ICES WGEF REPORT 2009

ICES ADVISORY COMMITTEE

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Report of the Joint Meeting between ICES Working Group on Elasmobranch Fishes (WGEF) and ICCAT Shark Subgroup

22–29 June 2009

Copenhagen, Denmark

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CIEM Conseil International pour l'Exploration de la Mer

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Contents

Executive Summary

WGEF addresses the chondrichthyan fishes in the ICES area; collates available fisheries, survey and biological information; and evaluates the status of the main stocks of commercial and/or conservation importance.

The first part of the Report addresses spurdog (Section 2) and various deep-water squaliform sharks, including leafscale gulper shark and Portuguese dogfish (Section 3) and kitefin shark (Section 4), with data for other deep-water sharks and skates summarized in Section 5. These sections have updated information on the landings, fisheries and management applicable.

The Report then updates information on the various pelagic species, including porbeagle shark (Section 6), basking shark (Section 7), blue shark (Section 8), shortfin mako (Section 9), tope (Section 10), thresher shark (Section 11) and other pelagic species (Section 12). Following on from a successful joint meeting with the International Commission for the Conservation of Atlantic Tunas (ICCAT) in September 2008 to assess the North Atlantic stocks of shortfin mako and blue shark, the 2009 WGEF meeting was a joint meeting with ICCAT to assess the Atlantic stocks of porbeagle.

The exploratory assessments undertaken with ICCAT included a Bayesian Surplus Production (BSP) model and an age structured production model. The BSP model was used to estimate the status and project population trends for NE Atlantic porbeagle. The projections indicate that sustained reductions in fishing mortality would be required if there is to be any stock recovery. Recovery of this stock to B_{MSY} under zero fishing mortality would take in the region of 15–34 years (under the more credible model scenarios), with a reduced TAC resulting in recovery to B_{MSY} within 25–50 years under nearly all model scenarios. However it must be noted that the catch data used in the model are considered underestimates, as not all nations have reported catch data throughout the time period; the BSP model was generally more optimistic than the age-structured production model; and the main cpue index available was for a targeted fishery which may not necessarily reflect stock abundance. Hence, model outputs should be considered highly uncertain and subsequent management should account for both this uncertainty and the low productivity of the stock.

The next part of the Report focuses on demersal elasmobranchs (including skates) from continental shelf ecoregions of the ICES area, which are updated for the Barents Sea (Section 13), Norwegian Sea (Section 14), North Sea, Skagerrak and eastern English Channel (Section 15); Iceland and East Greenland (Section 16), Faroe Islands (Section 17), Celtic Seas (Section 18), Biscay-Iberian waters (Section 19) and the Azores and mid-Atlantic Ridge (Section 20). These sections have updated information on the landings, fisheries, management applicable with some fishery-independent survey data updated. For most of the species in these areas, there is no accurate delineation of stock structure, and further biological studies (tagging, genetics, etc.) are required to verify the identity of the stocks. To date, WGEF have examined these species by ICES Division (or adjacent Divisions). Whereas this may be appropriate to coastal, oviparous species (in the absence of other information), it is more problematic for some of the offshore species (e.g. cuckoo ray).

Much of the landings data for skates, especially historical information, are provided as "skates and rays"), and the absence of species-specific catch data has hampered stock assessments. Since 2008, species-specific landings should have been reported for the main skate species in the North Sea, and these data have been appraised. Although there have been improvements in species-specific data, there is still confusion

between blonde and spotted rays, and data for these species are confounded. Some species-specific data are available for other regions of the ICES area, and landings data for the main skate species in the Celtic Seas, Bay of Biscay and Iberian waters should be collected from 2009. Several national laboratories and other bodies are developing identification material to assist in the collection of species-specific data, and examples of these are illustrated.

1 Introduction

1.1 Terms of Reference

The Working Group on Elasmobranch Fishes [WGEF] (Chair: Jim Ellis, UK) will meet in ICES HQ 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) finalize chapters for the ICES CRR;

f) finalize the manuscript of a photo-ID key for elasmobranchs in the ICES area;

g) review the biological parameters that should be collected on the NEACS survey by stock in addition to those specified by PGNEACS.

WGEF will report by 6 July 2009 for the attention of ACOM.

The TORs are addressed in the sections identified in Table 1.1

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

TOR	Description	Sections
(a)	Update descriptions of elasmobranchs fisheries.	2–20
(b)	Critically review species-specific landings data for demersal elasmobranchs.	13–20, summarized in 21.1
(c)	Undertake assessments for NE Atlantic spurdog.	2
	Undertake assessments for NE Atlantic porbeagle.	6
(d)	Examine the potential benefits of size-based restrictions (MLS, MLL) for spurdog.	2
(e)	Finalise chapters for the ICES CRR.	-
(f)	Finalise the manuscript of a photo-ID key for elasmobranchs in the ICES area.	21.2
(g)	Review the biological parameters that should be collected on the NEACS survey.	21.3

1.2 Participants

The following WGEF members attended the meeting:

• Stephen Beggs	UK (Northern Ireland)
• Steve Campana	Canada
• Guzman Diez	Spain (Basque Country)
• Helen Dobby	UK (Scotland)
• Jim Ellis (Chair)	UK (England and Wales)

- Ivone Figueiredo — Portugal
- Sarah Fowler — UK
- Boris Frentzel-Beyme — Germany
- Graham Johnston — Ireland
- Armelle Jung — France
- Sophy McCully — UK (England and Wales)
- 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
- Ingo Stuermer — Germany
- Tone Vollen — Norway

The following WGEF members assisted by correspondence:

- Maurice Clarke — Ireland
- Andrey Dolgov — Russia
- Henk Heessen — The Netherlands
- Francisco Velasco — Spain

Additionally, the following scientists/observers attended the joint ICCAT meeting:

- Elizabeth Babcock — USA
- Gérard Biais — EC/France
- Enric Cortés — USA
- Andrés Domingo (Chair) — Uruguay
- Sonja Fordham — NGO
- Laurie Kell — ICCAT
- Hiroaki Matsunaga — Japan
- Sandrine Polti — NGO
- Victor Restrepo — ICCAT
- Finlay Scott — EC/UK
- Gerry Scott — USA

The following ICCAT scientists assisted by correspondence:

- Jaime Mejuto García — EC (Spain)

1.3 Background

The Study Group on Elasmobranch Fishes (SGEF), having been first established in 1989, was re-established in 1995 and had meetings in that year, 1997 and 1999. Assessments for elasmobranch species had proven very difficult because of the lack of data. The 1999 meeting was held concurrently with an EC-funded Concerted Action Project meeting (FAIR CT98–4156) allowing for a greater participation from various European institutes. Exploratory assessments were carried out for the first time at the 2002 SGEF meeting, covering eight of the nine case study species considered by the

EC-funded DELASS project (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, with the paucity of species-specific landings data a major data issue.

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) for stock identification, analytical models and to carry out such assessments as are required by ICES' customers.

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 ICES landings data, the FAO FISHSTAT database, and data from national scientists. 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 were provided for spurdog, kitefin shark, thornback ray (North Sea) and deep-water sharks (combined). ACFM produced advice on these species, as well as for 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), with good progress made in some ecoregions. Work was begun on developing standard reporting formats for length frequency, maturity and cpue data.

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, 2007), 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 ongoing tagging and genetic studies), 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.

WGEF met twice in 2008. The first meeting was in March (in parallel with WGDEEP) in order to update assessments and advice for deep-water sharks and demersal elasmobranchs. A second WGEF subgroup met with the ICCAT shark subgroup in Madrid in September 2008 to address the North Atlantic stocks of shortfin mako and blue shark, and to further refine data available for the NE Atlantic stock of porbeagle (ICES, 2008a).

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 recent years, with participation from quantitative assessment scientists, survey scientists and elasmobranch biologists.

Stock assessments for many elasmobranchs are particularly difficult owing to incomplete (or lack of) species-specific catch data, the straddling and/or highly migratory nature of some of these stocks (especially with regards deep-water and pelagic sharks), and that internationally coordinated fishery-independent surveys only sample a small number of demersal elasmobranchs with any degree of effectiveness.

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	2009	2010	2011
Spurdog	Yes	2	2	1
Portuguese dogfish and Leafscale gulper shark	Yes	1	1	1
Kitefin shark	Yes	1	1	1
Other deep-water sharks		1	1	1
Porbeagle	Yes	2	1	1
Basking shark	Yes	1	1	1
Blue shark in the North Atlantic		1	1	1
Shortfin mako in the North Atlantic		1	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 ecoregion (III, IV, VIId)	Yes	1	2	1
Demersals at Iceland and east Greenland		1	1	1
Demersals at the Faroe Islands		1	1	1
Demersals in the Celtic Seas	Yes	1	2	1
Demersals in Biscay and Iberian waters	Yes	1	2	1
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 Community plan of action for sharks

Because of their specific biological characteristics, shark populations are particularly vulnerable to unregulated and intensive harvesting. To ensure their sustainable exploitation the EU Action Plan for the Conservation and Management of Sharks (EU, 2009) was adopted by the Commission on 5 February 2009. The plan outlines the measures already in place and describes the additional measures that still need to be taken to ensure that sharks within and outside Community waters are managed in a comprehensive and coherent way. The action plan is based on the following objectives:

- Broaden our knowledge of both shark fisheries and shark species and their role in the ecosystem;
- Ensure that directed fisheries for shark are sustainable and that bycatches of shark resulting from other fisheries are properly regulated;
- Encourage a coherent approach between the internal and external Community policy for sharks.

Actions to meet these objectives and the parties responsible for them are defined in the Action Plan. Some of these actions can be implemented without delay whereas others need a longer term commitment.

1.6 Sentinel fisheries

ICES advice for several elasmobranch stocks suggests that their fisheries should, for example "*consist of an initial low* (level) *scientific fishery*". In discussions of such fisheries, WGEF would suggest that a 'sentinel fishery' is a science-based data collection fishery conducted by commercial fishing vessel(s) to gather information on a specific fishery over time using a commercial gear but with standardized survey protocols. Sentinel fisheries would:

- Operate with a standardized gear, defined survey area, and standardized index of effort,
- Aim to provide standardized information on those stocks that may not be optimally sampled by existing fishery-independent surveys,
- Include a limited number of vessels,
- Be subject to trip limits and other technical measures from the outset, in order to regulate fishing effort/mortality in the fishery,
- Carry scientific observers on a regular basis (e.g. for training purposes) and be collaborative programmes with scientific institutes,
- Assist in biological sampling programmes (including self-sampling and tagging schemes),
- Sampling designs, effort levels and catch retention policy should be agreed between stakeholders, national scientists and the relevant ICES Assessment Expert Group.

1.7 Current ICES Working Groups of relevance to the WG

1.7.1 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 Greater Thames Estuary 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.

1.7.2 Working Group for the Celtic Seas Ecoregion (WGCSE)

Several elasmobranchs are taken in the waters covered by WGCSE, including spurdog (see Section 2), tope (Section 10) and various skates and rays (Section 18). WGCSE should note that common skate *Dipturus batis,* which has declined in many inshore areas of northern Europe, may be locally abundant in parts of ICES Division VIa and the deeper waters of the Celtic Sea (VIIh–j). 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*. WGSCE should also note that the Bristol Channel is of high local importance for smalleyed ray *Raja microocellata*, as well as being an important nursery ground for various small sharks (e.g. smoothhounds and tope) and other rajids.

In 2009, the EC prohibited landings/retention of angel shark, white skate, common skate and undulate ray from this ecoregion (CEC, 2009). Angel shark was formerly abundant in parts of Cardigan Bay, the Bristol Channel and Start Bay, and is now rarely observed. Similarly, white skate may also be extirpated from most parts of the region. Common skate may be locally abundant on some offshore fishing grounds, and undulate ray are locally abundant in parts of the (western) English Channel, and so these measures may have caused controversy with some sections of the fishing industry.

1.7.3 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. WGDEEP is proposing to hold benchmark assessments for the main deep-water squaliform sharks. WGEF members would aim to attend such a benchmark workshop and Ivone Figueiredo (IPIMAR) would offer to act as a stock coordinator.

1.7.4 Working Group on Fish Ecology (WGFE)

WGFE has often addressed elasmobranchs within their ToRs, and the participation of WGEF members in WGFE meetings to further develop collaborative research (e.g. on important elasmobranch habitats) should be encouraged.

1.7.5 International Bottom Trawl Survey Working Group (IBTSWG)

In 2009, IBTSWG continued to provide maps of the distribution of a variety of demersal elasmobranchs from the IBTS surveys in the North Sea and western areas (ICES, 2009a. WGEF considered that these plots provide useful information and hope that IBTSWG will continue such work in 2010.

WGEF recommend that IBTSWG compile comparable maps examining the overall distributions (all survey data combined) of lesser-known elasmobranchs, specifically *Dipturus batis, Raja brachyura, Leucoraja circularis* and *L. fullonica* using all available IBTS survey data.

1.7.6 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 commercial 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. Given the difficulties in separating these species, market sampling may still be required to get a more accurate species composition for these sister taxa.

PGCCDBS has recently provided an overview of some of the national programmes on mixed species sampling, including rajids (See Annex 13 of ICES, 2009b). Given that there will be increased reporting of species-level landings data for skates from 2009, in accordance with the EC TACs and quota regulations (CEC, 2009), better standardized and robust market sampling designs (including training in species identification) is still required to ensure that these data are of an appropriate quality with which to provide data for assessing the stocks.

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

Annex 8 of ICES (2008b) provided a useful overview of technical issues relating to fisheries in the North Sea and Celtic Seas ecoregions, etc. It was noted that were "*Problems with the introduction of the 5% bycatch limits for dogfish (Squalus acathias) on west coast and North Sea grounds. They can be encountered in large congregations but it is almost impossible for vessels to identify them using sonar etc so they are difficult to avoid*".

WGFTFB also noted that "*Regulations introduced at the start of 2008 preventing the targeting of spurdog have created problems, particularly for inshore gillnetters off the North Galway and Mayo coasts*". Several of these vessels now spent more time potting for crab and lobster. The regulation also affected vessels operating in the southwest of the British Isles, including for trawlers which can sometimes catch large quantities of spurdog. Hence, this regulation will have led to some discarding (ICES, 2008b).

The 5% bycatch limit is no longer in force, although a maximum landing length (100 cm) was introduced for 2009.

Other elasmobranch issues discussed by WGFTFB include the switch from beam trawls to outrigger trawls (see Section 3.1.1. of ICES, 2008b). This change of gear, driven by the reduction in fuel consumption, may lead to increased catches of skates and rays, and WGFTFB noted that "*In terms of overall catch composition ray represented between 32.35%–45.07% (average 36.65%) of the total catch by weight for the four vessels*". It is thought that fishers may target skates with such gears in order to compensate for the reduction in catches of sole *Solea solea.* The move away from beam trawls may also allow vessels to fish inside 12 nm, where there can be large concentrations of skates.

WGEF recommend that WGFTFB be asked to further monitor developments in this fishery.

ICES 2008b also provided some information on the use of electropositive alloys (mischmetals) as a shark bycatch reduction method for longline fisheries (See various projects summarized in Section 19.13 of ICES, 2008b). Although some (but not all) of these studies demonstrated reduced hooking rates of elasmobranchs, the use of mischmetals in commercial operations may be limited by expense, hazardous nature, and its rapid dissolution in seawater.

Intersessionally, the Chairs of WGFTFB and WGEF have discussed convening a theme session on "Elasmobranch Fisheries: Developments in stock assessment, technical mitigation and management measures" at the 2010 ICES ASC, and this will be proposed (see Annex 3).

1.8 Other fisheries meetings of relevance to WGEF

1.8.1 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), and this facilitated the ICCAT/ICES WGEF meeting in September 2008, where improved data for porbeagle were compiled and assessments for the North Atlantic stocks of blue shark and shortfin mako.

ICES and ICCAT have continued collaborating and addressed porbeagle in a joint meeting with WGEF (this report), and could usefully collaborate in future assessments of those pelagic sharks occurring in the North Atlantic.

1.9 Relevant biodiversity conservation issues

ICES' work on elasmobranch fishes is becoming increasingly important as a source of information to various multilateral environmental agreements concerned about the conservation status of some species. Table 1.3 lists species occurring in the ICES Area that are being considered within these fora.

Table 1.3. Species listed by Multilateral Environmental Agreements.

Species	Multinational Environmental Agreement			
	OSPAR	CMS	CITES	BERN
Spurdog *Squalus acanthias*	✓	App II	Proposed, App II	
Gulper shark *Centrophorus granulosus*	✓			
Leafscale gulper shark *Centrophorus squamosus*	✓			
Portuguese dogfish *Centroscymnus coelolepis*	✓			
Angel shark *Squatina squatina*	✓			App III (Med)
Sawfish *Pristis pristis* and *P. pectinata*			App I	
Common skate *Dipturus batis*	✓			
White skate *Rostroraja alba*	✓			App III (Med)
Thornback ray *Raja clavata*	✓(North Sea)			
Spotted ray *Raja montagui*	✓ (North Sea)			
Giant devil ray *Mobula mobular*				App II (Med)
Basking shark *Cetorhinus maximus*	✓	App I and II	App II	App II (Med)
White shark *Carcharodon carcharias*		App I and II	App II	App II (Med)
Shortfin mako shark *Isurus oxyrinchus*		App II		App III (Med)
Longfin mako shark *Isurus paucus*		App II		
Porbeagle shark *Lamna nasus*	✓	App II	Proposed, App II	App III (Med)
Blue shark *Prionace glauca*				App III (Med)

1.9.1 OSPAR Convention

The OSPAR Convention (www.ospar.org) guides international cooperation on the protection of the marine environment of the North-East Atlantic. It has 15 Contracting Parties and the European Commission, representing the European Community. The OSPAR List of threatened and/or declining species and habitats, developed under the OSPAR Strategy on the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area, provides guidance on the future conservation priorities and research needs of marine biodiversity (species and habitats) at risk in this region. To date, 11 elasmobranch species are listed (Table 1.3), either across the entire OSPAR region or in areas where they are declining. Background Documents that summarize the status of each of these species and propose actions and measures to be taken, including through ICES, are currently under development.

1.9.2 Convention on the Conservation of Migratory Species (CMS)

CMS recognizes the need for countries to cooperate in the conservation of animals that migrate across national boundaries, if an effective response to threats operating throughout a species' range is to be made. The Convention actively promotes concerted action by the Range States of species listed on its Appendices. The CMS Scientific Council has determined that in all 35 shark and ray species, globally, meet the criteria for listing in the CMS Appendices (Convention on Migratory Species 2007). Table 1.3 lists Northeast Atlantic elasmobranch species that are currently included in the Appendices. CMS Parties should strive towards 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 Range States of Appendix II species (migratory species with an unfavourable conservation status that need or would significantly benefit from international cooperation) are encouraged to conclude global or regional Agreements for their conservation and management (www.cms.int). CMS is currently developing a global Memorandum of Understanding and an Action Plan for migratory sharks, which may be completed and open for signature by the end of 2009.

1.9.3 Convention on International Trade in Endangered Species (CITES)

CITES was established in recognition that international cooperation is essential to the protection of certain species from overexploitation through international trade. It creates the international legal framework for the prevention of trade in endangered species of wild fauna and flora and for the effective regulation of international trade in other species which may become threatened in the absence of such regulation. Species threatened with extinction may be listed in Appendix I, essentially banning commercial international trade in their products. Appendix II of CITES includes "*species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival*". Trade in these species is closely monitored and allowed only after exporting countries provide evidence that such trade is not detrimental to populations of the species in the wild (e.g. where fisheries are regulated). Table 1.3 lists elasmobranch species occurring in the Northeast Atlantic that are listed in the Appendices or currently known to be proposed for listing. Resolution Conf. 12.6 encourages parties to identify endangered shark species that require consideration for inclusion in the Appendices if their management and conservation status does not improve; several other ICES species are included in these lists. Decision 13.42 encourages parties to improve their data collection and reporting of catches, landings and trade in sharks (at species level where possible), to build capacity to manage their shark fisheries, and to take action on several species-specific recommendations from the Animals Committee (CITES 2009).

1.10 ICES fisheries advice

The ICES mixed fisheries advice for demersal fisheries in Division IIIa (Skagerrak–Kattegat) in Subarea IV (North Sea), and in Division VIId (Eastern Channel) in 2009 was that they should be managed according to the following rules, which should be applied simultaneously:

- should minimize bycatch or discards of cod;
- should implement TACs or other restrictions that will curtail fishing mortality for those stocks mentioned above for which reduction in fishing pressure is advised;
- should be exploited within the precautionary exploitation limits or where appropriate on the basis of management plan results for all other stocks;
- where stocks extend beyond this area, e.g. into Division VI (saithe and anglerfish) or are widely migratory (Northern hake), should take into ac-

count the exploitation of the stocks in these areas so that the overall exploitation remains within precautionary limits;

- **should have no landings of angel shark and minimum bycatch of spurdog, porbeagle, and common skate and undulate ray.**

ICES Advice for 2009 was that fisheries in the Celtic Seas should be managed according to the following rules, which should be applied simultaneously. In these fisheries, there should be:

- **no catch or discard of cod and whiting in Division VIa and in Division VIIa, of haddock in Division VIa and sole in Division VIIa, or of spurdog, white skate, and angel shark;**
- **minimal catch of common skate and undulate ray**;
- adherence to the recommended reduction in fishing mortality for cod in Divisions VIIe–k, whiting in Divisions VIIe–k, plaice in Divisions VIIfg, and plaice and sole in Division VIIe;
- development of rebuilding plans for herring in Divisions VIa (South) and VIIb, c and Celtic Sea herring (VIIg, j, VIIa south). Both stocks are in need of rebuilding and fishing should not proceed without rebuilding plans;

1.11 Data availability

1.11.1 Provision of data before working group

WGEF members felt that future meetings of WGEF should continue to meet in June, as opposed to earlier meetings, 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.

1.11.2 Landings data

Since 2005, 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:

Replacement with more accurate data provided by national scientists.

