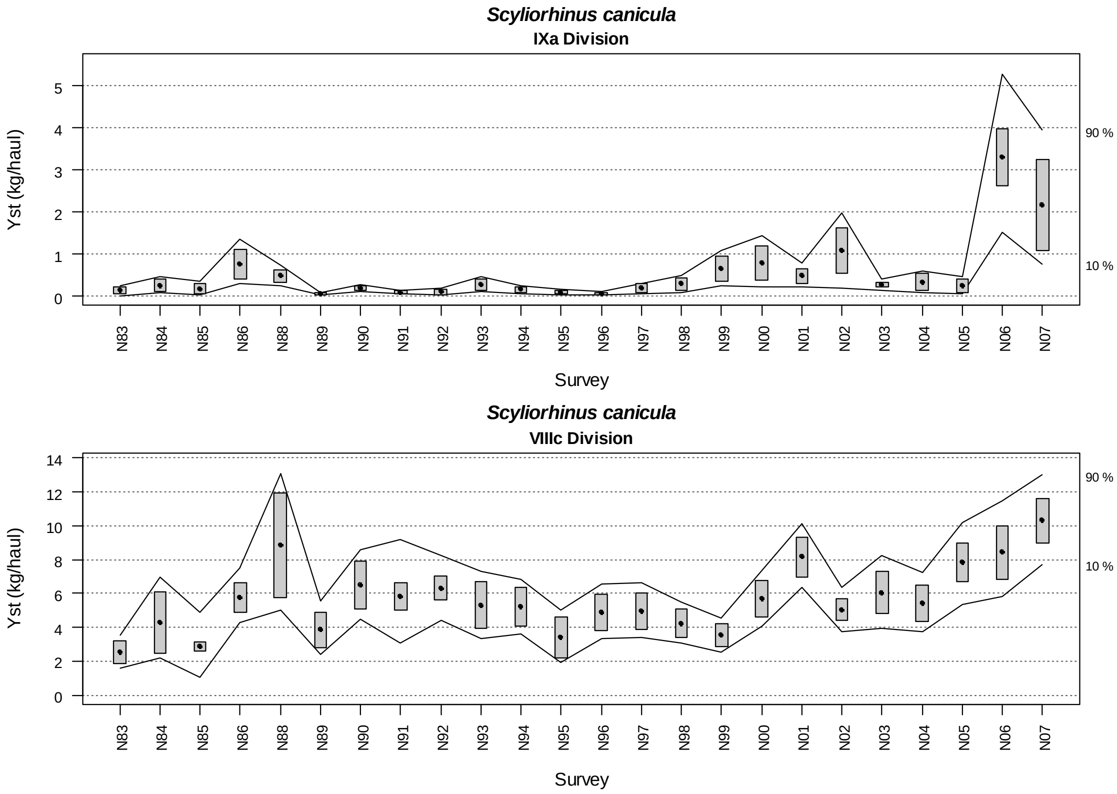


Figure 19.5 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Changes in lesser-spotted dogfish (*Scyliorhinus canicula*) biomass indices, in ICES Division IXa and VIIIc, during North Spanish Coast Survey time-series (1983–2007). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

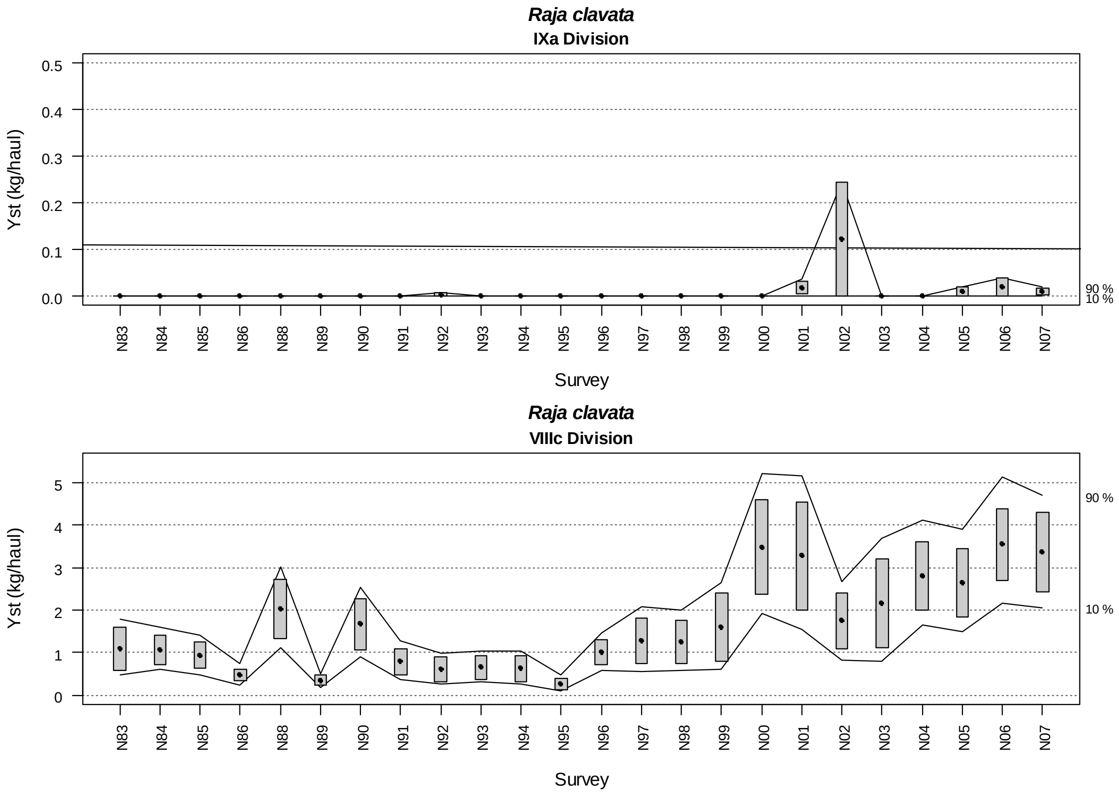


Figure 19.6 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Changes in thorny ray (*Raja clavata*) biomass indices, in ICES Division IXa and VIIIc, during North Spanish Coast Survey time-series (1983–2007). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

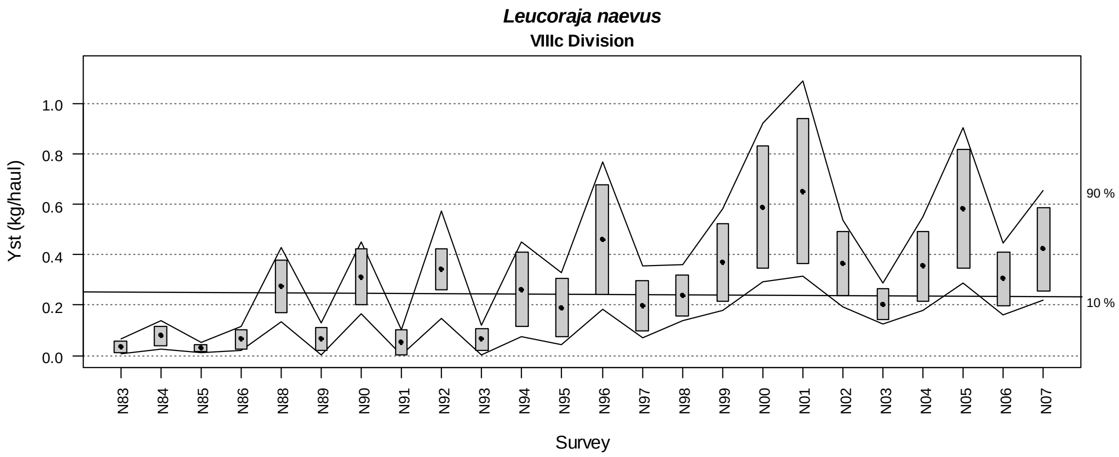
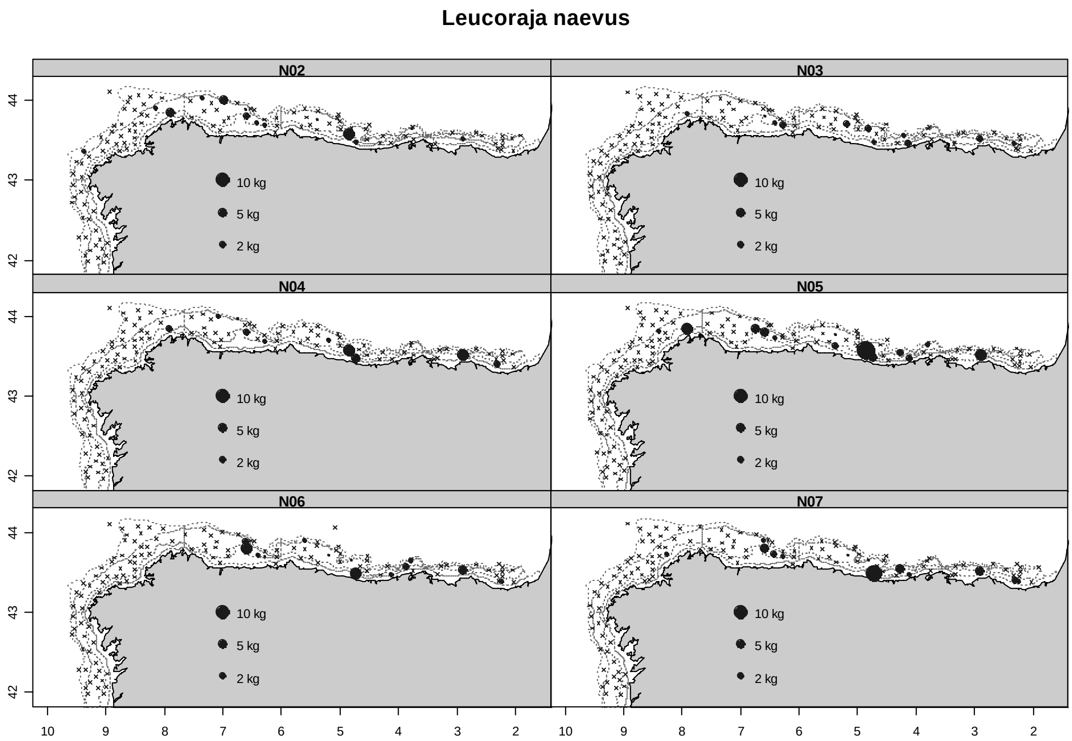
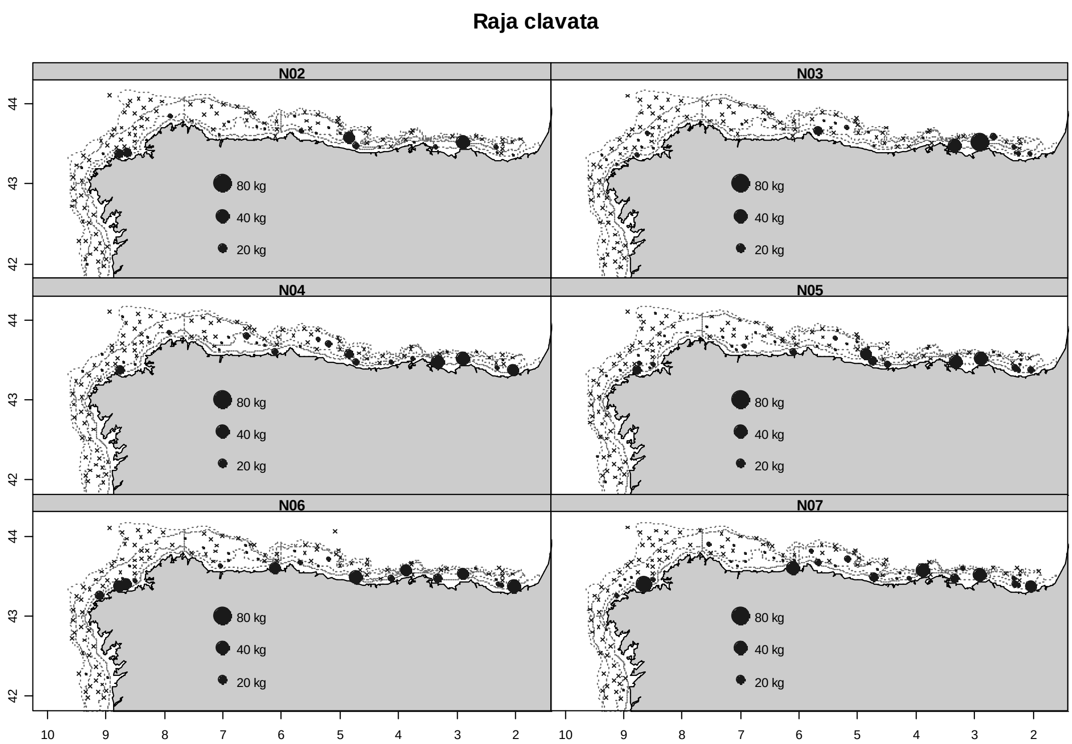