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 (see ICES, 2006; 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 overreporting;

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.

Since 2008, more species-specific recording of skate landings have been collected for the North Sea (see Section 15), and this will be extended to some other parts of the ICES area in 2009. These data should be evaluated by WGEF in 2010.

1.11.3 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.

1.11.4 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 mostly 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.

1.11.5 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.

WGEF recommend that PGCCDBS ensures that all nations providing length data for sharks, state clearly which measurements have been collected.

1.12 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 evaluate the status of the species/stocks.

In 2009 WGEF focused on spurdog and porbeagle.

1.13 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 in recent 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.

1.14 Working documents presented

The following Working Documents were provided:

Biais, G. and Vollette, J. (2009 WD. CPUE of the French porbeagle fishery. Working document presented to ICES WGEF, 3 pp.

Figueiredo, I. and Farias, I. 2009 WD. Information on rays and skates and sharks from mainland Portugal. Working document presented to ICES WGEF 4 pp.

Vinnichenko, V.I. and Fomin K. Yu. 2009 WD. Russian research and fisheries of sharks and skates in the Northeast Atlantic in 2008. Working document presented to ICES WGEF 12 pp.

Vollen, T. 2009 WD. Distribution of chondrichthyan species in Norwegian deep-sea waters. Working document presented to ICES WGEF 15 pp.

1.15 References

CEC. 2009. Council Regulation (EC) No 43/2009 of 16 January 2009 fixing for 2009 the fishing opportunities and associated conditions for certain fish stocks and groups of fish stocks, applicable in Community waters and, for Community vessels, in waters where catch limitations are required. Official Journal of the European Union L 22; 205 pp.

CITES 2009. Conservation and management of sharks and stingrays. AC24 WG5 Doc. 1. http://www.cites.org/common/com/AC/24/wg/E–AC24–WG05.pdf.

Convention on Migratory Species. 2007. Report of the Fourteenth Meeting of the Scientific Council of the Convention on the Conservation of Migratory Species of Wild Animals. http://www.cms.int/bodies/ScC/Reports/Eng/ScC_report_14.pdf.

EU, 2009. Communication from the Commission to the European parliament and the council on a European Community action plan for the conservation and management of sharks. COM (2009) 40.

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

ICES. 2008a. Report of the Working Group Elasmobranch Fishes (WGEF), 3–6 March 2008, Copenhagen, Denmark. ICES CM 2008/ACOM:16. 332 pp.

ICES. 2008b. Report of the ICES-FAO Working Group on Fish Technology and Fish Behaviour (WGFTFB), 21–25 April 2008, Tórshavn, Faroe Islands. ICES CM 2008/FTC:02. 265 pp.

ICES. 2009a. Report of the International Bottom Trawl Survey Working Group (IBTSWG), 30 March—3 April 2009, Bergen, Norway. ICES CM 2009/RMC:04. 241 pp.

ICES. 2009b. Report of the Planning Group on commercial Catches, Discards and Biological Sampling (PGCCDBS), 2–6 March 2009, Montpellier, France. ICES CM 2009/ACOM:39. 160 pp.

Johnston, G., Clarke, M., Blasdale, T., Ellis, J., Figueiredo, I., Hareide, N. R., and Machado, P. 2005. Separation of Species Data from National Landings Figures. ICES CM 2005/N:22, 16 pp.

2 Spurdog in the North East Atlantic

2.1 Stock distribution

Spurdog, *Squalus acanthias*, has a worldwide distribution in temperate and boreal waters, and occurs mainly in depths of 10–200 m. In the NE Atlantic this species is found from Iceland and the Barents Sea southwards to the coast of Northwest Africa (McEachran and Branstetter, 1984).

WGEF considers that there is a single NE Atlantic stock ranging from the Barents Sea (Subarea I) to the Bay of Biscay (Subarea VIII), and that this is the most appropriate unit for assessment and management within ICES.

Spurdog in Subarea IX may be part of the NE Atlantic stock, but catches from this area are likely to consist of a mixture of *Squalus* species, with increasing numbers of *Squalus blainville* further south. The relationships between the main NE Atlantic stock and populations in the Mediterranean are unclear.

In the ICES area, this species exhibits a complex migratory pattern. Norwegian and British tagging programmes conducted in the 1950s and 1960s focused on individuals captured in the northern North Sea. These were regularly recaptured off the coast of Norway, indicating a winter migration from Scotland, returning in summer (Aasen, 1960; 1962). Other tagging studies in the English Channel indicated summer movement into the southern North Sea (Holden, 1965). Few individuals tagged in this more southerly region were recaptured in the north and vice-versa and therefore at this time, distinct Scottish-Norwegian and Channel stocks were believed to exist. A tagging study initiated in the Irish and Celtic Seas in 1966 yielded recaptures over 20 years from all round the British Isles and suggests that a single NE Atlantic stock is more likely (Vince, 1991). Transatlantic migrations have occurred (e.g. Templeman, 1976), but only occasionally, and therefore it is assumed that there are two separate North Atlantic stocks.

No studies have been conducted using parasitic markers and only preliminary studies on population genetics, to identify spurdog stocks. Data on morphometrics/meristics are inadequate for stock identification. The conclusions drawn about stock identity are therefore based solely on the tagging studies described above.

2.2 The fishery

2.2.1 History of the fishery

Historically, spurdog was a low-value species and in the 1800s was considered as a nuisance to pelagic herring fisheries, both as a predator and through damage to fishing nets. However, during the first half of the 20th century, this small shark became highly valued, both for liver oil and for human consumption, and NE Atlantic spurdog was increasingly targeted. By the 1950s, targeted spurdog fisheries were operating in the Norwegian Sea, North Sea and Celtic Seas. Landings peaked at a total of over 60 000 tonnes in the 1960s (Figure 2.1; Table 2.1) and since then have declined, except for a brief period during the 1980s when targeted gillnet and longline fisheries along the west coasts of Ireland and in the Irish Sea developed.

In more recent years, an increasing proportion of the total spurdog landings are taken as bycatch in mixed demersal trawl fisheries. The larger, offshore longline vessels that targeted spurdog around the coasts of the British Isles have stopped, although there are landings from gillnet and longline fisheries, which are often undertaken in seasonal, inshore fisheries.

The main exploiters of spurdog have historically been France, Ireland, Norway and the UK (Figure 2.2 and Table 2.2). The main fishing grounds for the NE Atlantic stock of spurdog are the North Sea (IV), West of Scotland (VIa) and the Celtic Seas (VII) and, during the decade spanning the late 1980s to 1990s, the Norwegian Sea (II) (Figure 2.3 and Table 2.3). Outside these areas, landings have generally been low.

2.2.2 The fishery in 2008

In the UK (E&W), more than 70% of spurdog landings were taken in line and gillnet fisheries in 2005, with most landings coming from Subarea VII and in particular the Irish Sea. Such fisheries are likely to be closer inshore and may be targeting aggregations of mature female spurdog. The introduction of a bycatch quota deterred such target fisheries in both Subareas IV and VII in 2008.

Scottish landings of spurdog in 2008 mainly came from the mixed demersal trawl fisheries in the North Sea and to the West of Scotland. Less than 5% of landings were taken by longliners, compared with more than 20% in 2007. It seems likely that this reduction was due to the extension of the 5% bycatch regulation to the West of Scotland region in 2008. Effort in the Scottish demersal trawl fleet is likely to have reduced in recent years due to decommissioning of vessels and days at sea regulations, and therefore effort on spurdog from this fleet may well have been reduced. However, the WG was unable to quantify the magnitude of this reduction.

The Irish fishery for spurdog consists mainly of bottom otter trawlers, and less than 30% of landings coming from longline and gillnet fisheries. Most landings are reported from Division VIa and Division VIIg. From April 2008 there was no directed spurdog fishery in Irish waters.

No information was available on Norwegian and French fisheries for spurdog.

2.2.3 ICES advice applicable

In 2008, ICES provided the following advice for spurdog:

'The only new information available for spurdog (*Squalus acanthias*) is landings data which does not offer any reason to change the advice from 2006. The advice for **2009 and 2010** is therefore the same as the advice given in 2006: *The stock is depleted and may be in danger of collapse. Targeted fisheries should not be permitted to continue, and bycatch in mixed fisheries should be reduced to the lowest possible level. The TAC should cover all areas where spurdog are caught in the Northeast Atlantic and should be set at zero (...).'*

ICES also stated that "If a non-zero TAC would be set, ICES recommends the introduction of a maximum landing length (MLL). This is expected to deter fisheries targeting areas where large females occur. The maximum landing length should initially be set at 100 cm."

2.2.4 Management applicable

The following table summarizes ICES advice and actual management applicable for NE Atlantic spurdog during 2001–2009:

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 IIIa(EC) (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	-	-	-	12 547[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	-	-	2575
2008	No new advice	No new advice	631[(2,3)]	-	-	2004 [(2)]	1583
2009	F=0	Stock depleted and in danger of collapse	316[(3,4)]	-	104(4)	1002[(4)]	
2010	F=0[(5)]	Stock depleted and in danger of collapse[(5)]					

[(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.

[(4)] A maximum landing size of 100 cm (total length) shall be respected.

[(5)] Advice given in 2008 is applicable to both 2009 and 2010.

The TAC for spurdog in the North Sea and the Norwegian Sea (IIa (EC) and IV) has been reduced annually and in 2009 is 316 t, which is a 50% reduction on that set for 2008. For ICES Subareas I, V, VI, VII, VIII, XII and XIV (EU and international waters) the TAC for 2009 is 1002 t which is also a reduction of 50% of the 2008 value. The landings of spurdog in Division IIIa were unregulated in 2008, but a TAC (104 t) was introduced for 2009 following a request from Sweden and Denmark for a separate TAC for this area. In all regulated areas, an additional measure (a maximum landing length of 100 cm) has been introduced with the aim of preventing target fisheries for mature female spurdog.

In 2007 Norway introduced a general ban on fishing and landing of spurdog in the Norwegian economic zone and in international waters of ICES Subareas I–XIV. However, vessels less than 28 m in length are allowed to fish for spurdog with traditional gear in inshore (within 4 nm) territorial waters. 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 year's level. Norway has a 70 cm minimum landing size. This regulation is valid also for 2008.

Since 1st January 2008, fishing for spurdog with nets and longlines in Swedish waters has been forbidden. In trawl fisheries there is a minimum mesh-size of 120 mm and the species may only 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 (with a track record of at least 2000 kg of spurdog in 2005 or 2006) an annual permit to fish for spurdog. In 2008, 10 permits were issued and no other vessels were allowed to apply for a permit in 2009.

2.2.5 Landings

Total annual landings (over a 60 year time period), 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 2008 were 1583 t, although this value will be revised next year. Small updates were made to the WG estimate of 2007 total landings.

There are some differences between national landings data and those submitted to ICES. Some nations also report spurdog within the mixed "dogfish and hounds *nei*" category. WGEF will re-evaluate total landings of spurdog at the 2010 meeting.

2.2.6 Discards

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

Some preliminary elasmobranch discard estimates from the Basque fleets operating in Subareas VI, VII and VIII were presented in Diez *et al.*, (2006, WD). Initial studies found no discarding of spurdog by the Baka trawler fleets.

2.2.6.1 Discard survival

A recent study on the estimated short-term discard mortality of otter trawl captured spurdog in the NW 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.

Discard survival from liners is unknown, and may depend on hook type, where the fish is hooked and also whether there is a bait stripper. Spurdog with broken jaws (i.e. possibly have gone through a bait stripper) have been observed (Ellis, pers. obs.) with healed wounds, although quantitative data are lacking.

2.2.7 Quality of the catch data

In addition to the problems associated with obtaining estimates of the historical total landings of spurdog due to the use of generic dogfish landings categories, anecdotal information suggests that widespread misreporting by species may have contributed significantly to the uncertainties in the overall level of spurdog landings.

Under-reporting may have occurred in certain ICES areas when vessels were trying to build up a track record of other species, for example deep-water species. It has also been suggested that over-reporting may have occurred where stocks with highly restrictive quotas have been recorded as spurdog. However, it is not possible to quantify the amount of under and over-reporting that has occurred. The introduction of UK and Irish legislation requiring registration of all fish buyers and sellers may mean that these misreporting problems have greatly declined since 2006.

It is not known whether the 5% bycatch ratio has lead to any misreporting or reporting under generic landings categories, although the buyers and sellers legislation should deter this and so the bycatch ratio may have resulted in more discarding.

2.3 Commercial length frequencies

2.3.1 Landings length compositions

Sex disaggregated length frequency samples are available from UK (E&W) for the years 1983–2001 and UK (Scotland) for 1991–2004 for all gears combined. Scottish data are available for the North Sea and West of Scotland separately while the English data are all areas combined. The two sets of Scottish length frequency distributions (IV & VIa) are very similar and these have therefore been combined to give a 'total' Scottish length frequency distribution. Typically these appear to be quite different from the length frequency distributions obtained from the UK (E&W) landings, with a much larger proportion of small females being landed by the Scottish fleets. The length distributions of the male landings appear to be relatively similar. Figure 2.4 shows landings length frequency distributions averaged over 5 year intervals. The Scottish data have been raised to total Scottish reported landings of spurdog while the UK (E&W) data have only been raised to the landings from the sampled boats.

Raw market sampling data were also provided by Scotland for the years 2005–2008. However, sampled numbers have been low in recent years (due to low landings) and use of these data was not pursued.

2.3.2 Discard length compositions

There are no international estimates of discard length frequencies.

Discard length frequencies have previously been provided by UK (E & W) for fisheries operating in the Celtic Seas (Subareas VI–VII) and North Sea (Subarea IV), as observed for the years 1999–2006 (Figure 2.5). The data for beam trawl, demersal trawl and drift/fixed net fisheries indicate that most spurdog are retained, although juveniles (e.g. individuals <45–50 cm) tend to be discarded, which agrees with data from market sampling. Data were limited for seine and longline fisheries.

2.3.3 Quality of data

Length frequency samples are only available for UK landings and these are aggregated into broader length categories and have been used in the previously presented assessments. No data were available from Norway, France or Ireland who are the other main exploiters of this stock. Over the past 20 years, UK landings have on average accounted for approximately 45% of the total. However, there has been a systematic decline in this proportion since 2005 and the UK landings in 2008 represented less than 20% of the total. It is not known to what extent the available commercial length–frequency samples are representative of the catches by these other nations.

2.4 Commercial catch-effort data

No studies of commercial cpue data were undertaken.

2.5 Research vessel surveys

2.5.1 Availability of survey data

Fishery-independent survey data are available for most regions within the stock area. The following survey data were available to this meeting:

- UK (England & Wales) Q1 Celtic Sea groundfish survey: years 1982–2002.
- UK (England & Wales) Q4 Celtic Sea groundfish survey: years 1983–1988.
- UK (England & Wales) Q3 North Sea groundfish survey 1977–2003.
- UK (England & Wales) Q4 SWIBTS survey 2004–2008 in the Irish and Celtic Seas.
- UK (NI) Q1 Irish Sea groundfish survey 1992–2008.
- UK (NI) Q4 Irish Sea groundfish survey 1992–2008.
- Scottish Q1 west coast groundfish survey: years 1990–2008.
- Scottish Q4 west coast groundfish survey: years 1990–2008.
- Scottish Q1 North Sea groundfish survey: years 1990–2008.
- Scottish Q3 North Sea groundfish survey: years 1990–2008.
- Irish Q3 Celtic Seas groundfish survey: years 2003–2008.

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 further studies of these data will be undertaken in 2010.

2.5.2 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 (Figures 2.6 and 2.7), with catch rates also decreasing, although catch rates are highly variable (ICES, 2006). In some recent surveys in Subarea VII that were examined, the frequency of occurrence of spurdog seems stable, although these are mostly short time-series (Figure 2.8). 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.

2.5.3 Statistical modelling

At the 2006 WG meeting, an analysis of Scottish survey data was presented which investigated methods of standardizing the survey catch rate to obtain an appropriate index of abundance. Following on from this, and the subsequent comments of the Review Group (that met in 2006), further analysis has been conducted this year. The major concern was that given the large differences in size for this species, an index of abundance in Nhr^{-1} was less informative than an index of biomass catch rates. The analysis has therefore been updated to address these concerns.

Data from the four Scottish surveys listed above (1990–2008) were considered in the analysis. The dataset consists of length frequency distributions at each trawl station, together with the associated information on gear type, haul time, data, duration and location. Each survey dataset used in this analysis contains over 1000 hauls and the North Sea Q3 contains over 1500. For each haul station, catch-rate was calculated: total weight caught divided by the haul duration to obtain a measure of catch-per-unit effort in terms of g/30 min.

The objective of the analysis was to obtain standardized annual indices of cpue (on which an index of relative abundance can be based) by identifying explanatory variables which help explain the variation in catch-rate which is not a consequence of changes in population size. Due to the highly skewed distribution of catch rates and the presence of the large number of zeros, a 'delta' distribution approach was taken to the statistical modelling. Lo *et al.*, 1992 and Stefansson, 1996 describe this method which combines two generalized linear models (GLM): one which models the probability of a positive observation (binomial model) and the second which models the catch rate conditioned on it being positive assuming a lognormal distribution. The overall year effect (annual index) can then be calculated by multiplying the year effects estimated by the two models.

The analysis was conducted in stages: initially each survey was considered separately then the model fitted to all survey data combined. Because the aim was to obtain an index of temporal changes in the cpue, year was always included as a covariate (factor) in the model. Other explanatory variables included were area (Scottish demersal sampling area) and month and interactions terms were also investigated. Variables which explained greater than 5% of the deviance were retained in the model. All variables were included as categorical variables.

The model results, in terms of retained terms and deviance values are demonstrated in Table 2.4. Estimated effects are shown in Figure 2.9. The diagnostic plot for the final lognormal model fit is shown in Figure 2.10, indicating that the distributional assumptions are adequate: the residuals show a relatively symmetrical distribution, with no obvious departures from normality, and the residual variance shows no significant changes through the range of fitted values.

The estimated year effects for the binomial component of the model demonstrate a significant decline over the time period while the year effects for the catch rate given that it is positive do not indicate any systematic trend. It was considered that this is a potentially useful approach for obtaining an appropriate index of abundance for NE Atlantic spurdog. However, there are a number of issues associated with the analysis which should be highlighted:

- the survey data analysed do not cover the whole distribution of the stock;
- further attempts should be made to obtain sex-specific abundance indices.

2.5.4 Length distributions

Length distributions were analysed from survey data made available to the group in 2009. The UK (E&W) Q4 SWIBTS exhibits annual differences in length frequency distributions of spurdog caught. In 2005 the mean length frequency of females and males was higher than previous and preceding years. In 2008 relatively larger numbers of juveniles <55 cm were caught in the survey (Figure 2.11).

The length frequency distributions obtained from the UK(NI) Q4 GFS survey demonstrate a large proportion of larger fish (>85 cm) which are likely to be mature females (males are smaller) (Figure 2.12), although sexing has only been carried out since 2006

(Figure 2.13). A large haul of predominantly large females was caught in 2008 which has influenced the pattern of the length frequencies from this survey (Figure 2.14).

Length frequencies generated from the Irish Q3 GFS survey suggest spatial as well as temporal variation in the size distributions (Figure 2.15). Catches in the southern region of the survey area (VIIg) tended to consist of smaller individuals, while larger individuals were the dominant component in the remaining areas. Data by sex are also collected in this survey, with more overlap between female and male length frequencies evident than from other surveys (Figure 2.16). This may be due to the spatial variation observed in the population length frequencies.

2.5.5 Presence of pups

Pups of spurdog (individuals ≤25 cm) are caught in many of the surveys, although generally in very small numbers. Although catches of pups tend to be low and may not be accurate indicators of recruitment, the location of catches may indicate possible pupping grounds or nursery areas. The location of survey hauls were spurdog pups (individuals ≤25 cm) were present was plotted for data from the North Sea (Figure 2.17).

Seasonal distributions of spurdog catches in VIIa(N) and VIA(S) by biomass and numbers have been plotted from survey data in the area (Figure 2.18).

2.6 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 NE 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, 2008).

Ellis and Keable, 2008, reported a maximum uterine fecundity of 21 pups, which was greater than previously reported for NE Atlantic spurdog. It is unclear as to whether this increase is a density-dependent effect or sampling artefact.

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.

2.7 Exploratory assessment models

2.7.1 Previous assessments

No new assessments have been presented since 2006 although further model development and data collation was carried out at this meeting in preparation for a full assessment of spurdog in 2010. Exploratory assessments undertaken in 2006 included the use of a delta-lognormal GLM-standardized index of abundance and a population dynamic model. This has been updated at subsequent meetings. The results from these assessments indicate 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).

2.7.2 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 and suggested that there are strong potential benefits to the stock by protecting mature females. However, improved estimates of discard survivorship from various commercial gears are required to better examine the efficacy of such measures.

2.8 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.

2.8.1 Catch data

The WG has provided estimates of total landings of NE Atlantic spurdog and has used these, together with UK length frequency distributions in previous assessments 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.

2.8.2 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.

2.8.3 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.

2.9 Reference points

No reference points have been proposed for this stock.

2.10 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.

Since 2009, there has been a maximum landing length (MLL) to deter targeting of mature females (see Section 2.10 of ICES, 2006 for simulations on MLL). Discard survival of such fish needs to be evaluated. Those fisheries taking spurdog that are lively may have problems measuring fish accurately, and investigations to determine an alternative measurement (e.g. pre-oral length) that has a high correlation with total length and is more easily measured on live fish are required. Dead dogfish may also be more easily stretched on measuring, and understanding such post-mortem changes is required to inform on any levels of tolerance.

North Sea fisheries were regulated by a bycatch quota (2007–2008), whereby spurdog should not have comprised more than 5% by live weight of the catch retained on board. This was extended to western areas in 2008. The bycatch quota was removed in 2009, when the maximum landing length was brought in.