Figure 19.7 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Changes in Cuckoo ray (*L. naevus*) biomass indices, in ICES Division IXa and VIIIc, during North Spanish Coast Survey time-series (1983–2007). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

a)


Leucoraja naevus
N02
N03
N04
N05
N06
N07
10 kg
5 kg
2 kg
44
43
42
10
9
8
7
6
5
4
3
2

b)


Raja clavata
N02
N03
N04
N05
N06
N07
80 kg
40 kg
20 kg
44
43
42
10
9
8
7
6
5
4
3
2

c)

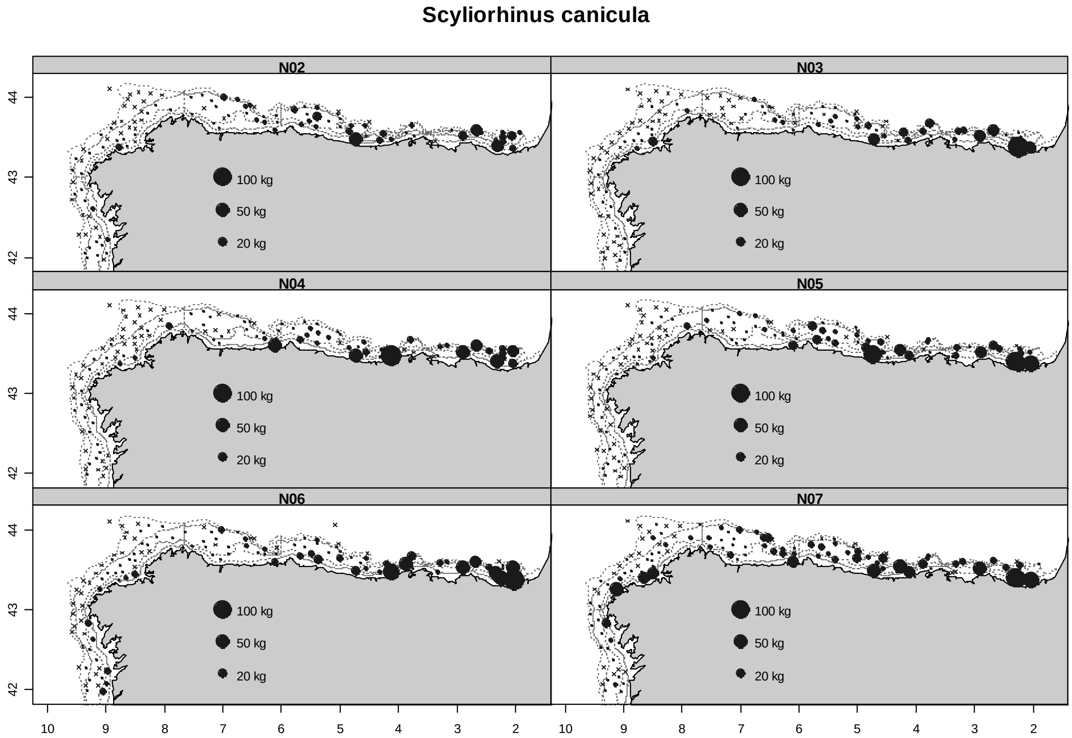


Figure 19.9a, b and c. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Geographic distribution of thornback ray (*R. clavata*), cuckoo ray (*L. naevus*) and lesser-spotted dogfish (*S. canicula*) catches (kg/30 min haul) in North Spanish Coast bottom-trawl surveys (2002–2007).

20 Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge

20.1 Eco-region and stock boundaries

The Mid-Atlantic Ridge (MAR) (ICES Subareas X, XII, XIV) is an extensive and diverse area, which includes several types of ecosystem, including abyssal plains, seamounts, active underwater volcanoes, chemosynthetic ecosystems and islands.

For most species dealt with in this section the stock boundaries are not well known. The main species of demersal elasmobranch observed in this ecoregion are deep-water species (*Centrophorus* spp., *Centroscymnus* spp., *Deania* spp., *Etmopterus* spp., *Hexanchus griseus, Galeus marinus, Somniosus microcephalus, Pseudotriakis microdon, Scymnodon obscurus, Centroscyllium fabricii* and various deep-water skates; see Sections 3 and 5), particularly whenever the gear fishes deeper than 600 m. Many of these may be discarded as a consequence of their low commercial value (ICES, 2005). In the Azores area, kitefin shark *Dalatias licha* and tope *Galeorhinus galeus* are the most important commercial demersal elasmobranchs (see Sections 4 and 10 respectively).

Of the skates, the most abundant species in Subarea X is thornback ray *Raja clavata*. Other species also observed include *Dipturus batis*, *D. oxyrinchus*, *Leucoraja fullonica*, *Rajella bathyphila*, *Raja brachyura*, *Raja maderensis* and *Rostroraja alba* (Pinho, 2005, 2006).

Other species of batoid, like stingray *Dasyatis pastinaca*, marbled electric ray *Torpedo marmorata* and electric ray *T. nobiliana* are also observed in this ecoregion. These species are generally discarded if caught in commercial fisheries. Some of the scarcer demersal elasmobranchs observed on MAR include *Bathyraja pallida* and *Bathyraja richardsoni* (ICES, 2005).

Stock boundaries are not known for the species in this area, neither are the potential movements of species that also occur on the continental shelf of mainland Europe. Further investigations are necessary to determine potential migrations or interactions of elasmobranch populations within this ecoregion and neighbouring areas.

20.2 The fishery

20.2.1 History the fishery

In the context of this report, this area is mainly a natural deep-water environment exploited by small-scale fisheries in the Azorean islands EEZ and industrial deep-sea fisheries in international waters. The fisheries from these areas where already described in ICES reports (ICES, 2005). Landings from the Azorean fleets have been reported to ICES. Landings from MAR remain very small and variable and few vessels find the MAR fisheries profitable.

Demersal elasmobranchs are caught in the Azores EEZ by a multispecies demersal fishery, using handlines and bottom longlines, and by the black scabbardfish fishery using bottom longlines (ICES, 2005). The most commercially important elasmobranchs caught and landed from these fisheries are *Raja clavata* and *G. galeus* (Pinho, 2005, 2006; ICES, 2005).

20.2.2 The fishery in 2006 and 2007

There is no new reported information to the WGEF from MAR.

20.2.3 ICES advice applicable

ACOM has never provided advice for these stocks.

20.2.4 Management applicable

No new information.

20.3 Catch data

20.3.1 Catch data

The catches reported from each country and Subarea is given in Tables 20.1–20.3. Historical total landings of skates reported for area X and XII are presented in Figure 20.1.

20.3.2 Discards

No new information.

20.3.3 Quality of catch data

Species-specific landings data are not currently available for skates landed in this region.

20.4 Commercial catch composition

20.4.1 Species and size composition

In the Azores there is no systematic fishery/landing sampling programme for these species, because they have very low priority on the port Minimum Sampling Programme. Landings statistics on rays and skates from Azorean fisheries are reported under generic categories. Since 2004, length samples of *Raja clavata* have been collected, however few individuals were sampled.

20.4.2 Quality of data

Only limited data are available.

20.5 Commercial catch-effort data

No new information.

20.6 Fishery-independent surveys

Since 1995 Department Oceanography and Fisheries (DOP) has carried out an annual spring demersal bottom longline survey around the Azores. An overview of the elasmobranch species occurring in the Azores (ICES Subarea X), their fisheries and available information on species distributions by depth were described by Pinho (2005 WD).

Raja clavata is one of demersal elasmobranch species most commonly reported from the Azorean spring bottom longline (ICES, 2006). Relevant biological information available from surveys on this species was updated. An annual abundance index for this species is presented in Figure 20.2.

Information on elasmobranchs recorded on MAR is available from the literature (Hareide and Garnes, 2001) and was presented in the WGEF 2005 report (ICES, 2005). There is no new information.

20.7 Life-history information

No new information.

20.8 Exploratory assessment methods

No assessments have been conducted, as a consequence of insufficient data.

20.9 Quality of assessments

No assessments have been conducted, as a consequence of insufficient data. Analyses of survey trends may allow the general status of the more frequent species to be evaluated in future.

20.10 Reference points

No reference points have been proposed for any of these species.

20.11 Management considerations

In 1998, the Azorean government implemented management actions in order to reduce effort on shallow areas of the islands, including a licence threshold based on the requirement of the minimum value of sales and the creation of a box of three miles around the islands areas, with fishing restrictions by gear (only handlines are permitted) and vessel type.

Under the Common Fisheries Policy of the EU a box of 100 miles was created around the Azorean EEZ where almost only the Azorean fleets are permitted to fish for deep-sea species (Reg EC 1954/2003). TACs for deep-water sharks are in place for ICES areas V, VI, VII, VIII, IX, X and XII.

WGEF considers that the elasmobranch fauna of Mid-Atlantic Ridge in ICES Subareas X and XII is poorly understood. The species of demersal elasmobranchs are probably little exploited compared with continental Europe. The ecoregion is considered to be a sensitive area. Consequently, commercial fisheries taking demersal elasmobranchs in this area should not be allowed to proceed unless studies are conducted that can demonstrate what sustainable exploitation levels should be.

20.12 References

Hareide, N. R. and Garnes, G. 2001. The distribution and catch rates of deep water fish along the Mid-Atlantic Ridge from 43 to 61 N. Fisheries Research, 519: 297–310.

ICES. 2005. Report of the Study Group on Elasmobranch Fishes. ICES CM 2006/ACFM:03, 224 pp.

Pinho, M. R. 2005. Elasmobranchs of the Azores. Working Document (WGEF 2005).

Pinho, M. R. 2006. Elasmobranch statistics from the Azores (ICES Area X).Working Document (WGEF, 2006).

Table 20.1 Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Landings of demersal elasmobranchs (t) from ICES Subarea X.

ICES Subarea X													
	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1996
Azores	Rajidae	48	29	35	52	43	32	55	62	71	99	117	71
France	Rajidae							1					
Spain	Rajidae							.					
Azores	Bluntnose six-gill shark	+	1	1	1	+	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Azores	Sharks	+	+	4	12	+	n.a.	138	256	328	n.a.	n.a.	328
Total		48	30	40	65	43	32	194	318	399	99	117	399

ICES Subarea X												
	Species	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Azores	Rajidae	99	117	103	83	68	70	89	72	50	62	80
France	Rajidae					2	.	.	.	.	.	.
Spain	Rajidae				24	29				.	.	.
Azores	Bluntnose six-gill shark	n.a.	n.a.	n.a.	n.a.	n.a.	7	2	1	1	n.a.	1
Azores	Sharks	n.a.	n.a.	6	18	22	n.a.	n.a.	n.a.	3	n.a.	n.a.
Total		99	117	109	125	121	77	91	73	53	62	80

Table 20.2 Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Landings of demersal elasmobranchs (t) from ICES Subarea XII.

ICES Subarea XII								
Country	Species	2001	2002	2003	2004	2005	2006	2007
UK	Rays and skates	1	1	6	1	.	.	.
UK	Sharks	-	6.7	-	-	113	.	.
Total		1	7	6	0,8	113	0	0

Table 20.3 Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Landings of demersal elasmobranchs (t) from ICES Subarea XIV.

ICES Subarea XIV									
Country	Species	2001	2002	2003	2004	2005	2006	2006	2007
UK	Rays and skates	+	+	.	.	.	.	.	.
Norway	Rajidae	.	.	.	.	.	6	.	.
Total		0.3	0.4				6		

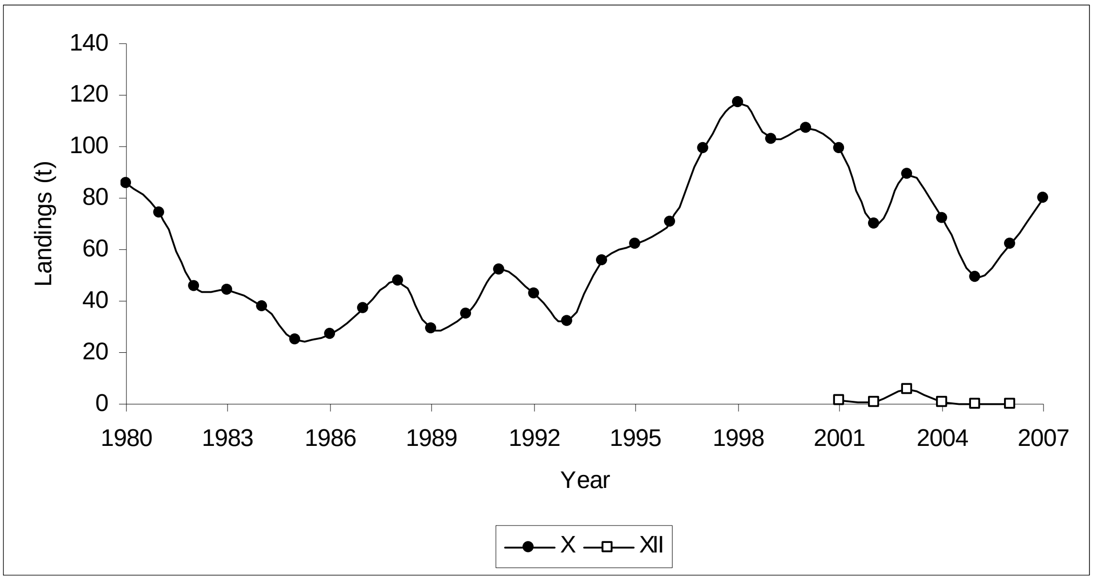


Figure 20.1 Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Historical landings of rays from Azores (Ices Subarea X) and MAR (ICES Subarea XII).

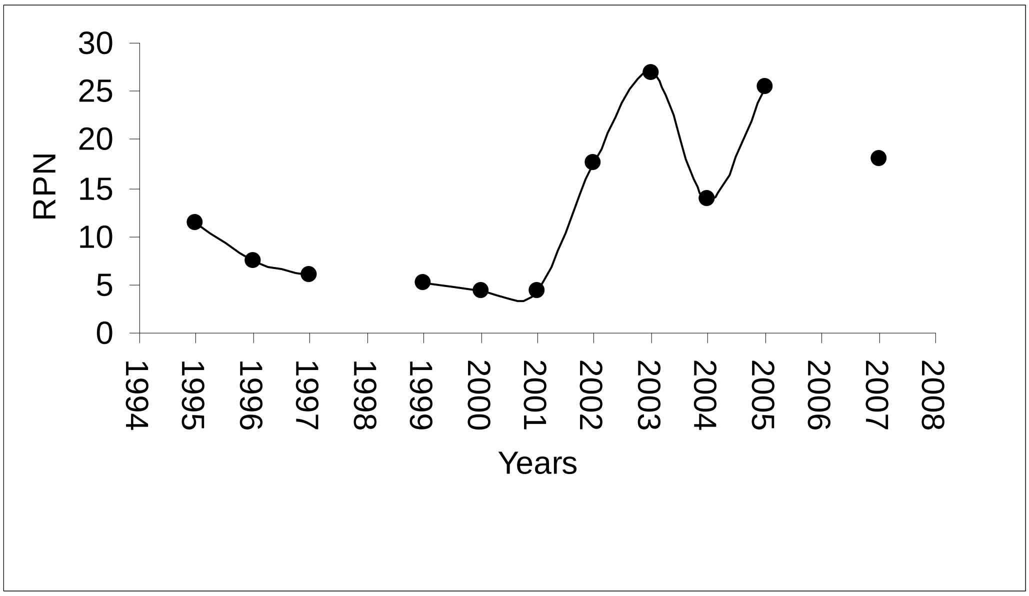


Figure 20.2 Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Survey annual Relative Population Numbers (RPN) of Raja clavata from the Azores (ICES X).