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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Table 2.1. Northeast Atlantic spurdog. WG estimates of total landings of NE Atlantic spurdog (1947–2008).

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	2575
1966	42 713	1987	41 361	2008	1583
1967	44 116	1988	34 730		

Table 2.2. Northeast Atlantic spurdog. WG estimates of total landings by nation (1980–2008).

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	646	567	623	547	590	447	469	339	135	188	100	68	57	46
Denmark	0	1418	1282	1533	1217	1628	1008	1395	1495	1086	1364	1246	799	486
Faroe Islands	0	22	0	0	0	0	0	0	0	0	0	0	0	0
France	11558	14222	11968	12474	8090	8619	6696	10938	7668	5695	3847	3365	2315	1827
Germany	43	42	39	25	8	22	41	48	27	24	26	6	55	8
Iceland	36	22	14	25	6	9	7	5	4	17	15	53	188	52
Ireland	108	476	1268	4658	6930	8791	5012	8706	5612	3063	1443	1000	1100	0
Netherlands	217	268	183	315	0	0	0	0	0	0	0	0	0	0
Norway	5925	3941	3992	4659	4279	3487	2986	3614	4139	5329	8104	9633	7113	6945
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Portugal	0	0	0	0	0	0	1	4	1	2	4	4	2	5
Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweden	399	308	398	300	256	360	471	702	733	613	390	333	230	188
UK (E&W)	8785	8281	6480	6641	7864	7733	6948	7533	6810	5287	5313	3641	4135	3419
UK (Sc)	4994	3970	3654	4370	4956	6749	6267	8043	8075	8024	7768	8529	9677	6613
	32711	33537	29901	35547	34196	37845	29906	41327	34699	29328	28374	27878	25671	19589

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	18	13	14	13	18	9	11	13	23	11	13	20	17	0	0
Denmark	212	146	142	196	126	131	146	156	107	232	219	82	68	0	0
Faroe Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	1225	1258	1365	1195	1047	998	1039	1302	1034	1050	1062	891	704	453	366
Germany	21	26	19	11	16	33	188	303	121	98	138	140	6	0	0
Iceland	34	96	188	110	92	60	117	202	322	231	141	71	75	34	0
Ireland	3624	1381	1160	1297	1063	738	900	1197	1214	1416	1076	940	614	558	163
Netherlands	0	0	0	0	0	0	28	39	27	10	25	41	34	28	26
Norway	4546	3940	2748	1567	1293	1461	1643	1424	1091	1119	1054	1010	790	616	711
Poland	.	.	.	.	.	.	.	.	.	.	.	0	0	0	0
Portugal	7	5	2	2	2	21	2	3	4	4	9	6	10	9	4
Spain	0	0	0	0	27	94	372	363	306	135	17	71	106	16	15
Sweden	95	104	154	196	140	114	123	238	0	275	244	170	148	95	9
UK (E&W)	3398	2316	2550	3023	4462	4408	3568	4443	2823	3109	1729	1887	434	331	91
UK (Sc)	4674	8499	6873	5665	4464	3119	3570	2865	2120	3708	3342	1263	766	434	198
	17 854	17 784	15 215	13 275	12 750	11 186	11 707	12 548	9192	11 398	9069	6592	3771	2575	1583

Table 2.3. Northeast Atlantic spurdog. WG estimates of landings by ICES Subarea (1980–2008).

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Baltic	0	0	0	0	0	0	0	1	0	0	0	1	3	0
I	0	0	0	0	2	3	0	0	0	2	0	0	2	0
II a	136	20	20	107	38	117	137	417	1559	2804	4296	6609	5061	5102
II b	0	0	0	0	0	0	0	0	0	2	0	5	0	0
III	1116	1729	2015	2257	1958	2412	1819	2233	2081	1811	1524	1242	1115	736
IV	17817	14277	9860	9205	8468	8649	7107	9316	8614	8520	9876	7983	9239	5771
V	45	27	18	27	6	22	8	41	6	73	44	60	195	53
VI	4131	3656	5012	6978	8454	12374	8079	9013	7496	6392	5125	5954	4338	3482
VII unspecified	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIIA	1801	2487	2902	3731	6038	6513	6153	6907	5274	3211	2457	2267	2420	2314
VIIB,C	608	807	420	1760	2164	1694	1193	2398	1576	891	368	285	301	84
VIID,E	1909	2107	1762	1382	561	567	741	1680	1089	727	395	442	291	335
VIIF	1533	2778	3955	3054	1575	487	635	947	751	416	544	443	333	313
VIIG-K	3331	5041	3595	6777	4763	4868	3724	7950	6069	4342	3632	2432	2250	1316
VIII	284	608	342	267	169	139	309	420	182	135	107	150	117	76
IX	0	0	0	0	0	0	1	4	1	2	4	4	2	5
X	0	0	0	0	0	0	0	0	0	0	0	0	0	0
XII	0	0	0	0	0	0	0	0	0	0	0	0	0	0
XIV	0	0	0	0	0	0	0	0	0	0	0	0	4	1
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	32 711	33 537	29 901	35 547	34 196	37 845	29 906	41 327	34 699	29 328	28 374	27 878	25 671	19 589

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Baltic	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0
I	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
II a	3123	2725	1853	582	607	779	894	461	357	440	423	685	498	312	337
II b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
III	315	292	421	598	510	393	433	639	346	687	551	274	255	191	159
IV	3907	6936	4764	4279	3285	2234	1953	1796	1558	1708	1612	743	487	355	331
V	39	97	198	111	95	63	181	361	514	390	382	248	186	110	15
VI	3983	3788	3759	3126	2678	2712	3306	3270	1761	2809	2630	1430	851	488	190
VII unspecified	0	5	12	10	6	4	0	0	0	0	0	0	1	0	0
VIIA	2143	950	1292	1333	1609	1899	1448	1782	1529	2021	938	605	411	279	74
VIIB,C	1147	627	467	377	779	851	928	723	510	586	432	341	270	264	56
VIID,E	211	300	317	230	146	170	218	214	167	162	223	242	119	125	141
VIIF	420	290	365	245	135	110	76	163	128	106	55	48	53	57	16
VIIG-K	2419	1501	1535	2117	2605	1780	1949	2626	2020	2275	1739	1863	530	333	196
VIII	138	265	230	253	190	162	287	391	269	134	56	97	75	51	64
IX	7	5	2	2	2	3	19	8	11	5	14	7	35	9	4
X	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0
XII	0	4	0	12	104	22	14	41	22	74	12	9	0	0	0
XIV	0	0	0	0	0	0	0	63	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0
Total	17 854	17 784	15 215	13 275	12 750	11 199	11 707	12 548	9192	11 398	9069	6592	3771	2575	1583

Table 2.4. Northeast Atlantic spurdog. Analysis of Scottish survey data. Summary of significance of terms in final delta-lognormal cpue model.

Binomial model	Df	Deviance	Resid. Df	Resid. Dev	% Dev	P-value
			5011	5697.5		
as.factor(year)	18	73.6	4993	5644	5.326	2.15E-05
as.factor(month)	10	957.9	4983	4666.1	69.31761	1.08E-203
as.factor(roundarea)	19	350.5	4964	4315.6	25.36363	7.94E-63

Lognormal model	Df	Deviance	Resid Df	Resid. Dev	% Dev	P-value
			1280	3318.7		
as.factor(year)	18	195.8	1262	3122.9	29.20209	8.18E-12
as.factor(month)	3	316.7	1252	2806.3	47.23341	1.05E-26
as.factor(roundarea)	16	158.1	1236	2648.2	23.57942	2.16E-09

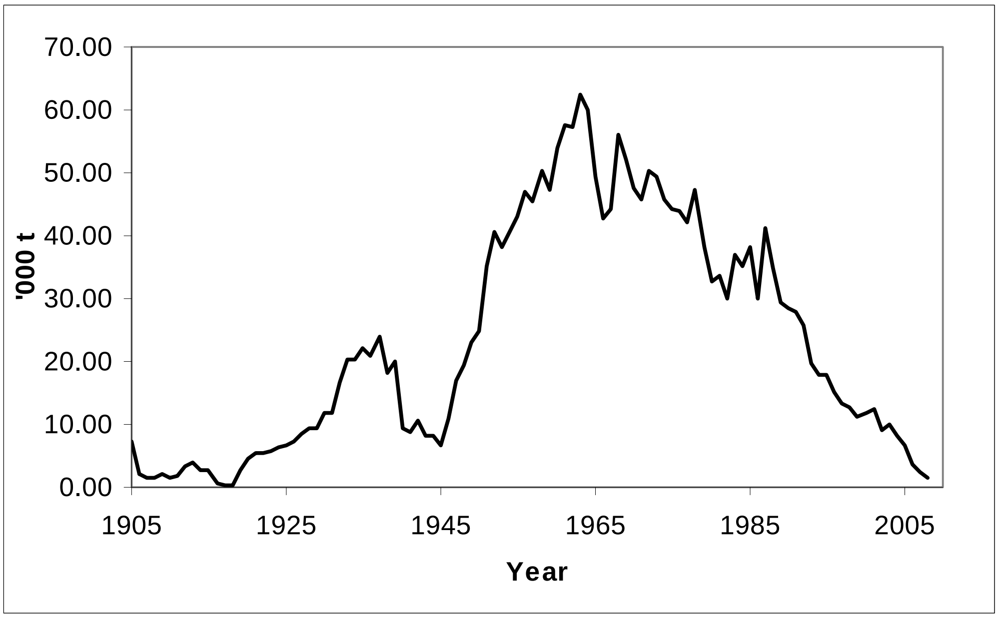


Figure 2.1. Northeast Atlantic spurdog. WG estimates of total international landings of NE Atlantic spurdog (1905–2008).

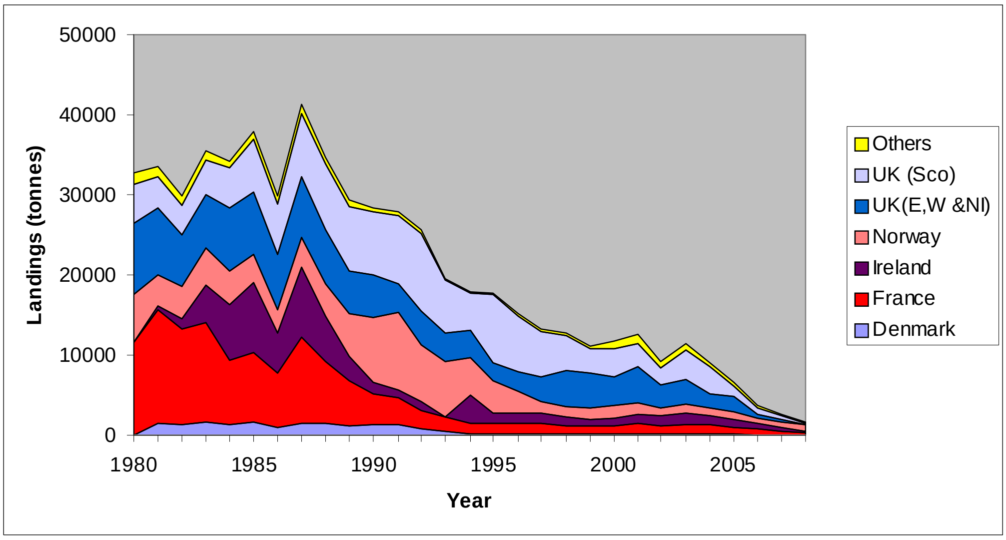


Figure 2.2. Northeast Atlantic spurdog. WG estimates of landings by nation (1980–2008).

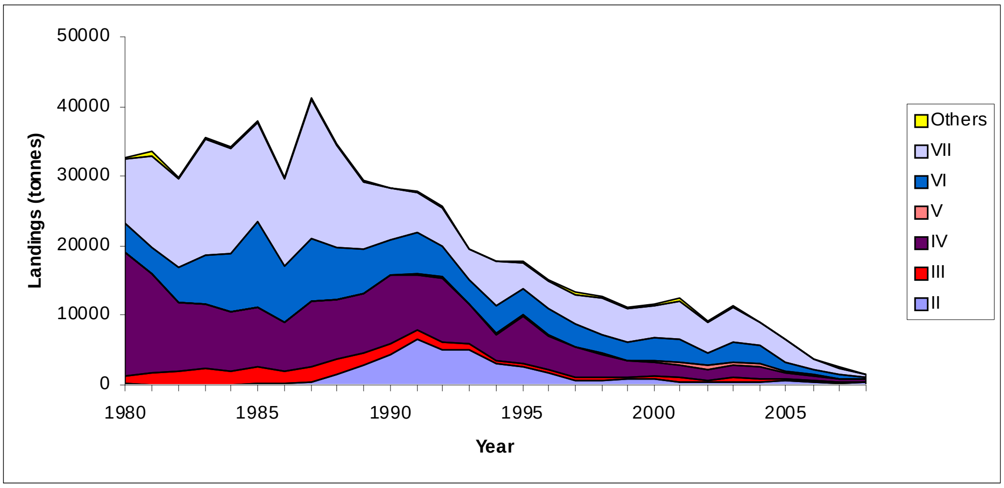


Figure 2.3. Northeast Atlantic spurdog. WG estimates of landings by ICES Subarea.

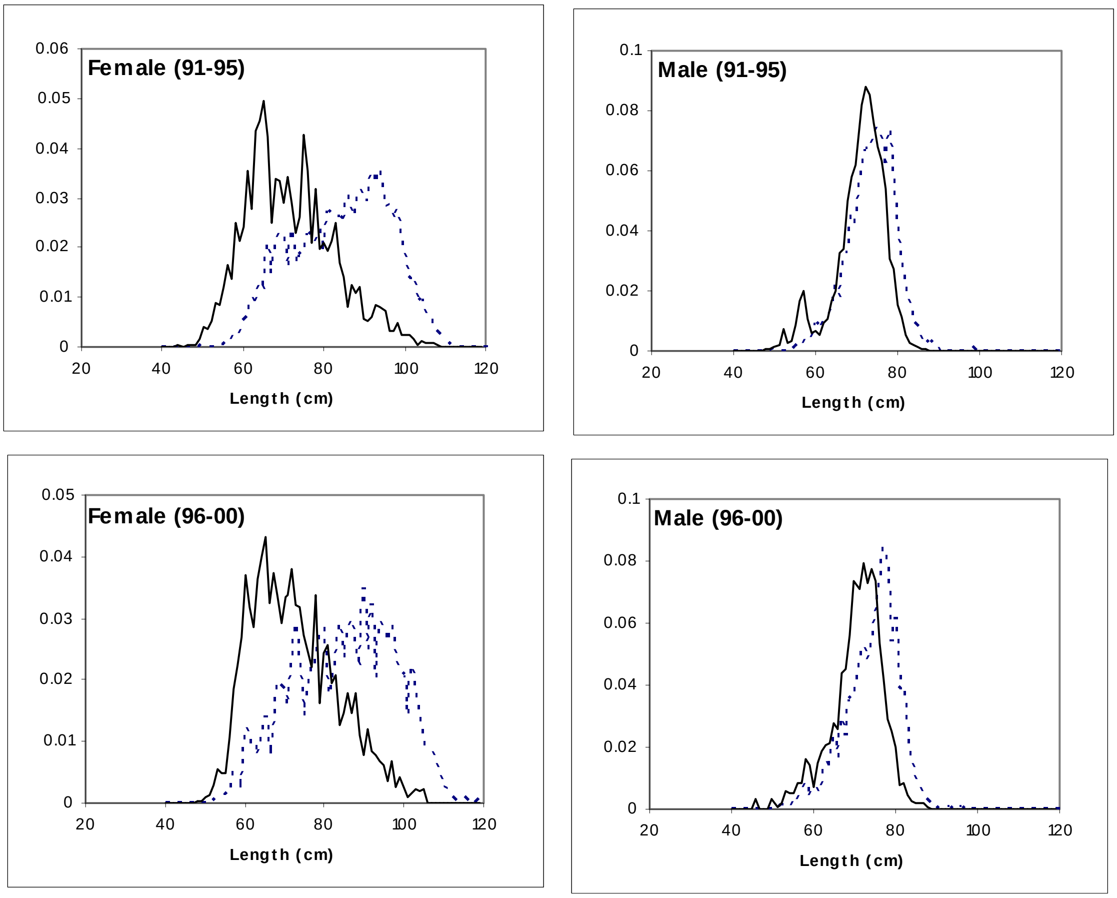


Figure 2.4. Northeast Atlantic spurdog. Comparison of length frequency distributions (proportions) obtained from market sampling of Scottish (solid line) and UK (E&W) (dashed line) landings data. Data are sex-disaggregated, but averaged over 5 year intervals.

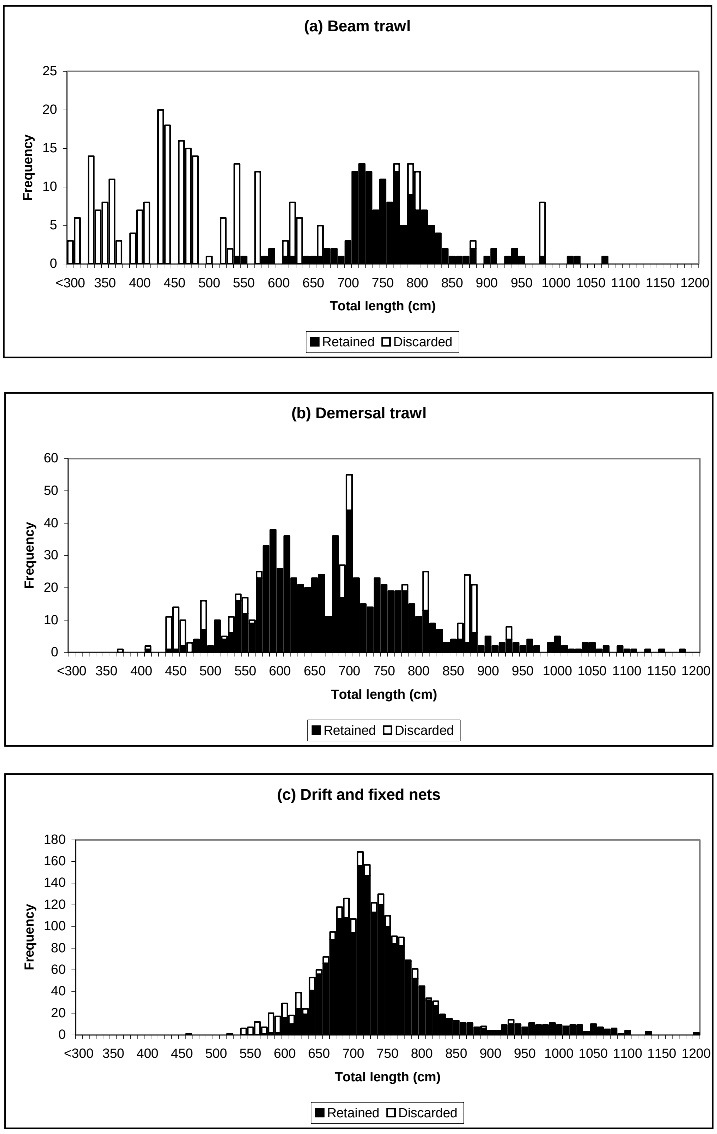
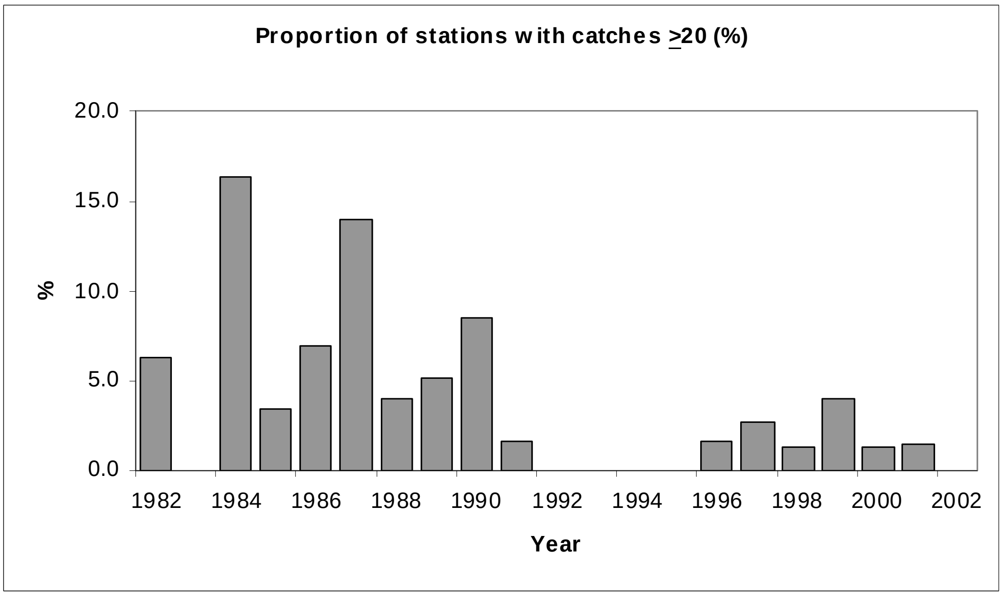


Figure 2.5. Northeast Atlantic spurdog. Length distribution of discarded and retained in fisheries in the North Sea and Celtic Seas ecoregions for (a) beam trawl, (b) demersal trawl and (c) drift and gillnets. These data (1999–2006) are aggregated across individual catch samples (Source: UK (E&W) Discards surveys).