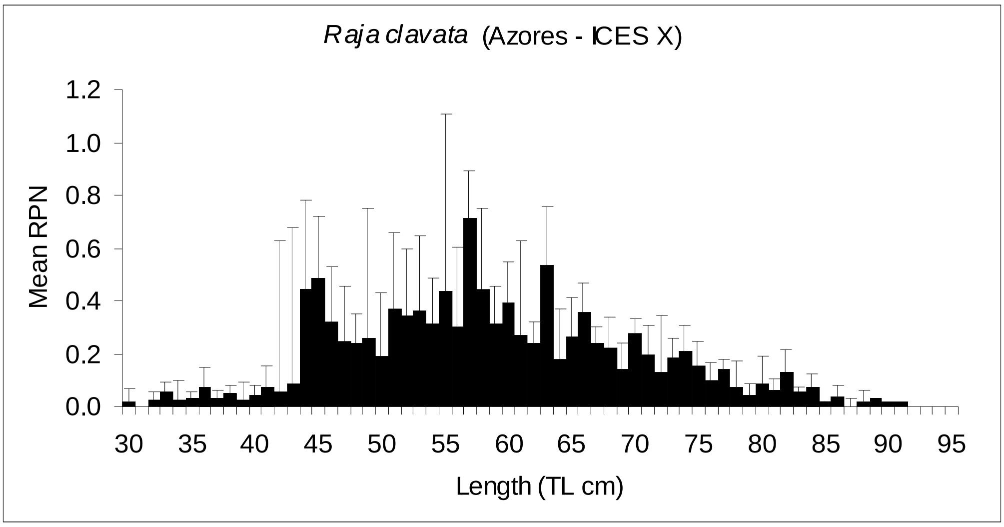


Figure 20.4 Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Length frequency of *Raja clavata* caught at the Azorean demersal spring bottom longline surveys during the period 1995–2005.

21 Other issues

This Section discusses the following ToRs:

- Compile available photographic images of deep-water elasmobranchs and demersal skates and rays to support the production of a photo-ID key for the elasmobranchs of the ICES area, and draft a supporting key for the identification of deep-water and demersal elasmobranchs.
- Address the OSPAR request on *Raja clavata* with a deadline of 20 December 2007.

21.1 Photographic images for an ID key for elasmobranchs in the ICES area

A start was made with the compilation of pictures of sharks and skates and rays from the ICES area provided by the participants during the meeting. It was agreed that the photo's should be submitted according the following guidelines, similar to those used for the Imares Zeus species-catalogue prepared in 2005:

- There is no preference for a certain background to be used, but ideally a cm-scale should be visible.
- As a light source Tungsten white balance bulbs are recommended.
- In the right hand corner the name of the photographer should be included as embedded information: a copyright symbol, the name of the institute (acronym), the name of the photographer and the year, for example: © FRS Marine Laboratory/Finlay Burns/2004. This text should be in black or white, in italics, in Arial 10.
- Apart from the text mentioned above, there should be no text on the photo, but distinguishing features may be highlighted by arrows or circles.

For the individual files the following format was agreed:

- File names should consist of the scientific species name and an image number, for example: Squalus_acanthias_01.jpg.
- The images should be JPEG files, with a critical resolution necessary for presentation on full screen: width of 15x20 cm, resolution 120, quality 7 (medium to high compression), and a size limit of approximately 150 kB.
- Non-digital pictures can of course be scanned, but in that case the same settings as mentioned above should be used.

In order to stimulate everyone's participation in the preparation of an Elasmobranch Photo-ID key, a site will be created under the ICES SharePoint system, where all members of WGEF can download there photo's according the above instructions. Others, outside WGEF, can on their request be given access to the site through the WGEF chair.

Some keys to specific groups have already been prepared, e.g. the keys for rays and skates and deep-water elasmobranchs by Matthias Stehmann (Germany) prepared under the DELASS project and a key for the identification of deepwater sharks prepared by Finlay Burns (UK Scotland).

Work on these keys will need to be continued over the next year.

It was agreed that Henk Heessen will coordinate the compilation of photos and that Bernard Seret, will work on the development of the identification keys. For this purpose he will cooperate with Matthias Stehmann.

21.2 Nominations to the OSPAR list of 'Threatened and Declining Species and Habitats": A review of the elasmobranch proposal

21.2.1 Introduction

WGEF has previously reviewed nominations for listing various elasmobranchs as 'Threatened and Declining', including basking shark *Cetorhinus maximus,* common skate *Dipturus batis,* spotted ray *Raja montagui*, angel shark *Squatina squatina*, stingray *Dasyatis pastinaca*, thornback ray *Raja clavata*, lesser-spotted dogfish *Scyliorhinus canicula*, spurdog *Squalus acanthias*, white skate *Rostroraja alba*, tope *Galeorhinus galeus*, porbeagle *Lamna nasus* and blue shark *Prionace glauca* (ICES, 2002) and *L. nasus*, *P. glauca*, *S. acanthias*, *R. clavata*, *R. alba, S. squatina,* leafscale gulper shark *Centrophorus squamosus*, gulper shark *Centrophorus granulosus* and Portuguese dogfish *Centroscymnus coelolepis* (ICES, 2007).

Following the review of the 2006 nomination for listing *R. clavata*, the OSPAR BDC agreed that the North Sea stock (i.e. in OSPAR Region II) could qualify as 'Threatened and Declining', and noted that further evidence was required to extend such listing to other OSPAR Regions. In 2007, Germany revised the nomination for *Raja clavata* to be included on the OSPAR List of Threatened and Declining Species and Habitats, taking into account the comments provided by ICES, 2007, and resubmitted these nominations to the OSPAR BDC. The revised nomination for *Raja clavata* focused on the stocks in OSPAR Region II (North Sea) and Region III (Celtic Seas) (OSPAR, 2007).

ICES has been asked to peer review the revised nomination for *R. clavata* in the Celtic Seas ecoregion (OSPAR Region III) including a review of whether the data used to support the nomination are sufficiently reliable and adequate to serve as a basis for conclusions that the species in this region can also be identified as threatened and/or declining according to the Texel/Faial criteria (see OSPAR, 2003). The six Texel/Faial criteria are global importance, regional importance, keystone species, rarity, decline and sensitivity. These criteria were reviewed recently by the Working Group on Fish Ecology (ICES, 2004). WGEF was originally asked to "Address the OSPAR request on *Raja clavata* with a deadline of 20 December 2007".

21.2.2 Evaluation of species nomination: Thornback ray (*Raja clavata*)

Global Importance: *R. clavata* is widely distributed in the eastern Atlantic and Mediterranean, and the OSPAR area is not of global importance to the species, as correctly stated in the nomination.

Regional Importance: The nomination states that *R. clavata* is "not of regional importance under the Texel-Faial criteria", which WGEF considers appropriate.

Rarity: The nomination states that *R. clavata* is "not rare", which WGEF considers appropriate.

Sensitivity: The nomination stated that *R. clavata* is "sensitive to very sensitive", which is appropriate. The first paragraph of this section described this species' demography and medium/large body size, which can make it susceptible to capture, over-exploitation and can also result in a lower capacity for stock recovery (depending on fishing effort). The second paragraph referred to the potential sensitivity conferred by the combination of declining historic abundance and concentration of range, as observed in the North Sea.

Keystone species: No.

Decline: The nomination reiterated the documented declines in distribution in the North Sea, with this population now concentrated in the south-western North Sea. Although the nomination used some of the most recent findings of WGEF (ICES, 2007), it was surprising that the issues of species misidentifications, as highlighted in ICES, 2007, were not raised as caveats in relation to earlier assessments made during the DELASS project and earlier WGEF meetings (ICES, 2002; Heessen, 2003), which were also cited in the nomination.

The nomination illustrated the landings of skates and rays in the North Sea, but stated that this figure "likely under-represents the decline in the proportion of *R. clavata* in commercial landings", citing the decline of larger bodied species, including *R. clavata*, and the concomitant increase in smaller-bodied species described *inter alia* by Heessen, 2003 and Walker and Heessen, 1996. However, the lack of long-term data on the species composition in commercial catches prevents further analyses to substantiate the claim.

For OSPAR Region III, the additional area under nomination, the available information used included recent analyses of survey trends (which have been broadly stable in recent years: see ICES, 2007), landings data, an earlier study by Dulvy *et al.*, 2000, and also cited studies using historic data (e.g. Rogers and Ellis, 2000).

In terms of the commercial landings of skates and rays from the Celtic Seas eco-region, the nomination stated that "the decline in the proportion of *R. clavata* in commercial landings may be under-represented", although once again there was no supporting evidence provided on the species composition in commercial landings over the time period. Species-specific landings data could be used, although such data are limited and would need to be viewed in the context of changes in fishing patterns (areas, gears, effects of other regulations, etc.) before a conclusion can be drawn. Changes in species composition over time in research vessel surveys provide limited information on this. WGEF has assembled various data sets on species composition within the Celtic Seas eco-region, and it varies depending on the ICES Division as well as data source (e.g. scientific/commercial). Further work on temporal trends in species composition is required.

The nomination stated that "Dulvy *et al.*, 2000 identified a decline in abundance of this species in surveys in the Irish Sea from 52.8% of skate catches in 1958–1964, to 42.7% in 1988–1997", though given that 1988–1997 groundfish surveys used a 4 m-beam trawl, which can under-represent larger batoids, whilst the 1958–1964 surveys were conducted with otter trawl and were undertaken specifically to tag and release skates, it is hardly an appropriate comparison. The nomination also cited Dulvy *et al.*, 2000 for illustrating a decline in *R. clavata* in 1988–1997, although this analysis is potentially biased by changes in the spatial distribution of sampling stations (with proportionately more inshore stations prior to 1993). The trends in the relative abundance of *R. clavata* since 1993, when the survey grid has been better standardised, are more stable.

The nomination also cited Rogers and Ellis, 2000; and although this study reported a historic decline in the relative abundance of some elasmobranchs, including thornback *R. clavata*, it only covered small areas (including Start Bay in ICES Division VIIe and the NW Irish Sea), and did not cover the wider parts of OSPAR Region III.

Overall, there was no clear evidence presented indicating major recent declines of *R. clavata* in OSPAR Region III. Observed historic declines only covered small parts of the species' range.

Threats: *R. clavata* is taken in targeted fisheries and as a bycatch in various demersal fisheries, as rightly highlighted in the nomination, and the nomination also acknowledges that *R. clavata* "is still one of the most abundant rajids in the North-eastern Atlantic and Mediterranean".

Other comments: The section on sufficiency of data stated "Fishery-independent survey data are also lacking in most regions". However, given that *R. clavata* is most abundant on the inner continental shelf, extensive areas of its distribution are covered by the various groundfish and beam trawl surveys conducted by national fisheries laboratories (though obviously the density of stations could be improved, and some data are compromised by misidentifications).

Completeness, sufficiency and interpretation of data: Adequate evidence was provided in the revised nomination for this species in the North Sea (Region II), as already supported by WGEF (ICES, 2007). There were, however, insufficient data presented to identify widespread and major declines in the relative abundance and distribution of *R. clavata* over OSPAR Region III (Celtic Seas ecoregion).

Conclusion: WGEF considered that there were insufficient data presented to conclude that *R. clavata* should be listed as a threatened and/or declining species over OSPAR Region III.

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Annex 2: Suggested ToRs for 2009

The **Working Group Elasmobranch Fishes** [WGEF] (Chair: Jim Ellis, UK) will meet in [Halifax, Canada?] from 22–29 June 2009 in a joint meeting with the ICCAT shark subgroup to:

a) Update the description of elasmobranch fisheries for deep-water, pelagic and demersal species in the ICES area and compile landings, effort and discard statistics by ICES Subarea and Division.

b) Critically review species-specific landings data for demersal elasmobranchs from national landings statistics, market sampling programmes and discard/observer programmes, in order to compile species-specific data by stock area.

c) Undertake assessments for the NE Atlantic stocks of spurdog *Squalus acanthias* and porbeagle *Lamna nasus*.

d) Examine the potential benefits of size-based restrictions (minimum landings sizes and/or maximum landing lengths) for spurdog under various model scenarios.

e) Finalise chapters for the ICES CRR.

f) Finalise the manuscript of a photo-ID key for elasmobranchs in the ICES area.

g) Evaluate the allocation of deep-water sharks in ICES Assessment Working Groups and advisory process.

h) To (a) review the biological parameters that should be collected on the NEACS survey by stock in addition to those specified by PGNEACS, and (b) comment on whether routine sampling for genetics and contaminants should be carried out and if so, what species should the focus be on. Similarly advice will be sought with respect to contaminant sampling.

Supporting information

Priority	High. The work of the Group is essential if ICES is to provide advice on elasmobranch stocks, as required by the MOU with the EU.
Justification	The work done within WGEF has included development of assessment methodology for a selection of elasmobranch case-study species, which have very different population and reproductive dynamics from the conventionally assessed teleosts. ICES is expected to give management advice for elasmobranch stocks (MoU between ICES and EC), and the scientific remit of this Group will be to adopt and extend these methods and review and define data requirements (fishery, survey and biological parameters) in relation to the needs of these analytical models and stock identity, and to carry out such assessments as required by ICES customers. Spurdog, skates and rays, lesser-spotted dogfish and porbeagle are mentioned as new species the EC wants advice on, according to the new EC-ICES MOU. It is important that the progress made by WGEF through the EU-funded DELASS project is maintained and built upon. WGEF undertook detailed studies of demersal elasmobranchs (2007) and deep-water sharks (2008), and catch data and fisheries information will be updated for these stocks (ToR a). Given that landings of the main skate and ray species should be recorded to species level in the North Sea in 2008, such data should be critically appraised and contrasted with the species compositions seen in scientific trawl surveys and observer programmes, in order to gauge data quality and highlight any identification problems that may need to be addressed (ToR b), which can also benefit from photo-ID guides (ToR f). Spurdog and porbeagle are two of the more biologically sensitive shark species in shelf seas and more detailed stock assessments are required (ToR c) in order to provide advice. Given that the group could benefit from the experience developed by Canadian scientists in assessing porbeagle, it is suggested that WGEF meet in Canada. Furthermore, given the interest that ICCAT have in porbeagle shark (including a request to assess porbeagle by 2009), this could usefully be undertaken in a joint meeting. In 2008, ICES recommended a precautionary size restriction on spurdog. Further modelling of size restrictions is required to determine the potential benefits of such measures (ToR d). Given that the EC is developing a Plan of Action for Sharks, WGEF should finalize the draft CRR (ToR e). WGEF will also discuss and comment on those ToRs given to the group by WGDEEP (ToR g) and PGNEACS (ToR h).
Relation to Strategic Plan	Directly relevant, it allows ICES to respond to requested advice on elasmobranch fisheries. It is also necessary to ensure that elasmobranchs are considered in the ecosystem approach and in fleet-based forecasts that ICES will be carrying out.
Resource Requirements	No specific resource requirements, beyond the need for members to prepare for and participate in the meeting.
Participants	Most countries are now participating in the group and membership includes biologists, mathematicians, fisheries specialists and environmentalists. There is a wide variety of interests represented. Delegates from France and Spain attended in 2007, and it is hoped that expertise from these nations will continue. In 2008, WGEF would benefit from attracting fisheries scientists with a knowledge of high seas fisheries for large pelagic fish.
Secretariat Facilities	Support is required to extract survey data from ICES databases. Otherwise very little input required from secretariat.
Financial	It is hoped to publish the work of WGEF as a CRR.
Linkages to Advisory Committees	WGEF reports to ACOM.

Linkages to other Committees or Groups	Close cooperation with LRC is essential. This should include presentation of WGEF report at LRC meetings. WGEF needs to maintain close working relationships with regional demersal assessment groups (WGNSSK, WGNSDS, WGSSDS, WGDEEP), relevant survey and biology working groups (e.g. IBTSWG, WGFE, SIMWG) and other fisheries and assessment groups (e.g. WGFTFB, WGMG, PGCCDBS). In terms of pelagic sharks, WGEF should work in cooperation with ICCAT's SCRS shark species subgroup.

Annex 3: Technical minutes from the Deep Sea Fisheries Review Group

- RGDEEP
- By correspondence March 31–April 4 2008
- Participants: Martin Pastoors, (Co-chair), Mark Tasker (Co-chair), Ciaran Kelly, Vincent Guida, Telmo Morato, Robert Brock, Tom Blasdale
- Working Group: WGEF

General comments

The reviewers appreciate the very difficult job the WGEF have in assembling the relevant information and would support the WG suggestion to hold future meetings later in the year when it would be easier to get the data. The report sections reviewed are well written in parts and contain some very useful information on the historical exploitation of the elasmobranch species concerned.

There is a tendency to make references to previous WGEF text and analyses. Whilst this may be satisfactory from the point of view of maintaining a manageable report size the WG should take care to summarize previous analyses and carry forward relevant figures and tables. When this has not been done the statements and some conclusions in the WG report appear unsubstantiated. There are several comments by the reviewers on this point which are detailed in the technical minutes.

WGEF have a tendency to present equivocal information without an accompanying expert opinion on the relative value of this information. This is particularly the case where the quality of the commercial landings data are concerned. This has the effect of undermining the basis of the information. The information presented could be transformed into useful knowledge for managers if it were accompanied by expert judgement.

The reviewers are aware that the issue of stock identity is very difficult for the WG to cope with given the lack of scientific information. The WG approach (in the absence of stock structure information) to provide advice on local resources in order to prevent localized depletion, is fine. However the WGEF should also be cognisant of the shortcomings of considering such structure. Where resource trends transcend traditional fishing areas this could indicate a major problem for a more widely distributed stock than considered. And by corollary differing trends in traditional fishing areas may be an indication of distributional changes in a more widely distributed stock, rather than a change in stock status.

The continuing allocation of fishing opportunities by client commissions on resources which the WGEF have clearly indicated to be vulnerable, and in many cases depleted, is a cause for concern. The reviewers considered that in such a situation WGEF should strive to provide the clearest and most unequivocal basis for meaningful advice. This would necessitate the increased application of expert opinion, more careful consideration of the language used to convey the conclusions of the expert group and stronger recommendations for the improvement of data collection measures.

Reviewer 1 general comments

I appreciate the many hours of hard work, creative thinking and skilled analysis by WGEF and WGDEEP as well as the many people that provided information and support for stock assessments. I know that everyone involved completed too much work in too little time with too few resources. Although many of my comments are critical, they are offered with my sincere respect and with the intent of improving assessments and management decisions. Suggestions that directly affect stock status determination or management considerations are in red.

The advice for many of the WGEF and WGDEEP assessment units is based on the precautionary approach and typically recommend that fishing should only be allowed when a stock assessment and a management plan, with the appropriate monitoring requirements are developed. If a fishery is being allowed despite advice, I recommend that compliance with advised data collection should be included in assessment reports.

Section 1 introduction

a) Section 1 (Introduction) This section is well written and offers valuable context for single species assessments, including historical development of assessments, common data problems and management challenges.

1. Table 1.3 distinguishes updates from assessments. In my opinion, this distinction helps to prioritize WG activities and makes the review and advisory process more efficient. However, other ICES WGs include a third category of 'observation' units, in which a full assessment is completed each year during critical management issues. I recommend that the WGEF resources at highest risk of collapse be given higher priority every year during the recovery plan implementation. Therefore, I suggest that spurdog and basking shark be assessed annually. Given that Portuguese dogfish, leafscale gulper and kitefin shark are essentially indicator stocks for the entire deep-water elasmobranch species complex, I also recommend that they be assessed annually.
2. On a similar note, some resources were scheduled for an 'assessment' in 2008 (Table 1.3), but the associated report sections are less informative than many 'update' assessments. For example, I don't think the kitefin section (4) is an adequate assessment report.
3. The over-arching issue of uncertain stock identification is important for provision of advice. One tendency in uncertain situations is to provide advice on local resources, with the intent to avoid local depletion of self-sustaining resources. Although this tendency seems reasonable, it may confound perceptions of stock status. For example, a recent review of demersal elasmobranchs in the Northwest Atlantic (Frisk *et al*., 2008 Ecological Applications, 18: 234–245) concluded that an increase in skate and dogfish biomass on Georges Bank resulted from a shift in distribution from the Scotian Shelf rather than increased production on Georges Bank. In this case a broader, transboundary stock definition would have promoted more accurate interpretation of fishery and survey data. Some of the resource trends in demersal elasmobranchs in the Northeast Atlantic (WGEF) also appear to transcend traditional fishing areas (e.g. depletion of spurdog in IIIa, VI, VIIa, VIId, VIIe–k). This may result from similar fishery development (i.e. overfishing separate resources), but the possibility of wide-ranging stocks should be considered in the provision of advice for smaller management units.