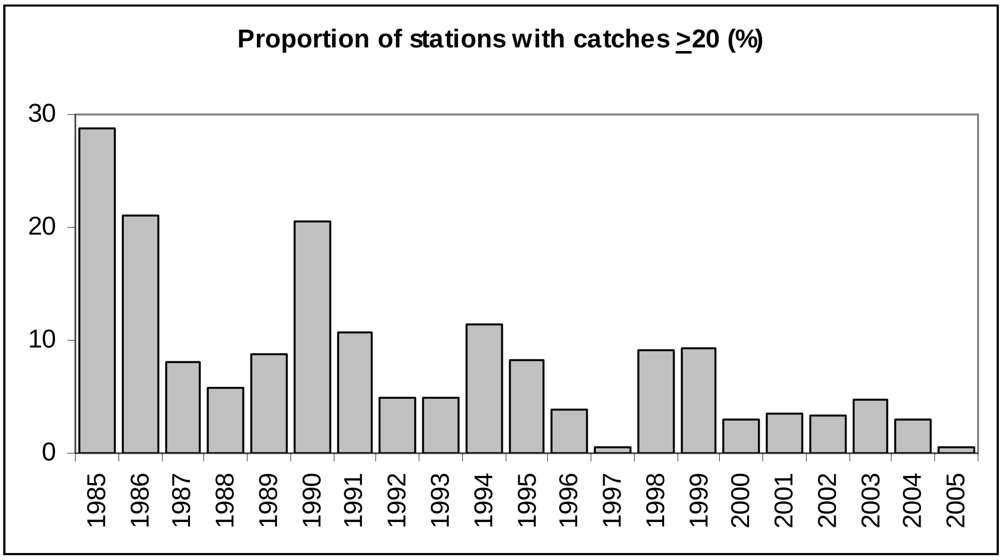
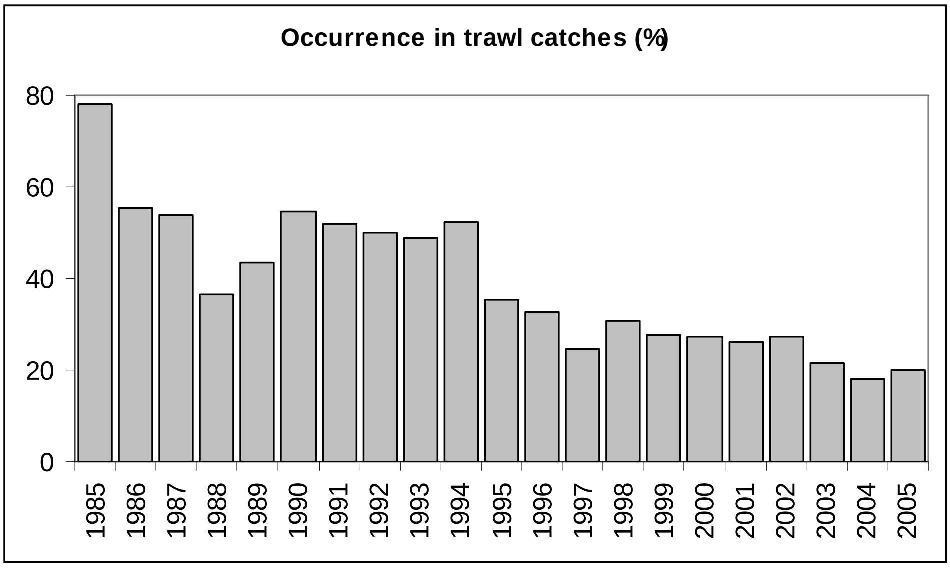


Figure 2.6. Northeast Atlantic spurdog. Proportion of survey hauls in the English Celtic Sea groundfish survey (1982–2002, top) and Scottish west coast (VIa) survey (Q1, 1985–2005, bottom) in which cpue was ≥20 ind.h^{-1}. (Source: ICES, 2006).

a)



b)

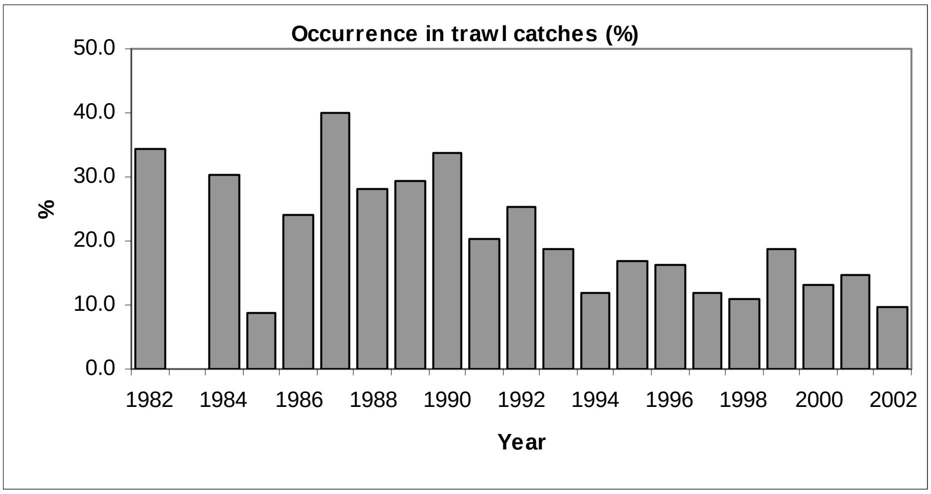


Figure 2.7. Northeast Atlantic spurdog. Frequency of occurrence in survey hauls in a) the English Q1 Celtic Sea groundfish survey (1982–2002), and b) the Scottish west coast (VIa) survey (Q1, 1985–2005).

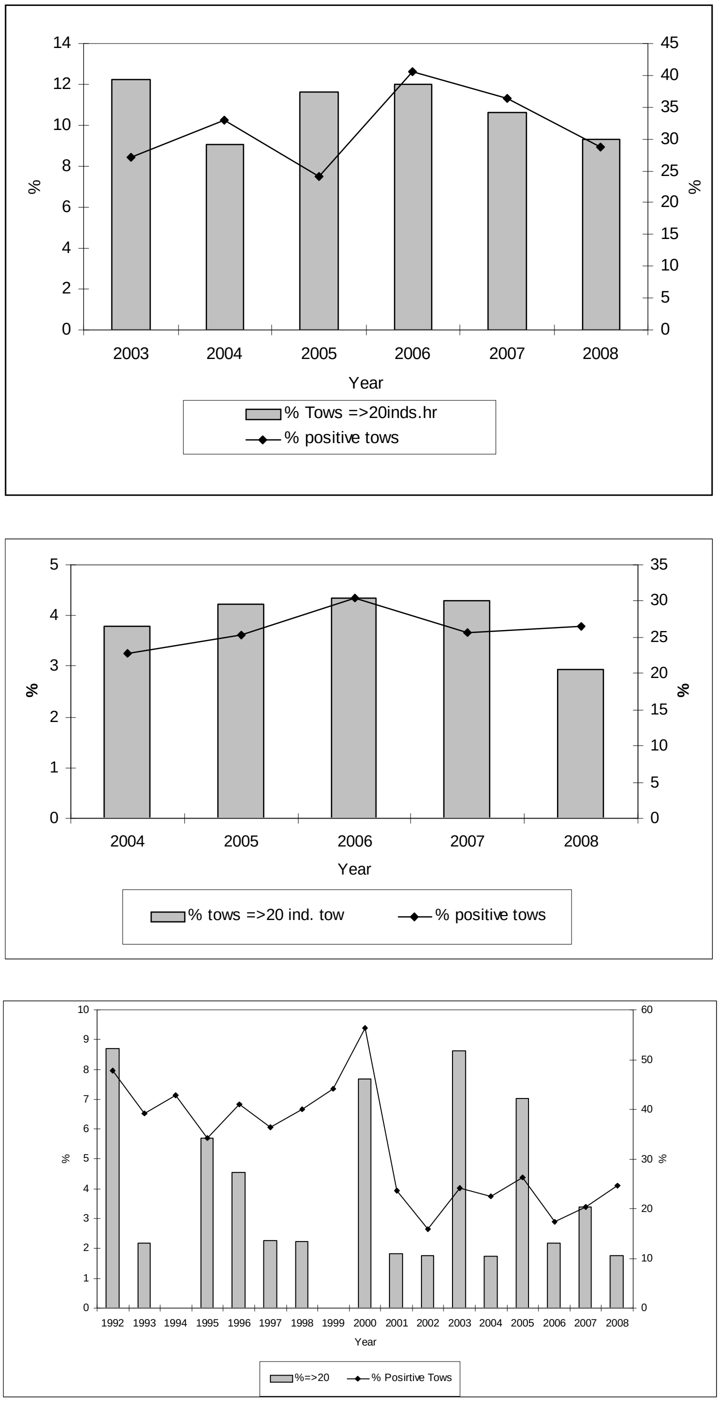


Figure 2.8. Northeast Atlantic spurdog. Proportion of survey hauls in Irish Q3 groundfish survey (2003–2008, top), UK (England and Wales) Q4 groundfish survey (2004–2008, middle) and Northern Irish Q4 groundfish survey (1992–2008, bottom) in which nominal cpue was ≥ 20 per ~1hr and percentage of tows in which spurdog were caught .These surveys cover ICES Subarea VII.

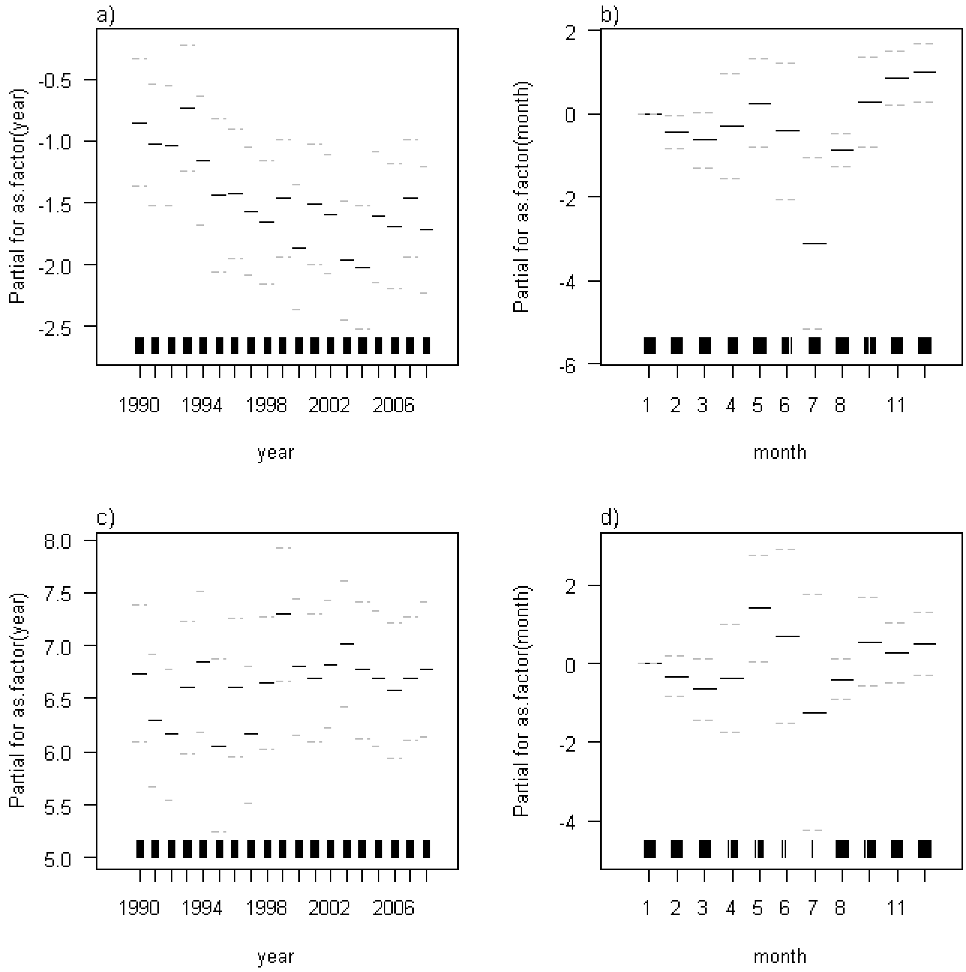


Figure 2.9. Northeast Atlantic spurdog. Estimated year and quarter effects (± 1 s.e.) from the delta-lognormal GLM: binomial model shown in a) and b), and lognormal results in c) and d) (log scale).

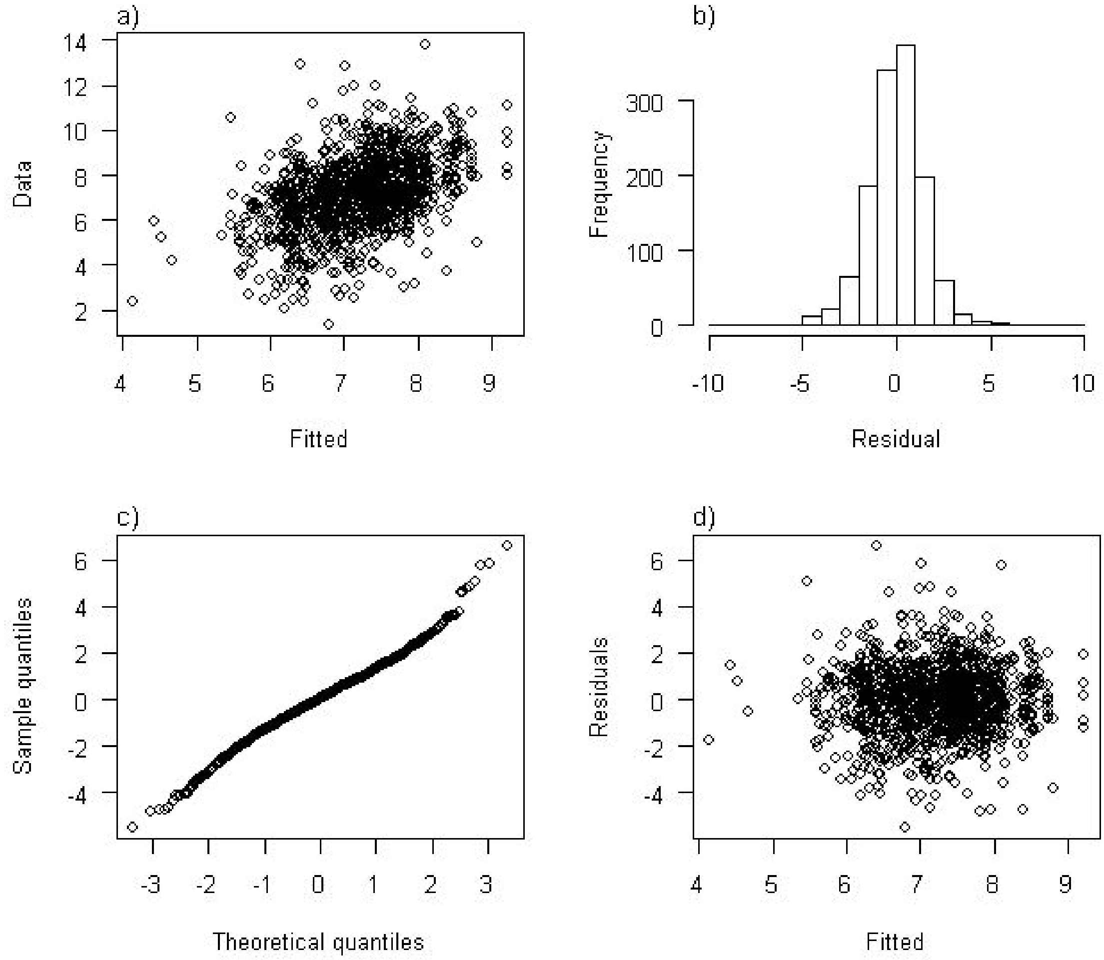
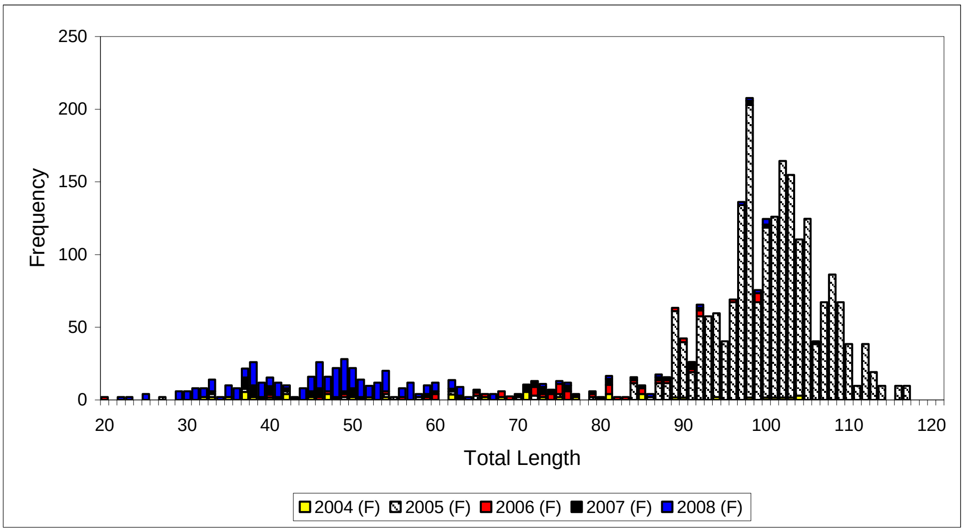


Figure 2.10. Northeast Atlantic spurdog. Analysis of Scottish survey data. Residual plot of final lognormal model fit: a) observed vs. fitted values, b) histogram of residuals, c) normal Q-Q plot and d) residuals vs. fitted values.



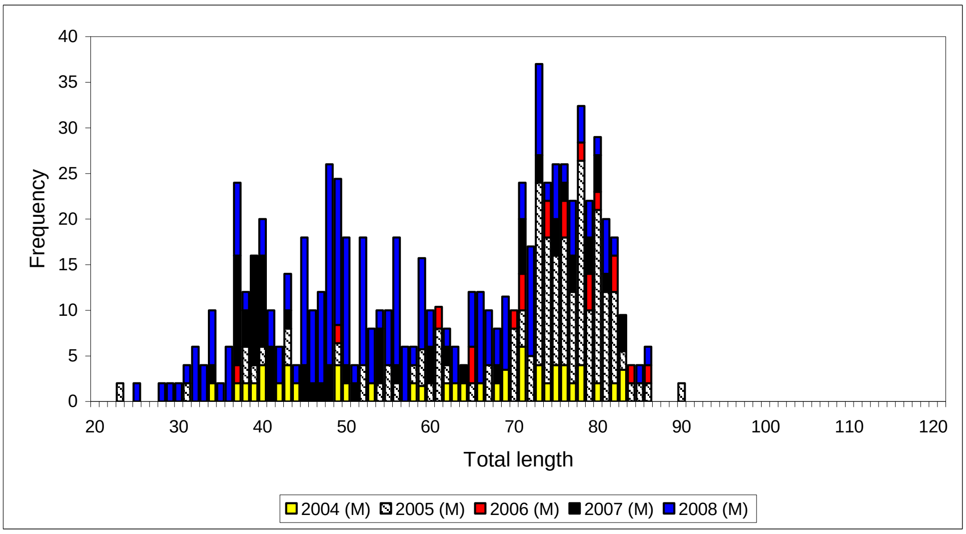


Figure 2.11. Northeast Atlantic spurdog. Temporal variations in length frequencies of female (top) and male (bottom) spurdog in UK (E&W) Q4 survey.

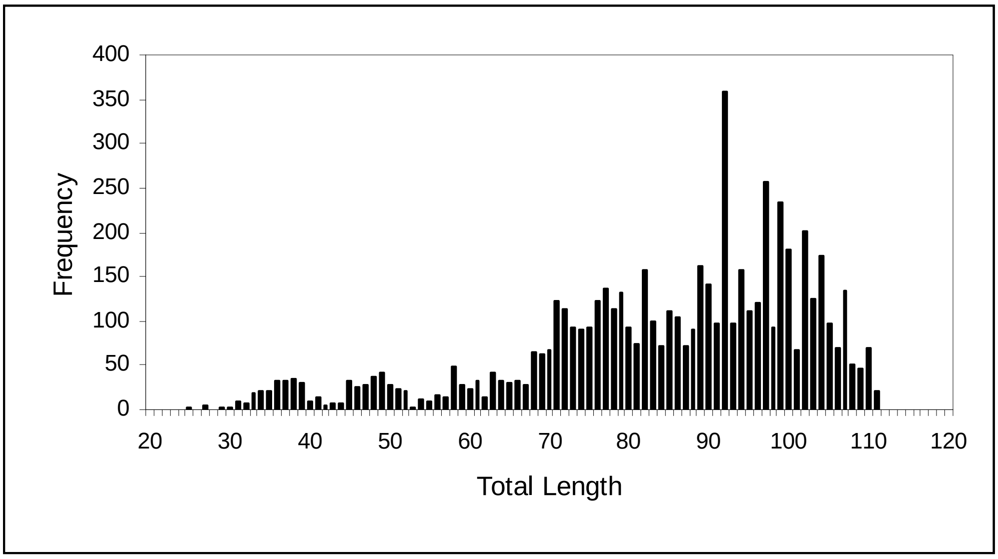


Figure 2.12. Northeast Atlantic spurdog. Length frequencies of spurdog in UK (NI) GFS Q4 survey 1992–2008.

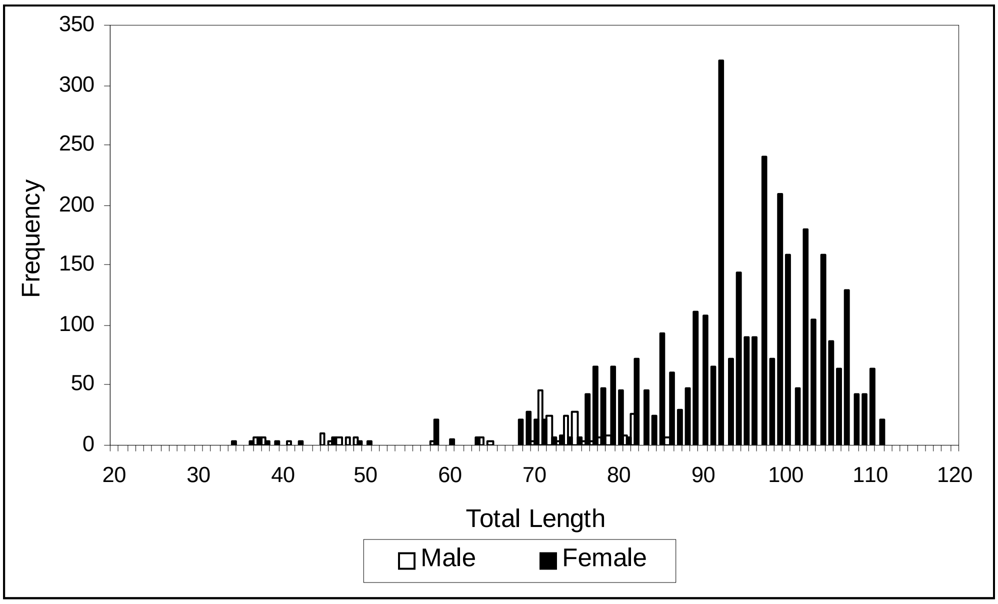


Figure 2.13. Northeast Atlantic spurdog Sex segregated length frequencies of spurdog in UK (NI) GFS Q4 survey 2006–2008.