4. The increase in attendance and productivity of WGEF may benefit from grouping resources taxonomically and attracting elasmobranch experts. There are also common life histories and data issues for WGEF species. However, the WG essentially lumps three different ecological groups: demersal, deep-sea and pelagic species; as illustrated by the two WGEF subgroups in 2008. There may be advantages to assessing elasmobranch species in regional WGs, particularly because most of the catch is incidental in other fisheries. For example, the time-series of Greenland shark liver landings (Figure 5.2) would make much more sense in the context of Norwegian longline effort for ling, tusk and Greenland halibut. Given the ICES trend of organizing regional groups rather than species-groups, future organizational decisions should consider the different eco-groups in WGEF.
5. ICES jargon is sprinkled throughout the text and should be defined (e.g. my ignorance about what 'MS' means, Sections 1.8.1 and 3.4.3, makes me feel inadequate).

Section 2 Spurdog

Reviewer 1 comments

b) Spurdog (WGEF Section 2) I do not think that the WGEF report provides '*sufficient relevant material… to support the results from the group*' with respect to spurdog. The conclusions of the group may be accurate, but the 2008 report is not an adequate basis for 'zero-catch' advice. Unfortunately, neither is the 2007 WGEF report. A summary of the relevant aspects of the 2006 WGEF should be provided. Several aspects of the spurdog section need more detail to support a technical review and provide a basis for advice (see recommendations below).

1. Stock distribution (2.1) The statement that 'WGEF consider there to be a single Northeast Atlantic stock in ICES Divisions I–IX' is not substantiated. It is possible that bathymetric features effectively separate the northeast and Northwest Atlantic portions of the population, but no evidence is provided in the report. If there is no evidence, the statement should be revised to 'WGEF considers the Northeast Atlantic stock in ICES Divisions I–IX to be a single assessment unit.'
2. History of the fishery (2.2.1) a brief summary of the spurdog fishery (e.g. when a market developed, when the fishery transitioned from bycatch to targeting, and when it shifted back to a bycatch fishery) is needed to interpret the landings series (Figure 2.1) and the impact of uncertain discards. Referring to Pawson *et al.* (in press) doesn't help, because readers cannot access that document.
3. ICES advice (2.2.3) A summary of the scientific basis of the zero-catch advice would help to clarify the cause of spurdog depletion (overfishing?) and support 2008 advice.
4. Landings (2.3.1) There is no evaluation of the effect of updated French data on estimates of landings data. The updated French data resulted in decreased landings from 1983 to 2003, after which they caused an increase. How does this affect the assessment?
5. Discards (2.3.2.)

5.1) Length composition of discards is not described.

5.2) The reference to discard mortality appears to be a combination of two publications. Mandelman and Farrington, 2006 is "The physiological status and mortality associated with otter trawl capture, transport and captivity of an exploited elasmobranch, *Squalus acanthias*. ICES JMS 64: 122–130), Madelman and Farrington, 2007 is the paper cited in the references. The distinction is important, because in the 2007 paper, the pens used to hold the dogfish for 72 hrs may have had a significant effect on the results; the 29% observed mortality of trawled individuals is much higher than the 5.9% mortality exhibited by individuals trawled, transported on land and held for 30 days. In addition the dogfish caught via hook and line exhibited similar mortality (24%) to the trawled individuals (29%) indicating pen enclosures may be strongly affecting the results.

6. Commercial length frequencies (2.4) According to the 2006 report, length samples are restricted by both area and years: UK (England and Wales) - 1983 to 2001; UK (Scotland) - 1991 to 2004. There is no discussion of the limitations of only UK data (2.4.2).

7. Survey data (2.6.2)

7.1) There is no data to support the statement about 'trend of decreasing occurrence.' The decreasing frequency of large catches (Figure 2.2) is the only survey data provided. I recommend tables and figures of conventional relative abundance and biomass from all surveys listed in section 2.6.1. I also recommend geographic plots of survey catches over time to assess resource areas and potential shifts or restrictions in distribution.

7.2) The survey data are essentially restricted to UK waters, but there is no discussion on how this might limit perceptions of the resource.

7.3) An analysis of the available length distributions from surveys would help to determine stock status and fishing effects.

8. Assessment models (2.8) There are no results provided from the most recent exploratory analysis (the GLM-index, length-based population dynamic model). The 2006 WGEF report indicates that the model performed well, with low correlation among parameter, no retrospective pattern. Results (e.g. Figure 9.4.6.3 in the 2006 advice and Figures 2.12–2.21 in the 2006 WGEF report) offer compelling evidence of depletion, but also suggests substantial reduction in fishing mortality in recent years. Given the critical management issues related to spurdog, I think assessment results are needed to support management advice. Furthermore, I recommend that updating and advancing the assessment model of spurdog should be a priority for WGEF for the foreseeable future. The exploratory analysis appears to be an objective way to synthesize all information on spurdog for an objective evaluation of stock status.

9. Quality of assessments the Section refers to the 2006 report with no summary of results. Therefore, the conclusion that all exploratory assessments and data indicate a decline is difficult to review.
10. Reference points (2.10) This Section merely states that no reference points have been proposed, with no explanation of why. Similar to my recommendation above for regularly updating and advancing the assessment, I strongly recommend that reference points be evaluated and considered for spurdog. The length-based model in the 2006 report should provide a framework for estimating several conventional reference points (e.g. $\%B_0$, Fmsy, Bmsy). Even exploratory analyses, similar to the simulations described in 2.8.2 would help.
11. Management considerations (2.11) The statement that 'trends in stock biomass are undeniable' are not supported by the information in the 2008 WGEF report, but the necessary information is in the 2006 WGEF report.

Reviewer 2 comments

2.2.1 History of the fishery

Reference to 2006 WG report, it would be useful to have electronic links to all cited ICES material available through the SharePoint site. i.e. 2005 WGEF report no longer available on ICES web but cited frequently in this report.

"Main exploiters France Ireland Norway and UK", however there is no information to assess the relative current or historical catches by these countries; conclusion therefore that the statement is not substantiated with data.

2.2.2 Fishery in 2007

Apart from the statement "No new information" the text in this paragraph belongs to 2.2.4. Given the current management advice for this stock, I expected, at very least, fisheries information to be updated for 2007. Even in the 2006 report there is no information available for French spurdog fisheries, given that they are putatively a major catching nation and that the stock is putatively in poor shape, there should be some recommendation to remedy this situation.

2.2.3 ICES advice applicable

"The 2006 ICES advised that:" Presumably this is a reference to the 2005 WGEF which provided the advice for the year 2006.

2.3.1 Landings

Text says 2007 landings 5563 t, Table 2.1 says 2501 t, presume mistake in the text.

2.3.3 Quality of the catch data

Could be more specific here; the reference to misreporting in ICES 2006 is based only on anecdotal evidence and involves under and over reporting. This information is equivocal without an expert interpretation of how much of each category, and how reliable the sources are.

2.6.2 Cpue

Figure 2.2 shows decreasing frequency of large catches but not a decreasing trend of occurrence. Even looking at ICES 2006, the analysis begs the question about the changes in gear and survey area over the period, these are not discussed.

2.7 Life history information

WG assumes length dependent natural mortality, where old fish (fully grown) have a greater mortality than less old fish (presumably also fully grown), there may be little or no size difference between these two groups, therefore the statement of size dependent natural mortality is not correct. There is no information presented as to the values by length, nor is the information used in any analyses in this report. Notwithstanding this, the concept of increasing natural mortality with age is unconventional in a fisheries science context and should at least be qualified with a hypothesis or citation.

2.9 Quality of assessments

The statement that the "models have not proved entirely satisfactory, as a consequence of the quality of the assessment input data" could imply that the models are fine and that the input data needs to be improved, or that the models are inadequate to describe the stock dynamics. Presumably it is the former conclusion but in the 2006 report it was stated that the "exploratory model shows promise as an assessment approach for spurdog demonstrating almost no retrospective bias and reasonable fits to the available data". If this was the case in 2006 what has happened to the data in the meantime, or why has the WG changed its opinion on the success of the exploratory assessments?

2.11 Management considerations

There is a mixed communication in the statements "the NE Atlantic stock of spurdog has been declining rapidly" and "this decline has being going on over a long period of time", the phrase "has been declining rapidly" implies a change to the rate of abundance decrease in the recent past, this is not substantiated by the data presented. This is an important subtlety as in the absence of any abundance quantification the rate of decline will inform the advice for the stock.

Section 3 Siki

Reviewer 1 comments

1. In my opinion, referring to this resource as 'siki' sharks is confusing. The ToR uses the common species names, but the WGEF section uses 'siki sharks' (maybe a minor inconsistency to some, but considerably confusing to a non-elasmobranchophile like myself). As noted in Section 1.1, the fishery uses the term 'siki shark' to refer to all deep-water sharks. The phrase also implies a single taxonomic unit, particularly accompanied by another section on 'other deep-water sharks.'
2. Some citations (e.g. Clarke, 2001; 2002) are not in the references.
3. Stock distribution (3.1) I think that both stock definitions are reasonable. The highly migratory nature and ontogenetic patterns of distribution of leafscale support the decision to provide advice on the entire Northeast Atlantic resource.
4. History of the fishery (3.2) It would help to include a brief description of when the market developed and when discarding may have been substantial to interpret fishery development from the landings series.