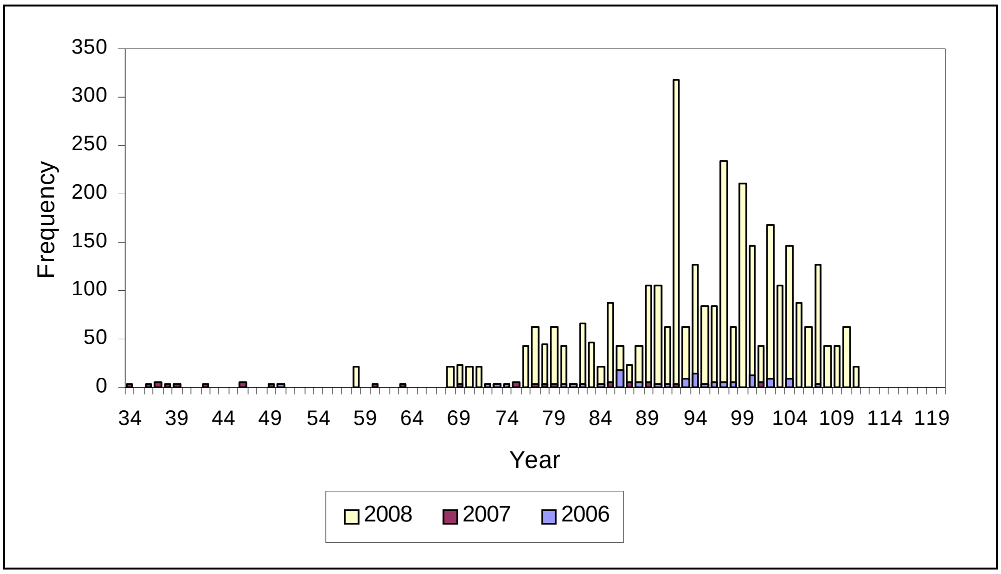


Figure 2.14. Northeast Atlantic spurdog. Length frequencies of female spurdog in UK (NI) GFS Q4 survey 2006–2008. Dominance of large females observed in 2008 influenced by single large haul.

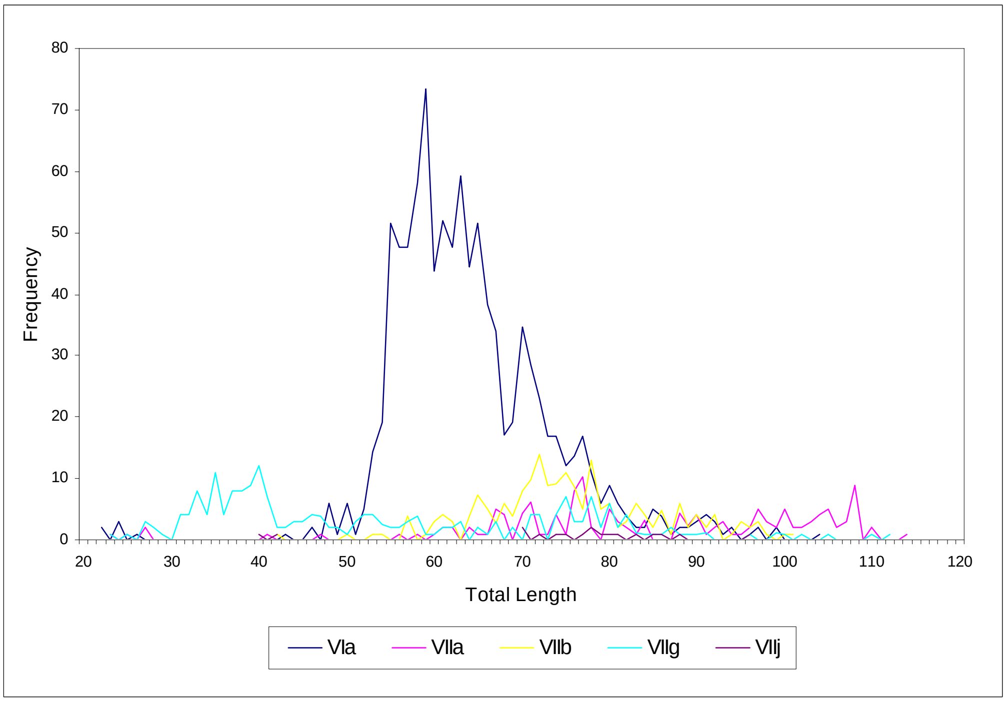


Figure 2.15. Northeast Atlantic spurdog. Variation in length frequencies of spurdog by region generated from MI GFS Q3 survey.

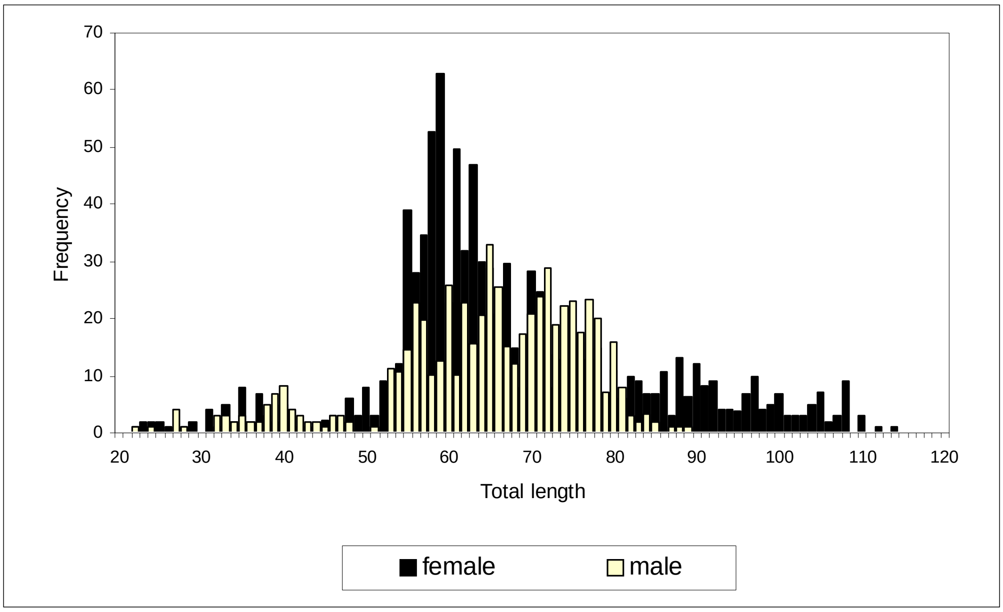


Figure 2.16. Northeast Atlantic spurdog. Sex segregated length frequencies of spurdog in MI GFS Q3 survey.

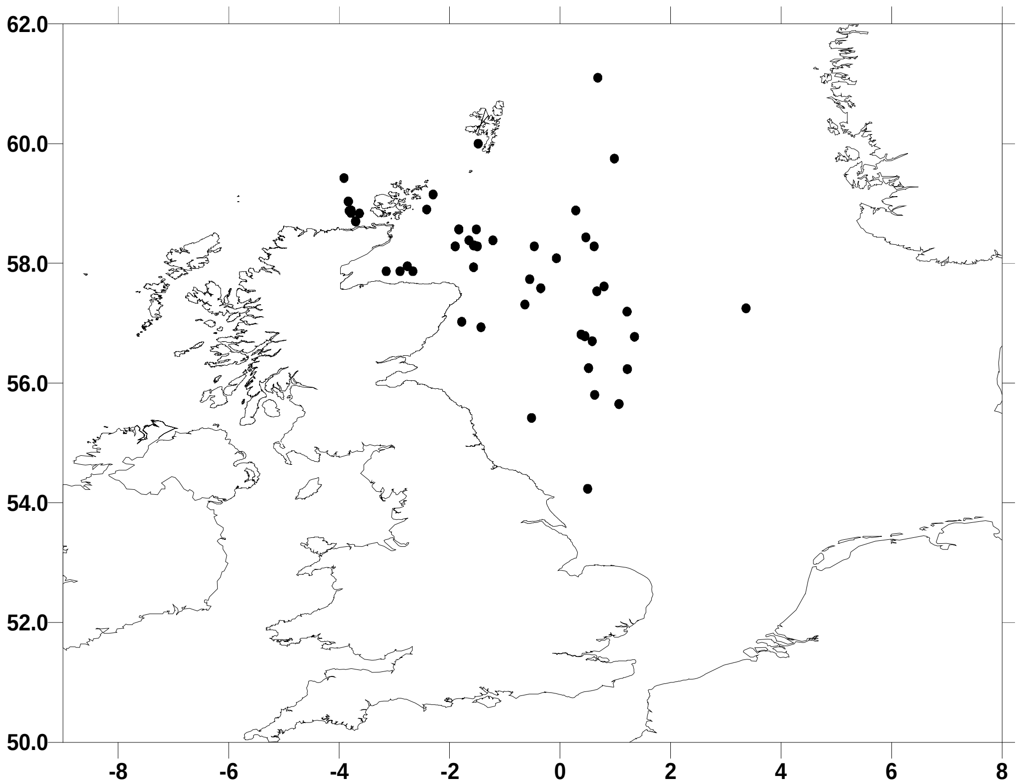


Figure 2.17. Northeast Atlantic spurdog. Occurrence of spurdog pups (ind. ≤250 mm) in North Sea (Source of dta: DATRAS, downloaded 25 June 2009).

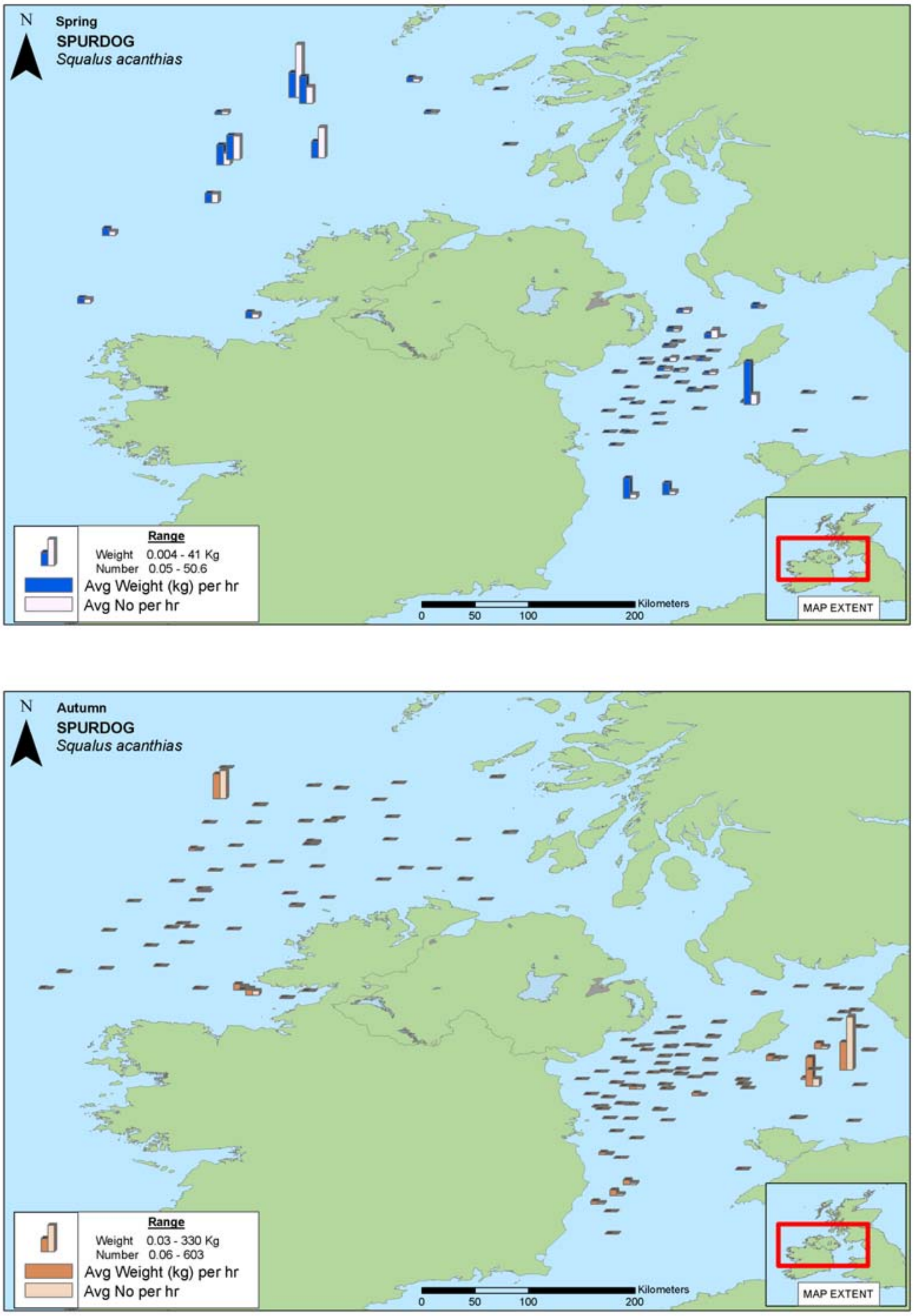


Figure 2.18. Northeast Atlantic spurdog. Seasonal distribution, average abundance (No. per hr.) and average weight (Kg per hr) of spurdog *Squalus acanthias* in VIIa(N) and VIa(S) as estimated from research surveys (see NIEA. 2008).

3 Deep-water "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 have been the two species 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 French 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). Recent information revealed that in contrast to other NE Atlantic areas, where males are predominant, the sex ratio at the Faroes was approximately 1:1 (Vinnichenko and Fomin, 2009 WD). Available information reveals that pregnant females and pups are found in Portugal, both the mainland (Moura *et al.*, 2006 WD) and Madeira, whereas pre-pregnant and spent females are found in the northern areas (Clarke *et al.*, 2001; 2002; Garnes, pers. comm.) and in the Faroes **(**Vinnichenko and Fomin, 2009, WD**)**. 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 NE Atlantic. Stock structure and dynamics are poorly understood. Specimens below 70 cm have been recorded very rarely 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

No new information was available in 2009. Fisheries taking these species were described extensively in ICES 2006.

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. Analyses of the French fishery were 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 revealed 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 reflected the change in fishing pattern.

3.2.2 The fishery in 2008

C. squamosus and *C. coelolepis* are both taken in several mixed trawl fisheries and mixed longline fisheries. They are taken as a bycatch in other fisheries, for example the anglerfish gillnet fishery. There was a directed Spanish (Basque country) longline fishery in Subarea VIII from 1995–2005, this stopped in 2006 (although bycatch was still taken), re-started in 2007 and ceased in 2009.

Information on deep-water shark bycatches made by Russian vessels operating in 2008 in other areas (Vinnichenko and Fomin, 2009 WD) is summarized below.

3.2.3 ICES advice applicable

In 2008, given the very poor state of Portuguese dogfish and leafscale gulper shark, ICES recommended a zero catch. This recommendation was based on cpue information available. Portuguese dogfish and leafscale gulper shark were considered depleted despite the fact that the rates of exploitation and stock sizes of deep water sharks could not be quantified.

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 (VI, VII and XII) 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.

3.2.4 Management applicable

The TAC adopted for deep-sea sharks in Community waters and international waters at different ICES subareas are summarized in the table below. The deep-sea shark category includes the following species: Portuguese dogfish, leafscale gulper shark, birdbeak dogfish (*Deania calceus*), kitefin shark (*Dalatias licha*), greater lantern shark (*Etmopterus princeps*), velvet belly (*Etmopterus spinax*), black dogfish (*Centroscyllium fabricii*), gulper shark (*Centrophorus granulosus*), blackmouth dogfish (*Galeus melastomus*), mouse catshark (*Galeus murinus*), and Iceland catshark (*Apristurus* spp).

FISHING OPPORTUNITIES	V, VI, VII, VIII, IX	X	XII (INCLUDES ALSO *DEANIA HISTRICOSA* AND *DEANIA PROFONDORUM*
2005 and 2006	6763	14	243
2007	2472(1)	20	99
2008	1646(1)	20	49
2009	824(1)	10(1)	25(1)
2010	0(2)	0(2)	0(2)

(1) Bycatches only. No directed fisheries for deep-sea sharks are permitted.

(2) Bycatches of up to 10 % of 2009 quotas are permitted.

A number of effort regulations also 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 sets a limit of effort (kilowatt*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.

Council Regulation (EC) No 881/2008 prohibited fishing for deep-sea sharks in Community waters and waters not under the sovereignty or jurisdiction of third countries of V, VI, VII, VIII and IX by vessels flying the flag of Portugal.

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 Tables 3.1-3.2. In 2006, WGEF produced estimates of landings of each of these species (ICES, 2006). This has not been updated since. In 2008 France presented a split of French landings, by species (Biseau, WD 2008a), but the ratios were not used by WGEF because they were derived from 1990s data on species abundance-by-depth which is no longer valid, as a consequence of the declining relative abundance of Portuguese dogfish.

It can be seen that landings have declined from around 10 000 t from 2001 to 2004, to about 1400 t in 2008 (Figures 3.1 and 3.2). Recent (2008) landings are the lowest since the fishery reached full development in the early 1990s and is slightly lower than TACs available (1715 t), although the TAC does include other deep-water shark species.

Information on deep-water shark bycatches made by Russian vessels operating in 2008 in various areas is summarized in Table 3.3.

3.3.2 Discarding

No new information on discarding was made available at the 2009 meeting, however it is expected that discarding has increased, as a consequence of management regulations (e.g. bycatch limits; quota may be limited for some fleets).

3.3.3 Quality of the catch data

Historically, very few MS presented landing data disaggregated by species. Portugal has supplied species-specific data for many years. In recent years other MS have increased species-specific reporting of landings but 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 (and vice-versa) in an effort to build up track record for other deep-water species (or deep-water sharks). 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. However, the introduction of legislation on buyers and sellers registration in the UK and Ireland in 2006 may mean that the reported landings for 2006 onwards are more reliable.

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 composition of generic landings. In 2005, WGEF split all generic elasmobranch "*nei*" landings from the Northeast Atlantic in the period 1973–2003 (Figueiredo *et al.*, WD 2005).

In 2006 WGEF siki landings were split by species using data available of species proportion by MS, fishery and ICES subarea. When such data were not available for a particular MS the proportion estimated to a similar fishery/subarea was adopted. Although many assumptions were made in order to reconstruct landings, the WGEF considered that they represented the best estimates of recent and historic catches of these species that can be produced.

3.4.2 Length composition

Length frequency information was provided for 2007 from the Portuguese fishery (Moura and Figueiredo, 2008 WD).

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.

Those nations undertaking scientific fisheries for deep water species can take large quantities of fish (e.g. deep water sharks) and should ensure that these catches are reported accordingly.

3.5 Commercial catch-effort data

In 2006, WGEF summarized all the available cpue series. In 2008, standardized lpue from Portuguese longliners data were presented (Figueriedo *et al.*, 2008 WD).

3.6 Fishery-independent surveys

In 2009 the deep-water survey undertaken by Scotland took place. These surveys are being conducted by Marine Scotland in Division VIa at depths ranging from 300–1900 m since 1996. However 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.

Ireland carries out a deep-water survey each year in Area VI and VII, concentrating on NW Ireland–west of Scotland, and the Porcupine area to the west of Ireland. Fishing takes place at 500 m, 1000 m, 1500 m and 1800 m. Parallel tows are carried out in the northernmost area with Scotland for intercalibration purposes. The survey took place in September from 2006–2008. The next survey will occur in December 2009. After this the survey will become biennial, beginning in 2011.

Several shark species are sampled during these surveys. Analysis distribution and life-history parameters of *Centrophorous squamosus* and *Centroscymnus coelolepis* will be presented at the 2010 WGEF meeting.

These and other surveys are part of a planned coordinated survey in the ICES area, through the Planning Group on North East Atlantic Continental Slope Surveys (PGNEACS).

3.7 Life-history information

No new information since 2006.

3.8 Assessments

No new assessments were conducted in 2009.

3.9 Quality of assessments

No new assessments were conducted in 2009.

3.10 Reference points

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

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.

There is no new information (from 2008), to alter our perception of the status of these stocks, which are considered depleted.