For example, the 2006 WGEF report states that the dataseries extends to the beginning of the fishery in 1988, and discards before 1988 are unknown but are believed to have occurred. This information is essential to correct interpretation of the landings series.

5. Catch data (3.3) The primary source of uncertainty in this assessment is the lack of species-specific catch data, particularly because of the different life histories of the two species. The 2006 efforts sound promising and should be updated. Information should be provided on how catch data were separated into individual species. Species composition ratios were reported in the 2006 WGEF report (Table 3.5), but associated assumptions were not described. Inaccurate distribution of catch may affect perceived trends.
6. Discarding (3.3.2) Observer data were available to WGEF in 2007, but is not reported in the 2008 document.
7. Length compositions (3.4.2) Length distribution can be valuable information, particularly for data-poor stock assessments, but only if compared to previous years and growth studies. I don't know if the frequency of >100 cm fish in Figure 3.3 is similar to previous years or even close to the maximum size. The text states that the length range is the same as previous years, but it would help my review to demonstrate the similarity (as done in Section 5, Figures 5.6–5.12). There is more information provided on length frequencies in the 2006 WGEF report (e.g. no obvious trend in mean length over time).
8. Quality of catch and biological data (3.4.3) The conversion factor for raising livers to total live weight should be reported, and the method of deriving the conversion. The basking shark assessment (Section 7) illustrates how errors in the conversion can substantially affect the catch series.
9. Cpue (3.5) I recommend that the y-axis of Figures 3.4 and 3.5 be restricted to positive values. Negative values of confidence intervals are meaningless, and the axis compresses the most important information in the series: trends in cpue.
10. Surveys (3.6)
    - 10.1) The report correctly describes the problem of few stations per stratum, but I agree that the decreasing trends in occurrence (Figure 3.5) are a cause for concern. Perhaps a frequency analysis (e.g. multiway frequency tables of positive and zero catches by year and depth stratum) would help to objectively test the perception of change in occurrence over time.
    - 10.2) Information in Section 5, the kg/tow series from the Scottish survey (Figure 5.4) and the comparison of exploratory surveys during the 1970s with the FRS survey in Section 5 (Figure 5.5), should be considered for inclusion in this assessment (with all associated caveats about comparability of the data in Figure 5.5). These data support the conclusions that Portuguese dogs and leafscales are depleted.
11. Management considerations (3.11)
    - 11.1) I think the phrase 'cpue of both species has demonstrated a strong decline…' can be confused to mean that cpue of each

species has declined. I think a less confusing phrase would be 'cpue of combined species has revealed a strong decline…'

I agree that 'there is no new information in 2008 to alter our perception…,' but I think a stronger conclusion would be that updated information confirms our perception.

Reviewer 2 comments

3.3.1 Second paragraph landings in 2007 at 1400 not consistent with Table 3.1 where it is 1849 t.

3.3.2 Last line, presumably replace "discard limit" with "bycatch limit".

3.3.3 It would be very useful to give an expert judgement on the extent and significance of any of the categories of misreporting. Without this all this text does is to undermine the confidence in any of the landings data, without being able to say where the problem lies.

3.4.2 Statement "This the same length range for these species as in previous years", not substantiated by Figure 3.3.

3.11 Comment of strong decline in cpue not referenced to previous work nor substantiated by text in report. Presumably this is referring to 2006 WG where the data are presented in Figures 3.6 and 3.7. The text "In Subarea IX cpue appears stable for leafscale gulper, though declining somewhat for Portuguese dogfish" is a rather selective summary of these figures which show cpue stable only for trawl catches of Portuguese dogfish, and declining for longline, and also both trawl and longline catches of leafscale gulper shark. In fact the 3 year time-series of line-caught leafscale gulper shark in IX demonstrates the most dramatic decline of any species in any area.

Section 4 Kitefin shark

Reviewer 1 comments

c) This resource was scheduled for an assessment in 2008 (Table 1.3), but many sections simply state 'no new information.' This is insufficient for an assessment and impossible to review as an assessment. More importantly, the report is not sufficient as a basis for the advice (no directed fishing). The 2006 report states that 'no information is available' for many of the data sources; if that is still true, then the phrase 'no new information' is misleading.

- i) Stock distribution (4.1)
    - 1) The meaning of the sentence 'elsewhere in the NE Atlantic, kitefin shark is recorded infrequently' is unclear. Elsewhere from where? Deeper water of the N. Atlantic? ICES area IX? Subareas V–VII?
    - 2) There is no justification for considering the Azorean resource (not a stock) as a management unit. Is there a geographically distinct Azorean resource and fishery?
- ii) Landings (4.3.1) It would help to have a description of the WGs interpretation of the landings series (Table 4.1) as an indication of fishery development.
- iii) Discards (4.3.2) I suspect that there is more information on discards than the three fish caught incidentally in mackerel fisheries. Which other fisheries catch kitefin? Are data available for them?

iv) Surveys (4.6) Information in Section 5, the kg/tow series from the Scottish survey (Figure 5.4) and the comparison of exploratory surveys during the 1970s with the FRS survey in Section 5 (Figure 5.5), should be considered for inclusion in this assessment (with all associated caveats about comparability of the data in Figure 5.5). These data support the conclusions that the kitefin resource is depleted.

v) Stock assessment (4.8.2) The text states that the biomass dynamics model developed in 2003 was not updated, because no new data were available, but catch data were updated to 2007.

vi) Management considerations (4.11) The advocacy for no directed fishery may be appropriate, but the WG report does not make a compelling case, and is an inadequate basis for that advice.

Reviewer 2 comments

4.11 the text "preliminary assessments", suggests that some contemporary analyses have been conducted, in fact I had to go back to the 2005 report to get the source of the text in management considerations. All the biomass dynamic models for this stock indicate a decrease from a virgin biomass of about 16 kt to about 7 kt. The biomass stabilizes under the more contemporary catch regime of >200 t. With the current catch at less than 20 t, about 10% MSY, and having been below MSY for the past 10 years, the stock should be in no immediate danger.

Section 5 Other sharks

Reviewer 1 comments

d) The section is informative, but emphasizes that advice and management are based on the Portuguese dog, leafscale and kitefin assessments. Trends in the Scottish survey (Figure 5.4) and the comparison of exploratory surveys during the 1970s with the FRS survey (Figure 5.5) suggests that these 'indicator stocks' are more depleted than the others in the analysis (with the possible exception of velvet belly, Figure 5.4), and are therefore appropriate indicators of the risks associated with deep-water elasmobranch resources.

i) History of the fishery (5.2.1) The time-series of Greenland shark liver landings (Figure 5.2) may be valuable, but need to be described in the context of Norwegian longline effort for ling, tusk and Greenland halibut. It appears as though there was a temporary increase in effort during World War I, and little effort during WWII (as is more typical with other NE Atlantic catch series). The WG should clarify whether these peaks in landings result from patterns in the resource or the fishery (I assume that the latter is more likely).

ii) Catch data (5.3) No catch data are provided for skate species.

iii) Surveys (5.6)

1) It would help to include confidence intervals in the survey trends plotted in Figure 5.4.

2) It appears that the scientific name for kitefin (*Dalatias licha*) is incorrectly labelled as *Scymnorhinus licha* in Figure 5.4, because the latter is not mentioned anywhere else in the section. There is inconsistent use of common and scientific names throughout the

report. I recommend consistent use of common names with an initial identification of scientific names.

3) There is no description of the size frequencies or geographic plots in Figures 5.6–5.13. It may be more informative to plot annual size frequencies to illustrate temporal changes.

4) There is a loose end in Section 5.6.3 on coordination of deep-water surveys.

5) Are survey data available for skate species?

iv) Life History information (5.7)

1) The text in this section is limited to velvet belly, but Table 5.11 lists life-history parameters of other shark species.

2) There is an error in the scientific name of the longnose velvet dogfish in Table 5.11.

References should be provided for the information in Table 5.11.

Reviewer 2 comments

Undoubtedly a lot of time and effort has been spent compiling landings data for a range of some 9 shark species and 14 skate species. This at least is valuable information. However in general this section does not make any clear conclusions from the available material.

5.2.2 There is a comment on the displacement of gillnetting effort from VI and VII to IV VIII and IX, but this begs the question, what, if any has been the likely impact on the exploitation on these species?

Questions outstanding from this section

- Are the current regulations sufficient to protect these species from overexploitation?
- Is the displacement of gillnet effort from VI and VII to IV VIII and IX undesirable?
- Is the conclusion that the fishing regulations for Portuguese dogfish and leafscale gulper shark are sufficient to manage these bycatch species? This is not very clear.

It would be nice to have more science available on these species, but in the absence of data from commercial fisheries more emphasis should be placed on whatever biological knowledge of the species there is. Without at least some expert comment on the likely susceptibility of these species to exploitation by the documented fisheries where they are taken as bycatch, the information is of little use for informing the advisory process. There is information in Table 5.11 which requires expert interpretation (or at least a complete legend as to the abbreviations used). My interpretation is that in general these species give birth to live young and have an extremely low fecundity compared to teleost fish, and that this makes them equally vulnerable as the shark species covered in Section 3.

Section 7 Basking Shark

Reviewer 1 comments

v) Stock distribution (7.1) The statement that 'WGEF considers that a single-stock of basking sharks exists in the ICES area' is not substantiated. If there is no evidence of population structure, the statement should be revised to 'WGEF considers the resource of basking sharks exists in the ICES area as a single assessment unit.'

vi) History of the fishery (7.2.1) This is a well-written and wonderfully informative section that offers insights on fishery development and productivity that should serve as a valuable baseline for rebuilding the resource.

vii) Discards (7.3.2) With the prohibition of fishing, the detailed description of discards is important and will need to be continued to monitor recovery.

viii) Life history (7.7)

1) Life history information is also critical to monitoring recovery. However, in comparison of the excellent sections of the historical fishery and discards, this section is simply a description of the length-weight relationship. It should be expanded to describe other aspects of life history.

2) Parker and Stott's 1965 study of the age of the basking shark should be included in this section.

ix) Exploratory assessment (7.8) The catch, cpue and sighting survey data should be analysed using an integrated population model (similar to the one developed for spurdog, WGEF 2006).

x) Reference points (7.10) Interim reference points should be evaluated for consideration in a recovery plan.

Reviewer 2 comments

There is a thorough report of historical information on this species; however as in Section 5, this section is lacking a clear conclusion, or expert opinion on the current status and management. Given that the species is listed under several conservation conventions, the obvious question of whether the current ban on directed fishing only is sufficient is not answered. In Section 7.3.2 the final sentence could be used as the basis for a useful management consideration.

Annex 4: Technical Minutes from the North Sea Review Group

- RGNS
- By correspondence, 26–28 May 2008
- Reviewers: Asgeir Aglen (Chair, Norway), Norman Graham (Ireland), Valentin Tryjillo (Spain), Eero Aro (Finland)
- Working Group: WGEF (Jim Ellis (Chair WG), Secretariat: Barbara Schoute/Henrik Sparholt

General

The Working Group is complimented for a clearly structured and understandable report.

Benchmark assessment proposal

Benchmarks to be performed **before the next assessment**

STOCK	PROBLEM	LAST BENCHMARK

Demersal Elasmobranchs in the North Sea, Skagerrak, Kattegat and Eastern Channel

Assessment type	Trends only
Assessment:	No assessment presented
Forecast:	None presented
Assessment model:	Not applicable
Consistency:	same as previous year with updated surveys and landings data
Stock status:	Unknown
Management Plan:	No specific management plan

General comments

The WG presented updated landings data but no further analysis of survey data were considered by the WG in 2008. The RG acknowledges the general data deficiencies for all elasmobranch species, in particular the problem of species identification of both commercial landings and misidentification of species associated with scientific survey data. The previous work on survey based methods to track relative abundance in relation to area occupancy is commended by the RG, it is likely that these stocks are well suited to an indicator based approach and the WG has made good progress in this direction. Further developments in this field are encouraged.

Technical comments

The WG note that no species-specific effort data area available for North Sea skates, although the RG acknowledge the issue of species id, it must be emphasized to note that the majority of the catches are taken in mixed demersal fisheries so lpue indices could be developed by ICES statistical rectangle using OTB and TBB effort for example. The WG are encouraged to explore this further.

The WG make reference to a number of previous studies and analysis. The WG are encouraged to either include the relevant information in the text or in the Stock Annex.

Section 15.3.3. The second sentence contradicts the first; data are available but are limited.

Section 15.6.2 2nd paragraph. The summarized catch rates have not been presented in the WG report.

Similarly, last paragraph 15.8.1. The WG note that "from the data….it can be seen" this information should either be included in the report or in the Stock Annex.

Typo under Section 15.6.3, Sub-section 1.6.3.1 should read 15.6.3.1

A mute point but, Section 15.10 should read "for *R. clavata* or other **elasmobranch** stocks in this ecoregion"

Improvements for next year

The RG note the previous analysis of survey data as a method to track abundance. However, as the WG note, the stock boundaries in many cases are not well defined. It would be useful in the first instance to identify the spatial distribution of the commercial fisheries by mapping landings information from logbook data by statistical rectangle; this could be complemented by incorporating fishers' knowledge for further validation. This may allow i) the build-up of a time-series of spatial and temporal trends in lpue and ii) it can be contrasted with the spatial and temporal distribution of the IBTS and beam trawl surveys to see if these provide adequate coverage, at least of the distribution of commercial activity. The RG acknowledge that this does not overcome the issue of species id in commercial logbooks, but the use of logbook data may be useful for species that are easily distinguishable such as spurdog.

The WG could also consider combining logbook and VMS data from individual vessels where their landings have been quantified through market sampling. Although this may limit the number of samples, it does offer the potential to obtain verified lpue data at a fine spatial and temporal scale and may provide a useful stock indicator e.g. length, maturity, sex, etc, if such data are recorded e.g. Trenkel *et al.*, 2007 ICES Journal of Marine Science 64 768–774.

The WG are also encouraged to explore the use of data obtained from discard observer trips, which will complement the information identified above, but may also provide insight into the effect of management regulations such as a the bycatch ratio and what the impacts on discarding may be. The WG should note that a number of recent publications have demonstrated that the discard survival rate of some species (lesser spotted dogfish and spurdog) indicate that mortality in some circumstances is low.

Things that need update before ADG

Nor applicable

Conclusions

RG agrees with WG on these stocks, but notes that more use of commercial data in future is advised for the development of lpue and other indicators on stock health and distribution.

Annex 5: Technical minutes from the Bay of Biscay and Iberian Seas Review Group

- RGBBI
- By correspondence May 19–21, 2008
- Reviewers: Jesper Boje (Denmark, Chair), Cecilie Kvamme (Norway), Marcel Machiels (Netherlands), Jim Ellis (WGEF Chair), Mette Bertelsen (ICES Secretariat)
- Working Group: WGEF

Preface

To ACOM

The RG would like to flag that present review is far from comprehensive as a consequence of a number of factors that include: the review correspondence meeting was scheduled 19–21 May. The review group got access to the WGHMM report 15 May meaning that the RG had two weekdays for the review. Second, a meeting by correspondence communicates significant less efficient than when being physical together (*i.e.* no presentation from WG chair). And finally, this review group consisted of the minimum number of members according to the ICES guidelines. However, despite the RG time pressure and the few members participating, the RG has put their maximum effort into this review.

For future consideration the RG suggests actions on the following issues: 1) national institutes should take their task serious of nominating members for RGs (*i.e.* both doing it and also ensuring the proper expertise), 2) instead of having correspondence RGs, ICES should have their secretariat check update assessments such as checking tables, figures and references and 3) RGs main task should be to review benchmark assessment apart from the task of WGMM.

To WGHMM

The present review has been conducted during a correspondence meeting in contradiction to previous reviews where reviewers met physically. A correspondence meeting has many shortcomings compared to a physical meeting. The usual presentation by the WG chair is omitted and communication with the chair is strongly impeded. Therefore the present review may contain comments that seem of minor importance and would normally be solved underway in a RG meeting. However, the WGHMM chair, Manica, has put a huge effort into addressing as many of the issues raised by the RG as time have allowed for during the meeting. These answers are included in the present report as well as responds to them by the RG.

General

The sections reviewed are according to the new AMAWGC ToC. However, the Group has not yet been able to produce integrated advice.

The numbering for each of the reviewed stocks below is referring to section number in the WG report.

A section under each stock entitled "changes in assessment from last year" o.a. should be provided in order to allow the reviewers to get an overview of whether the assessment is purely update or whether there have been changes in input data, models or model options. This will also allow the ADG to track information in the summary sheet section "Comparison with previous assessment and advice". Presently this information is found in various places of the report and sometimes not.

General comments to *Nephrops* stocks

In order to assess the consistency in catch matrices and tuning fleets, the RG recommend WG to present catch curves and within and between index consistency plots. However, it cannot be ruled out that such exercises might be in conflict with the ageing approach of slicing techniques combined with estimated growth parameters.

Nearly all *Nephrops* sections refer to Table 1.3 for biological sampling. However, this table contains no information on *Nephrops*.

Megrim and anglers

According to the new AMAWGC ToC no advice should be given in 2008 for those stocks. The RG did made a review on the data presented for the stocks, although not in depth.

Demersal elasmobranchs in the Bay of Biscay and Iberian Waters (WGEF)

Assessment type	No assessment, no advice
Assessment:	-
Forecast:	-
Assessment model:	-
Consistency:	same as last year
Stock status:	surveys indicate slow recovery for most stocks
Man. Plan:	-

General comments

The length distributions of dogfish and rays seem stable when comparing 2007 with the average. This in combination with decreasing lpues (Cuckoo ray) might suggest a gradual removal over the entire age span in the fishery.

Technical comments

The compilation of the survey catch rates *i.e.* the bootstrap CI indicated in Figures 19.5–7 is not explained in the text.

Conclusions

The RG recognizes the difficult conditions of the WG in compiling assessment for these stocks: inadequate species-specific landing information, lack of information on stock identity and no age determination.

Annex 6: Technical minutes from the Widely Distributed Stocks Review Group on the Northeast Atlantic porbeagle

Northeast Atlantic porbeagle (ICES Areas I–XIV)

Assessment type	Update landings only
Assessment	No assessment
Forecast	None
Assessment model	None
Consistency	same as last year
Stock status	not precisely known, considered depleted
Man. Plan.	No management plan. An EC Action Plan on elasmobranchs is being consulted on in 2008.

General comments

1. Porbeagle is a highly migratory and schooling species. Sporadic targeted fisheries develop on these schools, and such fisheries were highly profitable. The main countries catching porbeagle are Spain and France. However in the past, important fisheries were prosecuted by Norway, Denmark and Faroe Islands.
2. Overall 1973–2007 landings recorded a maximum level around 1600–1700 t first in 1979–1980 and after in 1991–1992, declining since then to the most recent 2005–2007 minimum level just below 400 tonne. Nevertheless, landings data could be incomplete and further studies are required to better collate catch data.
3. Preliminary analyses of available catch and effort data from the French fishery undertaken in 2008, demonstrated a decline in mean cpue from 1 to 0.73 kg per hook between 1994 and 2007, however with much associated variability (no significant differences). Further studies to clarify this trend are required. If possible, a longer time-series of logbook data should also be reconstructed allowing a better interpretation of cpue trends.

Improvements for next year

Things that need update before ADG

N/A

Conclusions

RG agrees with WG on stock status.