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. WGEF expresses concern that new fisheries are developing in new areas 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. Deep-water "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	2008
IV a	0	12	8	10	140	63	98	78	298	227	81	55	1	3	10	16	5	4	4	3	1
Va	0	0	0	0	1	1	0	0	0	0	5	0	1	0	0	0	0	0	0	0	0
Vb	0	0	140	75	123	97	198	272	391	328	552	469	410	475	215	300	229	239	195	590	171
VI	0	8	6	1013	2013	2781	2872	2824	3639	4135	4133	3471	3455	4459	3086	3855	2754	1102	638	737	620
VII	0	0	0	265	1171	1232	2087	1800	1168	1637	1038	895	892	2685	1487	3926	3477	842	323	94	110
VIII	0	0	6	70	62	25	36	45	336	503	605	531	361	634	669	746	674	376	208	23	27
IX	560	507	475	1075	1114	946	1155	1354	1189	1311	1220	972	1049	1130	1198	1180	1125	1033	1325	517	463
X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
XII	0	0	0	1	2	7	9	139	147	32	56	91	890	719	1416	849	767	134	0	1	0
XIV	0	0	0	0	0	0	0	0	0	9	15	0	0	0	12	4	0	0	0	61	0
Unknown Area																		1323	34	0	0
	560	527	635	2509	4626	5152	6455	6512	7168	8182	7705	6484	7059	10105	8093	10876	9031	5054	2727	2025	1392

Table 3.2. Deep-water "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	2008
France	0	0	140	1288	3104	3468	3812	3186	3630	3095	3177	3079	3519	3684	2103	1454	1189	866	744	855	802
UK (Scotland)	0	20	14	24	165	469	743	801	576	766	1007	625	623	2429	1184	1594	1135	802	184	86	48
UK (England and Wales)	0	0	0	104	80	174	387	986	1036	2202	1494	1019	413	320	335	4027	3610	1533	537	23	7
Ireland	0	0	0	0	0	0	0	33	5	0	3	2	138	454	577	493	764	381	113	36	8
Iceland	0	0	0	0	1	1	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
Spain (Basque C)	0	0	0	0	0	0	0	0	286	473	561	450	280	608	621	719	563	359	78	0	0
Portugal	560	507	481	1093	1128	946	1155	1354	1189	1314	1260	1036	1108	1151	1198	1180	1125	1033	1072	522	463
Germany	0	0	0	0	148	91	358	92	164	106	40	214	265	431	518	640	0	79	0	0	0
Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	4	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	14	40	28	0	0	0	1	62
Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0
Russia																			0	500	0
Spain (Galicia)	0	0	0	0	0	0	0	0	0	0	0	0	572	615	1381	737	626	0	0	0	0
Faeroe Island	0	0	0	0	0	3	0	60	282	226	158	54	23	0	0	0	0	0	0	0	3
Norway	0	0	0	0	0	0	0	0	0	0	0	5	118	399	75	0	19	0	0	0	0
Total	560	527	635	2509	4626	5152	6455	6512	7168	8182	7705	6484	7059	10105	8093	10876	9031.4	5053	2727	2023	1392

Table 3.3. Deep-water "siki" sharks in the Northeast Atlantic. Deep-water shark by-catches made by Russian vessels operating in 2008 in ICES Divisions I, V, VI and XII (Vinnichenko and Fomin, 2009 WD).

ICES	Date	Fishing gear	Fishing effort	Fishing Depth	Deep-water sharks
I Barents Sea		Trawl and Longline			1 t
Vb southern part of the Faroes		1–3 longliners class tonnage 8	Total: 99 fishing day 2 053 000 hook	500–1575 m	372.0 t
VIb1 Rockall Bank	July/August 2008	Longline	Total: 96 fishing days 2 862 000 hooks	300–1000 m	92.7 t
VIb1 Rockall Bank	March, Sept and Nov 2008	Longline	Total: 3 fishing days	980–1250 m	20.4 t
XIIc Mid-Atlantic Ridge	July–August Nov–Dec 2008	Bottom trawl			2.9 t

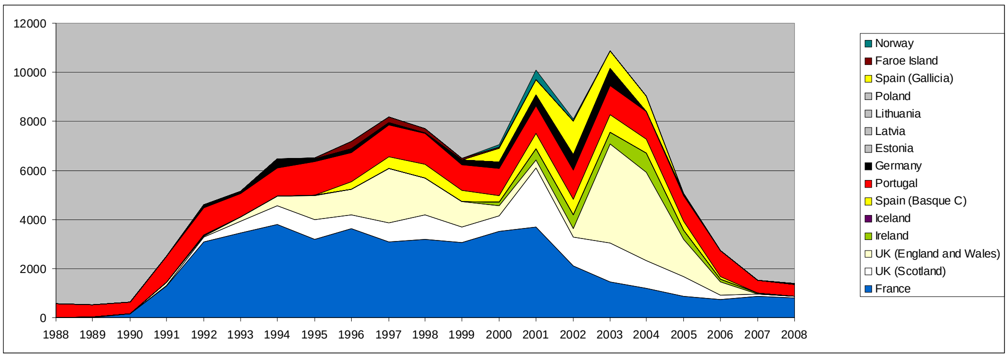

Figure 3.1. Deep-water "siki" sharks in the Northeast Atlantic. Working Group estimates of landings, by country.

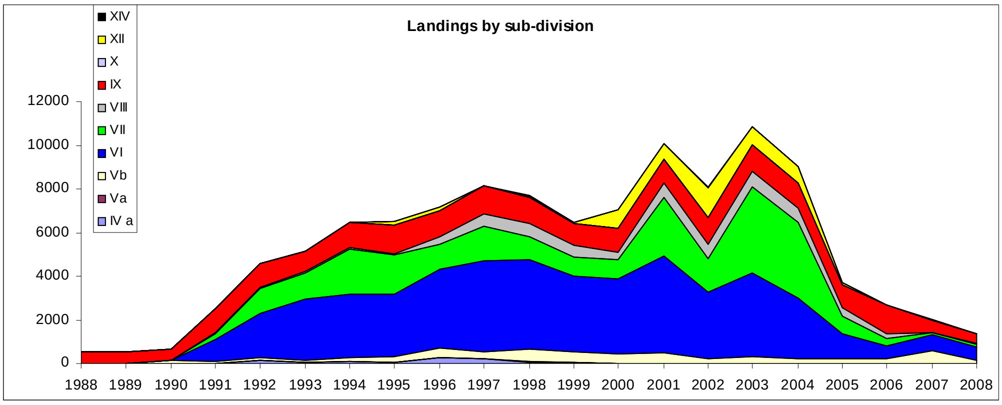

Figure 3.2. Deepwater "siki" sharks in the Northeast Atlantic. Working Group estimates of landings, by ICES Subarea.

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 NW 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 is caught as bycatch in mixed deep-water fisheries in Subareas V–VII, although at 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 historic fishery

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, possibly 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.

4.2.3 The fishery in 2007 and 2008

Kitefin from the Azores is now a bycatch from different deep-water fisheries, with landings in the period 2004–2008 usually 10 t or less.

4.2.4 ICES advice applicable

The advice provided by ICES for 2009 and 2010 is the same as provided in 2006, for 2007 and 2008. 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".

4.2.5 Management applicable

Deep-water 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. The 2009 TAC for V, VI, VII, VIII and IX was 824 t, for XII 25 t and 10 t for Area X. A zero TAC was set for all areas for 2010 (EC Reg. no 1359/2008).

There is a network of closed areas in Azorean waters, and these are summarized in Section 20.

4.3 Catch data

4.3.1 Landings

The landings reported from each country, for the period 1988–2008 are given in Table 4.1 and total historical landings 1972–2008 in Figure 4.1.

4.3.2 Discards

No new information.

4.3.3 Quality of catch data

Deep-water 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. The Azorean landings data reported to ICES come exclusively from the commercial first sale of fresh fish on the auctions. Therefore, data in Table 4.1 may be 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 cm (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 an 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 B_{MSY}.

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.

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.

There are no fishery-independent surveys with which to monitor any stock recovery. 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, sentinel fishery was to be established it should be accompanied by a scientifically robust data collection.

Evaluating the status of kitefin shark in the closed areas around the Azores could be usefully evaluated.

4.12 References

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ICES. 1998. Report on the Study Group on the Biology and Assessment of Deep Sea Fisheries Resources. ICES CM 1998/ACFM:12.

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ICES. 2005. Report of the Working Group on Elasmobranch Fishes. ICES CM 2006/ACFM:03, 224 pp.

Pinho, M. R. 2005. Elasmobranchs of the Azores. WGEF 2005 working document.

Silva, H. M. da 1987. An assessment of the Azorean stock of Kitefin Shark, *Dalatias Licha*. ICES Copenhagen.

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, VIII	.	.	.	.	.	.	.	.	.	.	.
UK Scotland	Vb, VI	.	.	.	.	.	.	.	.	.	.	.
UK (E&W)	VI, VII,VIII	.	.	.	.	.	.	.	.	.	.	.
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	Sub-area	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
France	VII, VIII	.	.	.	.		+	+	3	1	.
UK Scotland	Vb, VI	.	.	.	.	+	+	8	0	+	.
UK (E&W)	VI, VII,VIII	.	.	.	.	+	+	+	2	5	.
Germany	VII	.	.	.	.	.	.	21	.	.	.
Portugal	VI, IXa	14	282	176	5	119	2	3	6	3	1
Portugal (Azores)	X	31	31	13	35	25	6	14	10	7	10
Total		45	313	189	40	144	9	47	21	15	11

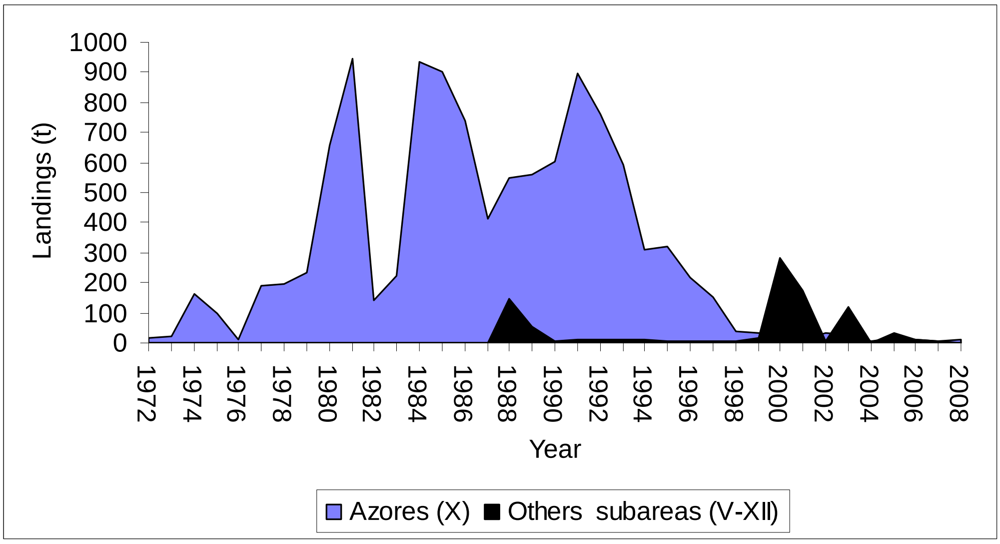

Figure 4.1. Kitefin shark in the Northeast Atlantic. Total landings of kitefin by ICES statistical areas.

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*), spinytail 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. 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 off-shore 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 2008

No new information.

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 species-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, black-mouth catshark, mouse catshark (*Galeus murinus*) and Iceland catshark (*Apristurus* spp.). In Subarea XII, rough longnose dogfish (*Deania histricosa*) and arrowhead dog-fish (*Deania profundorum*) are also included on the list.

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 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 5.1 and 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 con-sidered 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 con-sidered to be misidentified leafscale gulper sharks. Landings from all countries now average approximately 100 t per year.

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. Spanish data are not available for all years.

In 2008, Russian longline fishery in Division Vb captured specimens at depths ranging from 514–970 m. The range of total length was 75–110 cm, with a predominance of specimens with lengths varying between 83–87 cm long. Females predominated (58%) in the catches (Vinnichenko and Fomin, 2009 WD). In 2008 Russian bottom trawlers operating at the Rockall Bank specimens of this species were only caught in one fishing haul made at 825 m deep. Total length of specimens caught varied between 72 and 104 cm. The number of males was 1.2 times greater than that of females (Vinnichenko and Fomin, 2009 WD).

Longnose velvet dogfish *Centroselachus (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, 112 t were reported, primarily by Scotland (95 t) with smaller amounts 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), but recent data are lacking.

In 2007 and 2008, only France has reported catch of black dogfish, 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. The Russian 2008 longline fishery in Division Vb caught specimens at depths between 725 and 1136 m (Vinnichenko and Fomin, 2009 WD). Total length of the males varied between 60 and 65 cm and those of females between 75 and 80 cm. Females predominated in the catches (64%).

Velvet belly *Etmopterus spinax*

Reported landings of velvet belly are presented in Table 5.5 and in Table 5.10. Four European countries have reported landings of velvet belly: Denmark, UK (England &Wales), UK (Scotland) 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. UK landed 8 t in 2005 but no catch was reported in 2006 and 2007.

According to a recent study (Coelo and Erzini, in press) on the Portuguese population of velvet belly, the size, sex and maturity are correlated with depth: the larger, older and mostly mature specimens are predominantly at a greater depth. Females migrate from mating grounds to shallower nursery grounds; they are dominant below 600 m and exclusive below 700 m depth.

Lantern sharks *nei Etmopterus* spp.

Reported landings of lantern sharks *nei* are presented in Table 5.6 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 the catches of these species is retained.

Reported French landings began in 1994, peaked at nearly 3000 t in 1996 then declined by 1999. There is doubt as to whether these landings are actually of this species and further investigations are required. Please state when were these landings first reported to WGEF. Spanish landings began in 2000, peaked at over 300 t in 2001. 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.

Few landings data have been reported since 2003.

Blackmouth dogfish *Galeus melastomus*

Reported landings of blackmouth dogfish are presented in Table 5.7 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 35 t in 1996 and have remained steady at that level. Spanish landings began in 1996, peaked at 35 t in 2002, have since declined to low levels and not been reported in recent years.

In the Alboran Sea, *G. melastomus* cohabits with its congener *G. atlanticus* (Rey *et al.*, in press, 2009) throughout their whole bathymetic ranges. *G. atlanticus* is somewhat smaller than *G. melastomus*, but no size–depth trends were observed. Both species have extended reproductive period throughout the year.

"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 87 t in 1998, declined to 45 t in 2000, then increased to 58 t in 2004. Iceland reported 24 t in 2006 and 2 t in 2007 in Subarea Va. Since, no catch has been available to WGEF. The information centre of the Icelandic Ministry of fisheries published online a note on the Greenland shark (http://www.fisheries.is/main-species/cartilaginous-fishes/greenland-shark/) with a series of graphs describing the evolution of its fishery (Figure 5. 14).

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 196t in 2007, while Portugal reported 63.5 t in 2007 in Subarea X. (Table 5.10).

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, 90 t in 2007 and 50 t in 2008 (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 4 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 (they are small-bodied 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. UK reported 22 t of this skate in 2008. However, 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 hyperborea, 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.

The Russian 2008 longline fishery in Division Vb caught specimens of *Amblyraja hyperborea* at depths between 660 and 1642 m (Vinnichenko and Fomin, 2009 WD). Total length of specimens varied between 46 and 78 cm and males predominated in the catches (ca. 81.5%).

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 and 396 t in 2008. UK reported 4 t in 2006 and 6 t in 2007 of rabbitfish 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. There is evidence suggesting that some fisheries are now retaining a wider range of 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 Porcupine bank surveys

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).

These surveys indicated 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).

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).

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).

5.6.4 Norwegian surveys

A recent study (Williams *et al*., 2008) on the distribution and abundance of chondrichthyans along the north coast of Norway revealed that the abundance did not change significantly although average water temperature rise during the study (1992–2005) and that the current fishery levels do not appear to be impacting the population of the more commonly occurring chondrichthyans, including *Etmopterus spinax, Galeus melastomus* and the chimaeras (Figures 5.15 and 5.16).

5.6.5 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)

The apparent decline in landings of Greenland shark is a concern. This may simply represent a decline in the marketability of this species, or it may be a decline in the stock. More data should be collated for this species and further studies undertaken.

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	2008
UK (England and Wales)	+	+	+	+	+	+	+	2	n.a.	+	+	.	
UK (Scotland)	+	+	+	+	+	+	+	23	17	+	0	3	10
Ireland	+	+	+	+	+	+	+	2	n.a.	n.a.			
Portugal	242	291	187	95	54	96	159	203	89	62	104	129	90
Spain	+	+	+	+	+	+	8	+	n.a.	n.a.	0	.	
Total	242	291	187	95	54	96	167	230	106	62	104	132	100

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	2008
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	43	61
Total	.	.	.	.	13	38	72	75	195	194	94	50	61

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	2008
Ireland												2	
France	.	.	.	+	+	+	13	10	8	6	0	2	4
UK (Scotland)	.	.	.	+	+	+	+	21	7	97	128	95	
UK (England and Wales)	.	.	.	.	.	.	.	+	+	113	281	13	
Portugal	.	.	.	.	1	3	4	2	1	.	.	.	4
Spain	.	.	.	.	85	68	n.a.	n.a.	n.a.	n.a.	0	.	
Total	.	.	.	+	86	71	17	33	16	216	409	112	8

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	2008
France	.	.	.	+	382	395	47	90	49	.	35.1	1.2	137
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	137

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	.	.
Scotland												8
Spain	.	.	.	.	.	.	85	n.a.	n.a.		.	.
Total	8	32	359	128	25	52	85	n.a.	n.a.	8	0	8

Table 5.6. 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 5.7. 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	2008
Ireland	.	.	.	.	.	.	.	+	1	.	.	.	2
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	26	15
Total	39	32	28	25	43	37	87	30	58	41	32	26	17

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	2008
Iceland	41	42	43	61	73	87	51	45	57	56	55	58	53	24	2	
Portugal															1	1
Total	41	42	43	61	73	87	51	45	57	56	55	58	53	24	3	1

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	2008
Gulper Shark	1056	801	958	886	344	423	242	291	187	95	54	96	167	230	106,4	62,2	187	132	100
Birdbeak Dogfish											13	38	72	75	195	194	96	50	61
Black Dogfish											467	486	47	90	49	5	36	1	137
Longnose Velvet Dogfish											86	71	17	33	16	216	409	112	8
Velvet Belly				27	+	10	8	32	359	128	25	52	85	n.a.	n.a.	8	0	8	
Blackmouth Dogfish	17	17	16	20	37	29	39	32	28	25	43	37	87	30	58	41	32	26	17
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	41	42	43	61	73	87	51	45	57	56	55	58	53	24	3	1
Angular Roughshark															75	99	53	90	50
Knifetooth dogfish																61		260	
Total	**1127**	**876**	**1042**	**974**	**1269**	**2893**	**3238**	**2578**	**2704**	**299**	**894**	**1340**	**641**	**550**	**472**	**682**	**813**	**683**	**374**

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

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
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		-
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

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
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

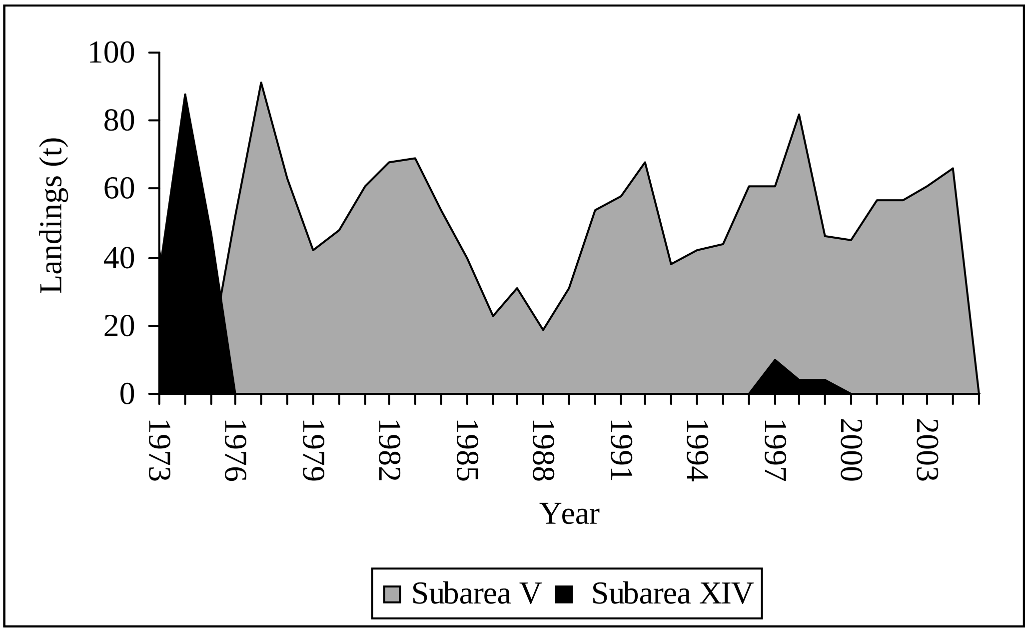

Figure 5.1. **Other deep-water sharks and skates from the Northeast Atlantic. Landings of Greenland shark from Subareas V and XIV.**

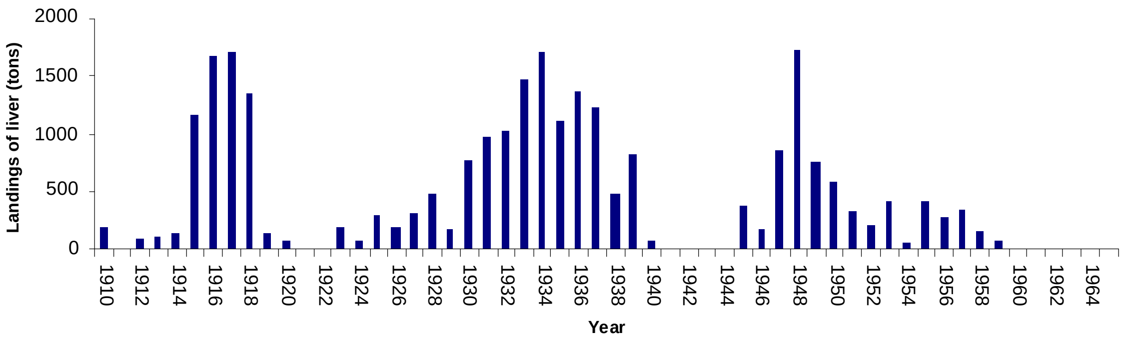

Figure 5.2. Other deep-water sharks and skates from the Northeast Atlantic. Time-series of landings of Greenland shark livers from Norway (Hareide, 2006 WD).

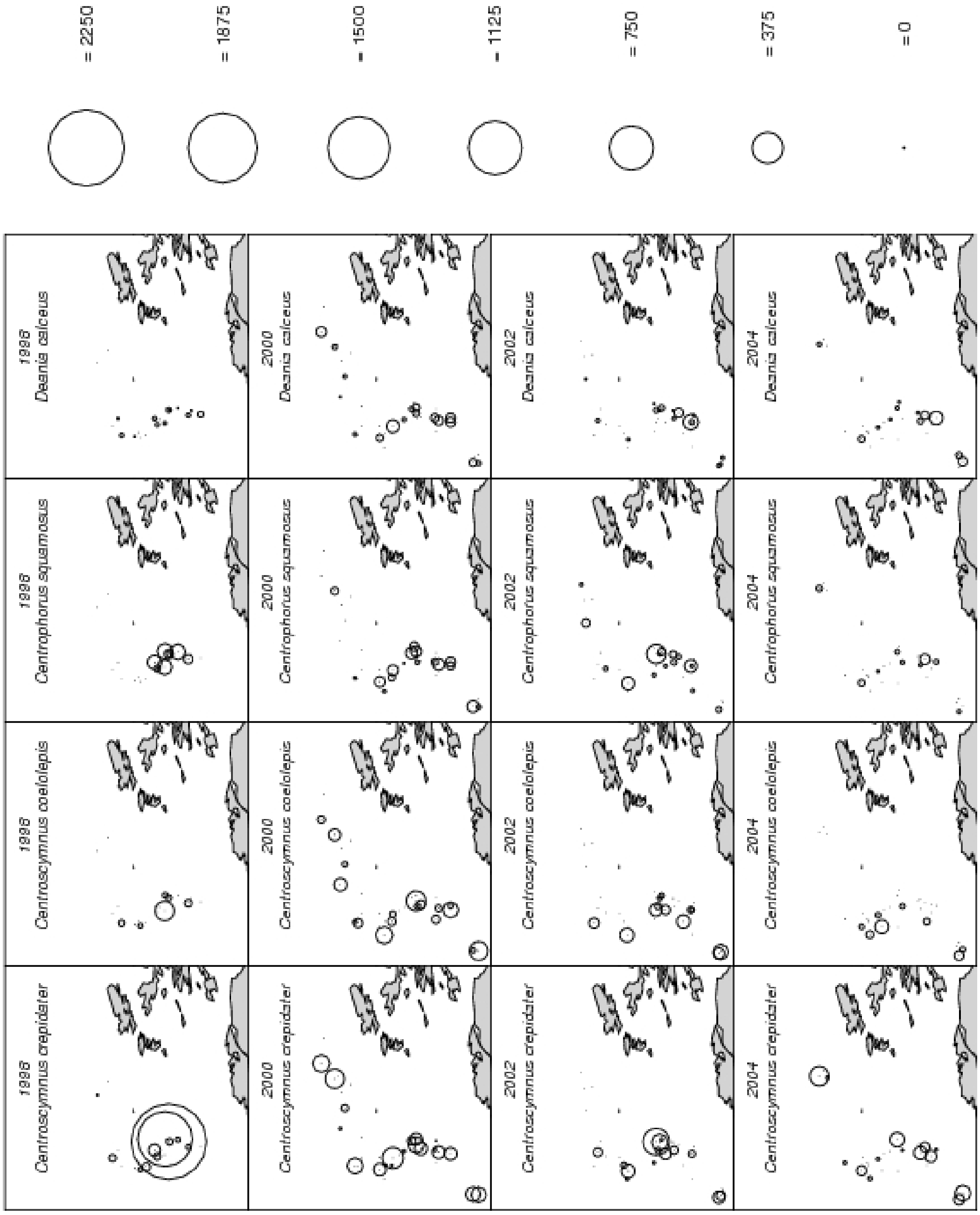

Figure 5.3. Other deep-water sharks and skates from the Northeast Atlantic. Spatial distribution and relative abundance (kg per hour) of four deep-water Squaliform species recorded during the FRS deep-water surveys, 1998–2004.

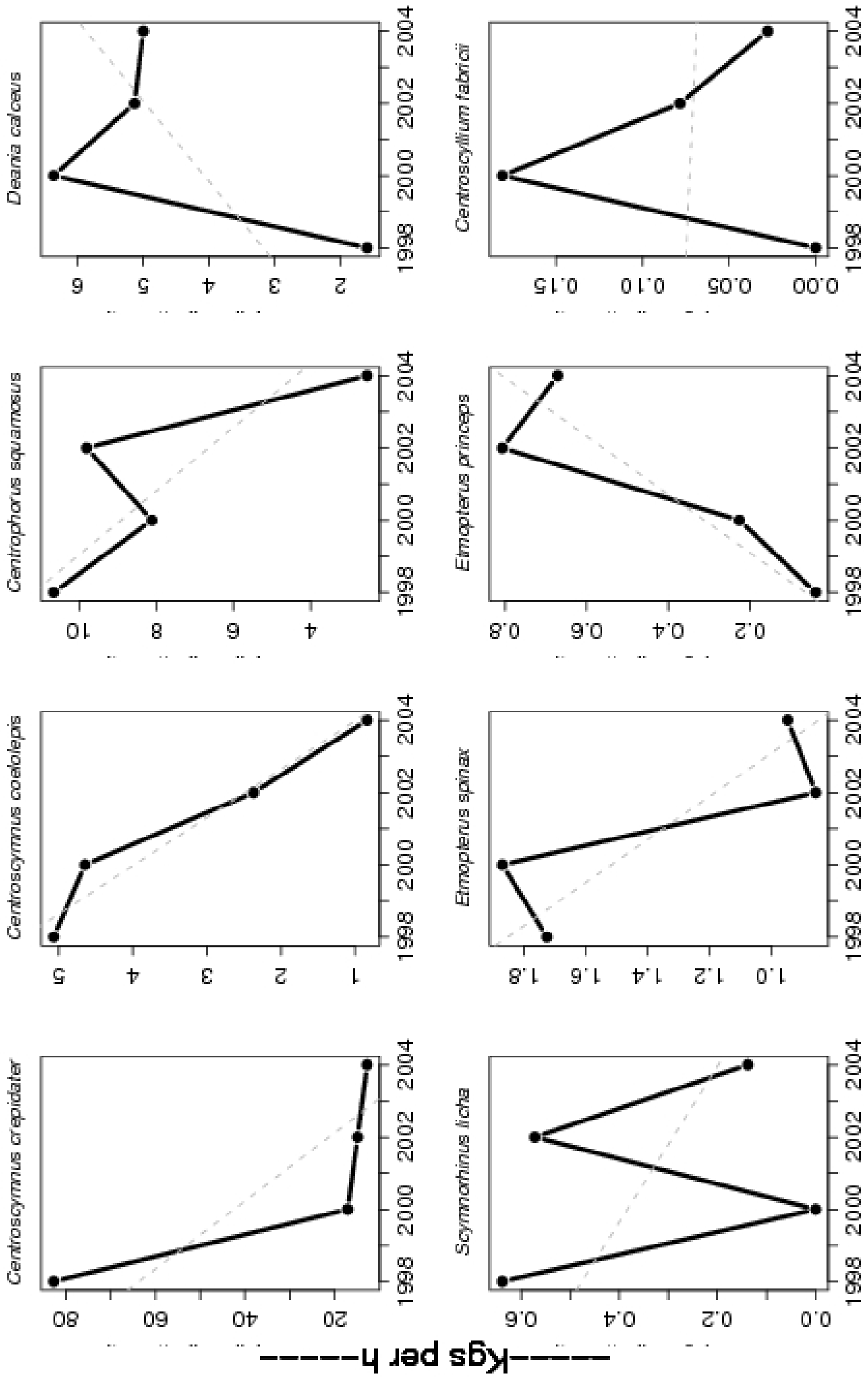

Figure 5.4. Other deep-water sharks and skates from the Northeast Atlantic. Change in cpue (kg per hour) in Scottish surveys in Division VIa between 1998 and 2004 for eight deep-water species.

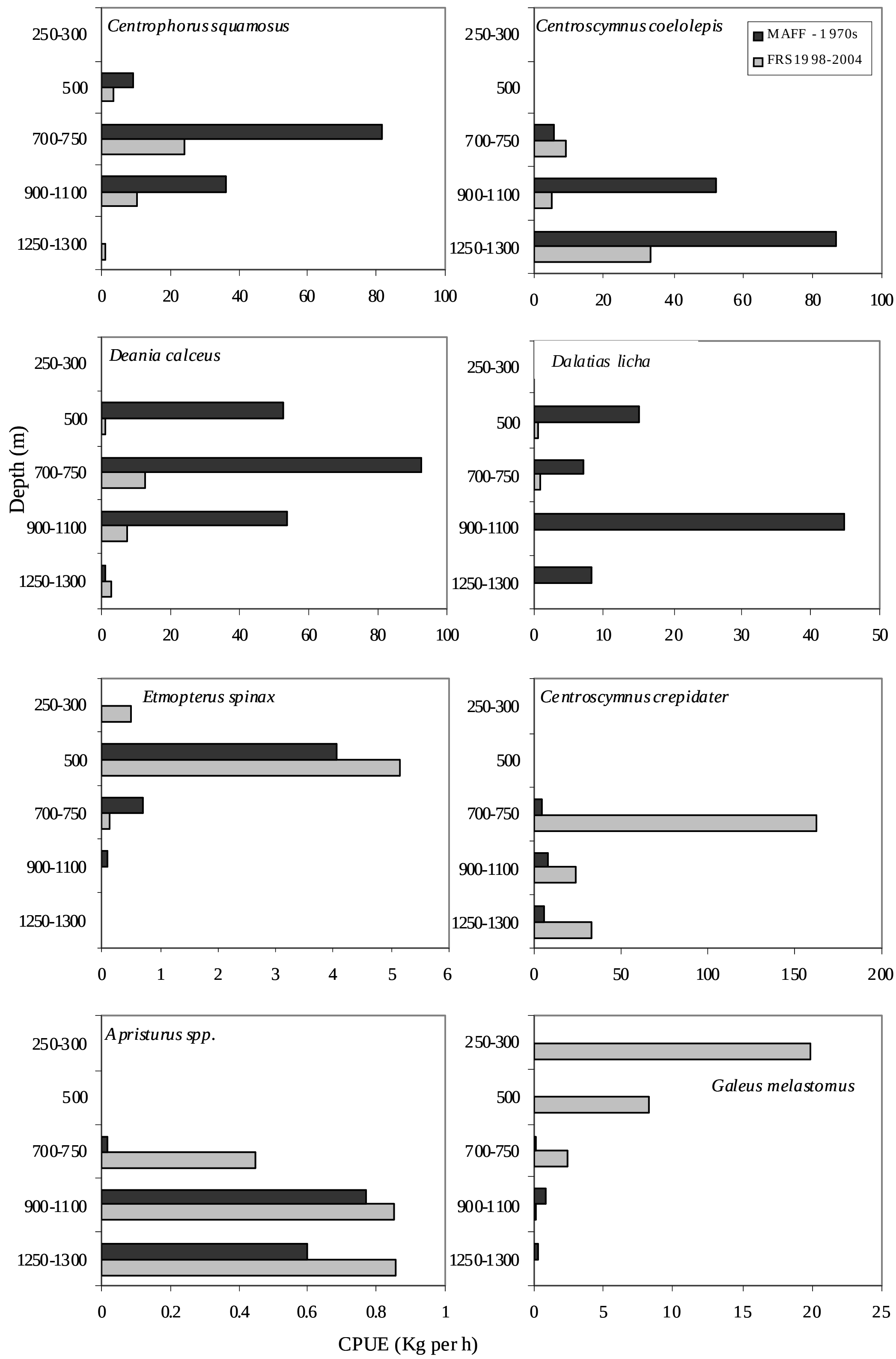

Figure 5.5. Other deep-water sharks and skates from the Northeast Atlantic. Comparison of catch rates (kgs per hour) for eight species of deep-water shark caught during MAFF and FRS deep-water surveys. Note: in this plot all the data from the FRS and MAFF surveys are pooled.

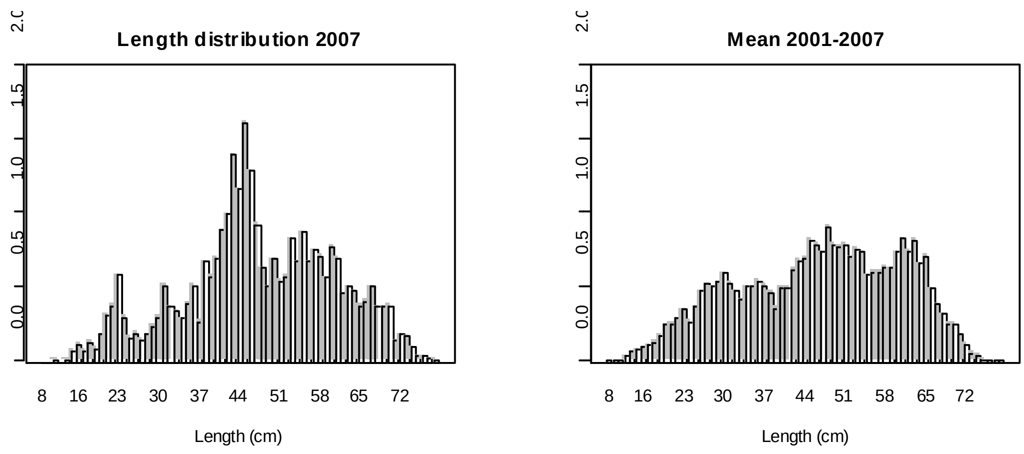

Figure 5.6. Other deep-water sharks and skates from the Northeast Atlantic. Stratified length distributions of blackmouth catshark (*G. melastomus*) in 2007 in Porcupine survey, and mean values during Porcupine Survey time-series (2001–2007; from Velasco and Blanco, 2008).

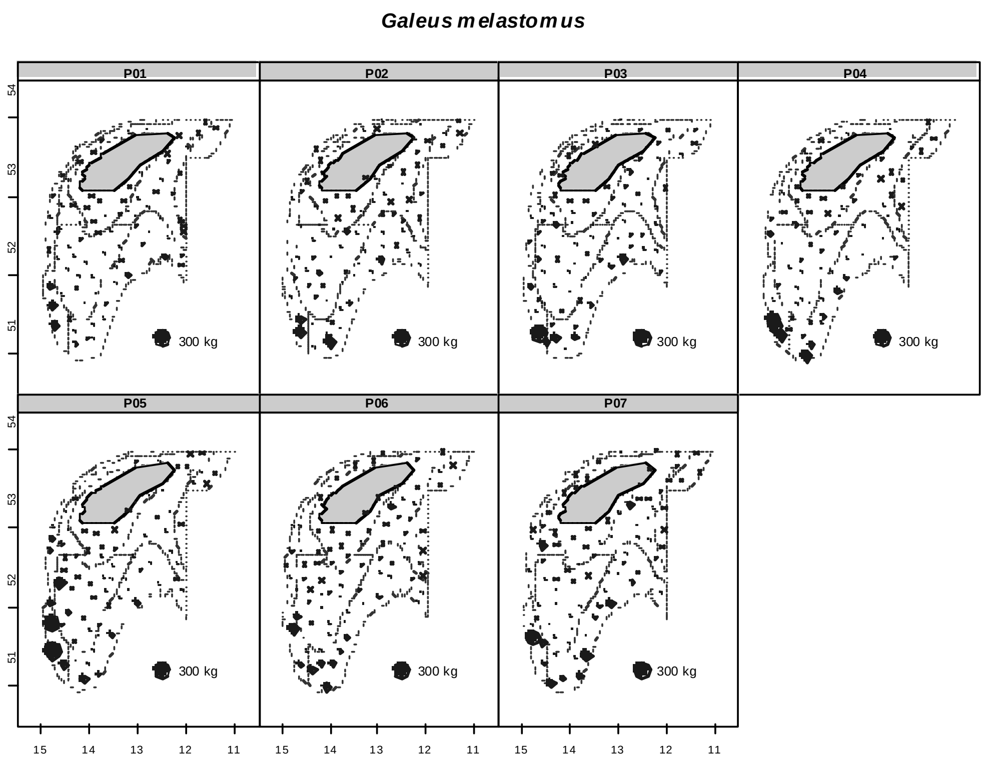

Figure 5.7. Other deep-water sharks and skates from the Northeast Atlantic Geographic distribution of blackmouth catshark (*G. melastomus*) catches (kg/30 min haul) during Porcupine surveys time-series (2001–2007; from Velasco and Blanco, 2008).

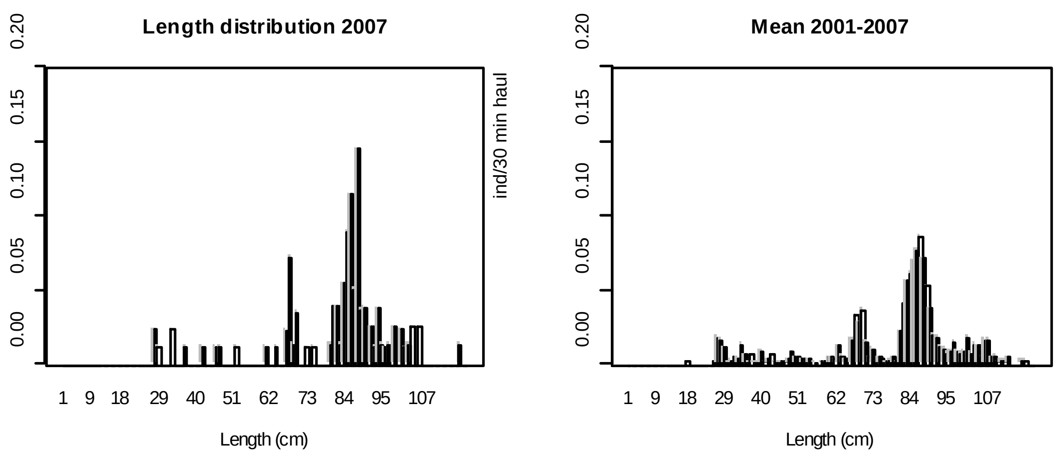

Figure 5.8. Other deep-water sharks and skates from the Northeast Atlantic Stratified length distributions of birdbeak dogfish (*D. calcea*) in 2007 in Porcupine survey, and mean values during Porcupine Survey time-series (2001–2007; from Velasco and Blanco, 2008).

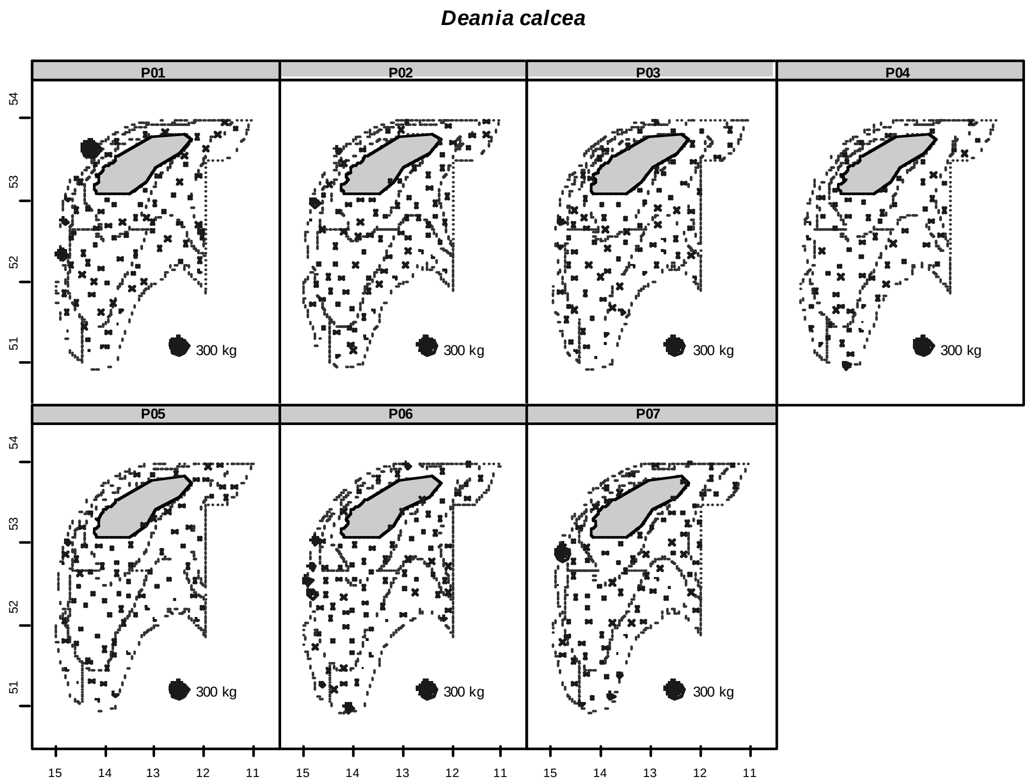

Figure 5.9. Other deep-water sharks and skates from the Northeast Atlantic Geographic distribution of birdbeak dogfish (*D. calcea*) catches (kg/30 min haul) during Porcupine surveys time-series (2001–2007; from Velasco and Blanco, 2008).

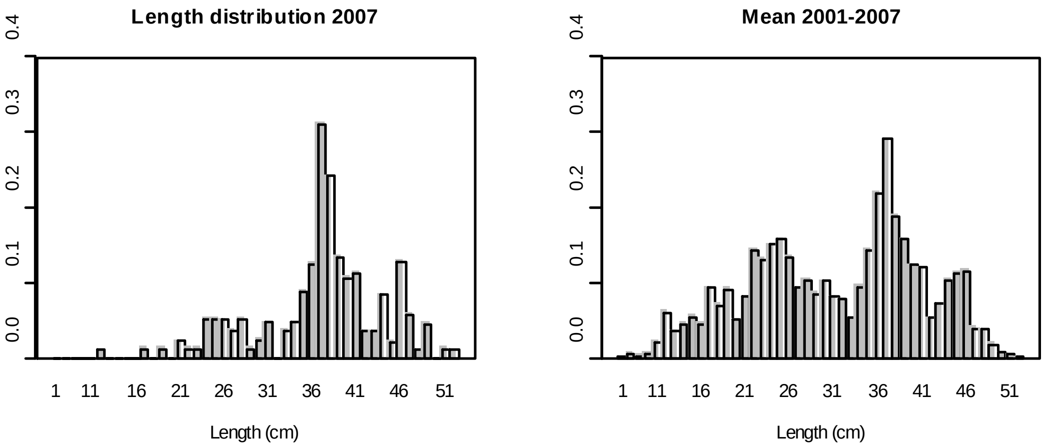

Figure 5.10. Other deep-water sharks and skates from the Northeast Atlantic Stratified length distributions of velvet belly (*E. spinax*) in 2007 in Porcupine survey, and mean values during Porcupine Survey time-series (2001–2007; from Velasco and Blanco, 2008).

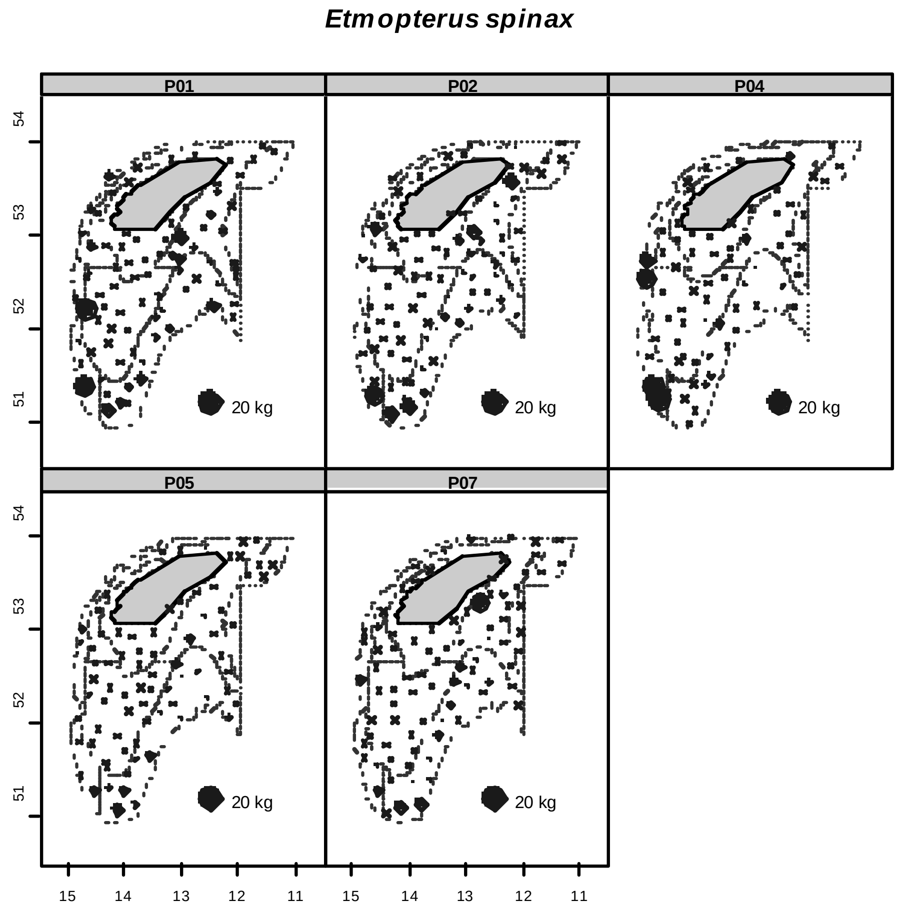

Figure 5.11. Other deep-water sharks and skates from the Northeast Atlantic Geographic distribution of velvet belly (*E. spinax*) catches (kg/30 min haul) in years with high biomass abundance in Porcupine surveys time-series (2003 and 2006; from Velasco and Blanco, 2008).

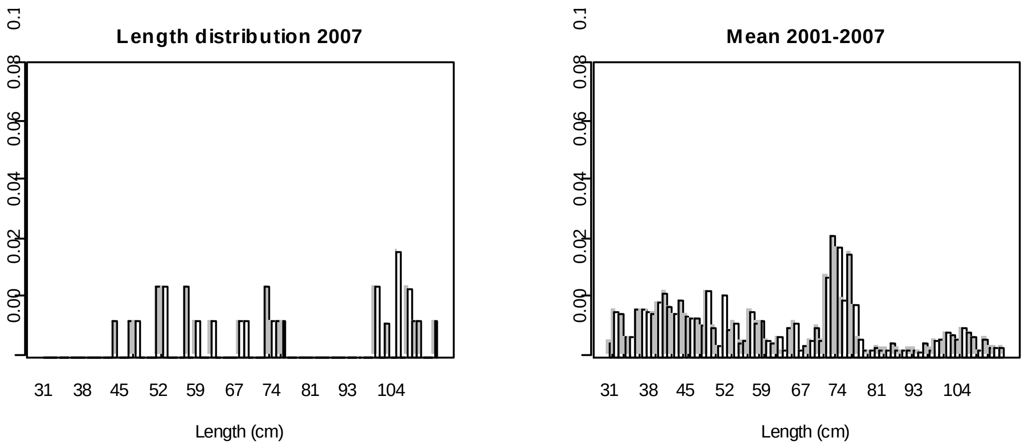

Figure 5.12. Other deep-water sharks and skates from the Northeast Atlantic Stratified length distributions of knifetooth dogfish (*S. ringens*) in 2007 in Porcupine survey, and Mean values during Porcupine Survey time-series (2001–2007; from Velasco and Blanco, 2008).

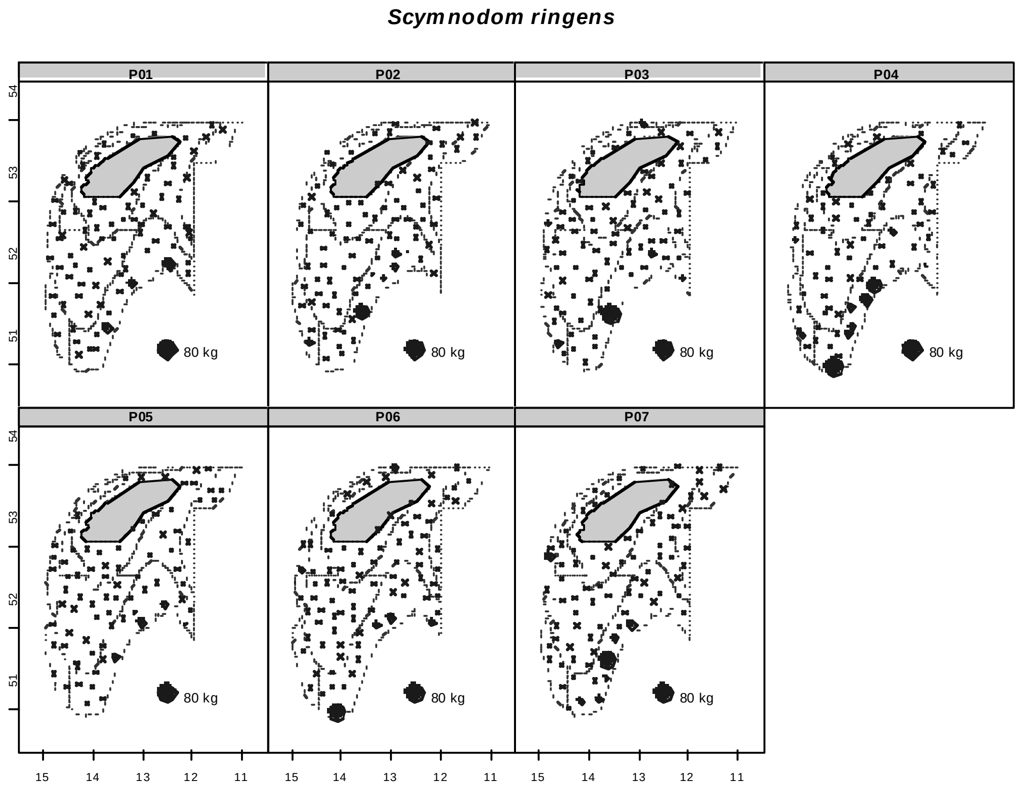

Figure 5.13. Other deep-water sharks and skates from the Northeast Atlantic Geographic distribution of knifetooth dogfish (*S. ringens*) catches (kg/30 min haul) during Porcupine surveys time-series (2001–2007; from Velasco and Blanco, 2008).

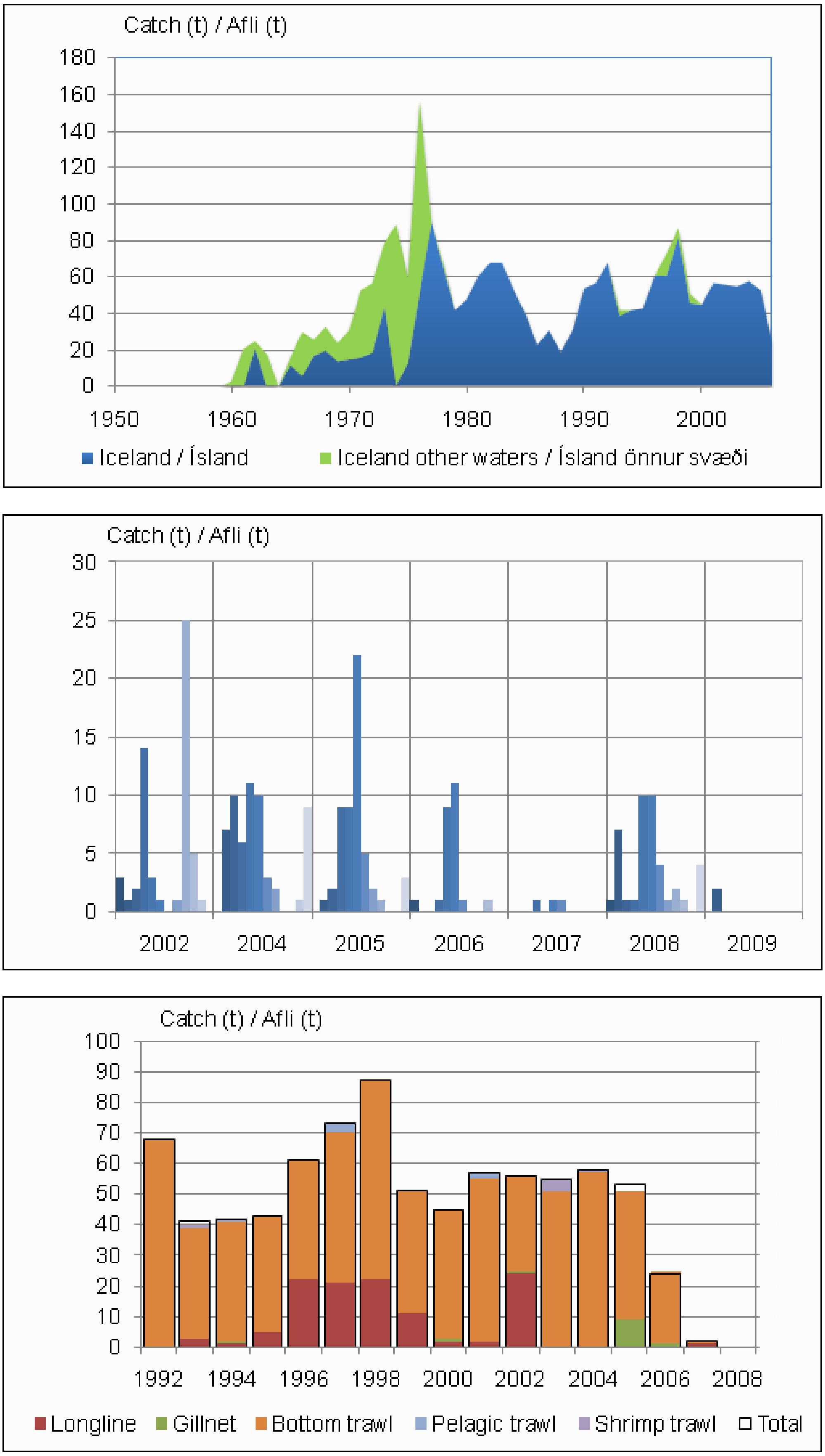

Figure 5.14. Icelandic Greenland shark fishery. Source: Information Center of Icelandic Ministry of Fisheries.

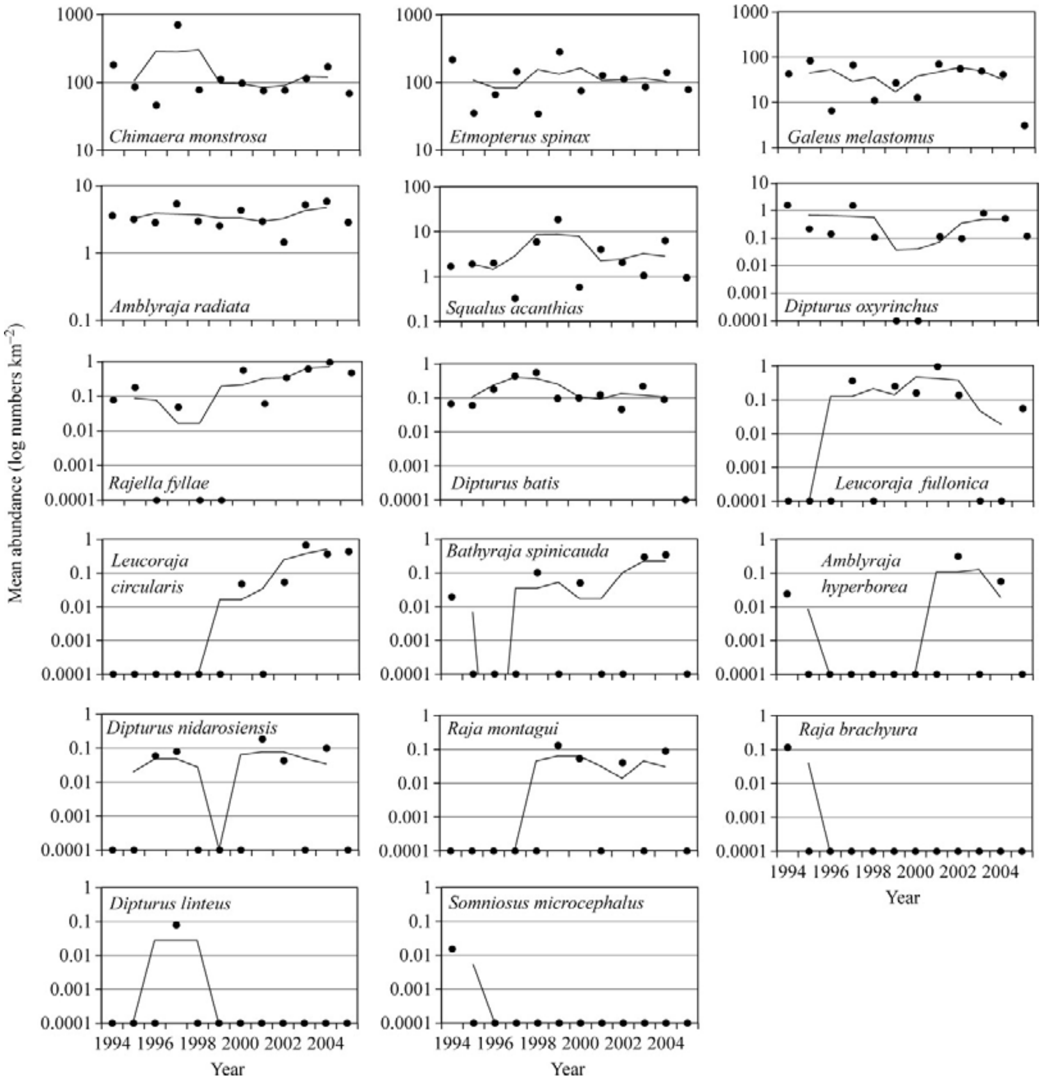

Figure 5.15. Mean abundance of all chondrichthyan species along the north coast of Norway from the coastal surveys of 1992–2005. Note that the abundance scales differ between panels (Williams *et al.*, 2008).

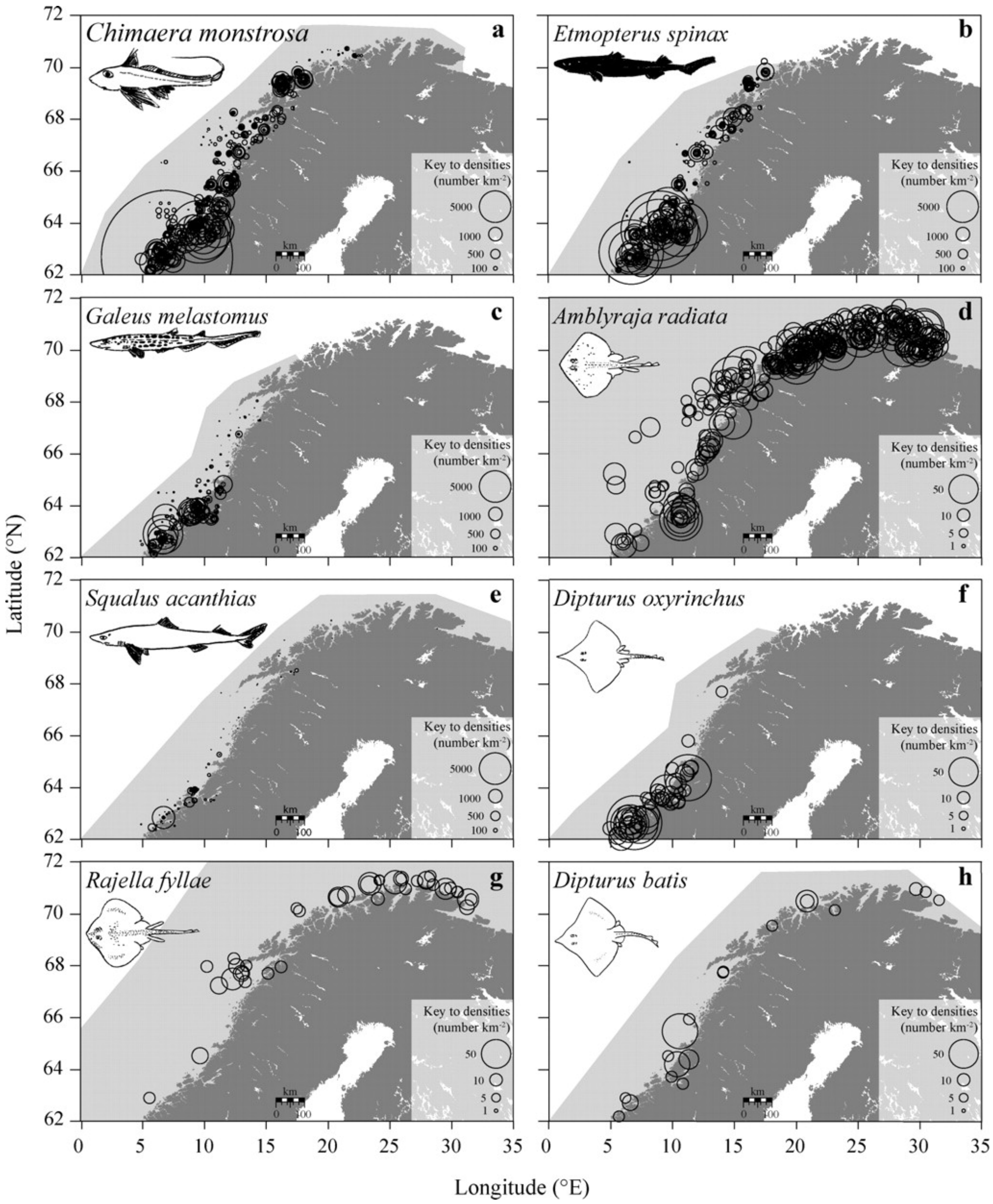

Figure 5.16. Distribution and abundance of (a) *Chimaera monstrosa*, (b) *Etmopterus spinax*, (c) *Galeus melastomus*, (d) *Amblyraja radiata*, (e) *Squalus acanthias*, (f) *Dipturus oxyrinchus*, (g) *Rajella fyllae*, and (h) *Dipturus batis* along the north coast of Norway from the coastal surveys of 1992–2005. Note that the abundance scales differ between panels (Williams *et al*., 2008).

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

6.1 Stock distribution

WGEF consider that there is a single-stock of porbeagle *Lamna nasus* in the NE Atlantic that occupies the entire ICES area (Subareas I–XIV). This stock extends from Norway, Iceland and the Barents Sea to Northwest Africa. For management purposes the southern boundary of the stock is 36°N and the western boundary at 42°W.

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. Some records of porbeagle south of the ICES area may be misidentified shortfin mako.

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. In all 197 recaptures were made (53 from Norwegian, 119 for USA and 25 from Canadian studies). Initial studies did not report any transatlantic migrations (Campana *et al.*, 2003), although a single transatlantic migration has been reported (e.g. Green, 2007 WD; Figure 6.1). Canadian tagging studies have not reported any recaptures east of 42°W.

Genetic evidence suggests some 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 France and, to a lesser extent, Spain and UK. However, historically there were important Norwegian, Danish and Faroese fisheries. 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 "boom" period for this fishery in the NE Atlantic began in the 1930s. The target fishery for porbeagles before the Second World War and was mainly a Norwegian longline fishery in the North Sea, starting in 1926 and landing around 500 t annually in the first years. After a peak in 1933 (ca. 3800 t) the fishery declined. After the war, the target fishery resumed with Norwegian, Faroese and Danish vessels involved. Norway took about 2800 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.

In the early 1950s, landings for the Danish porbeagle fishery were greater than 1000 t, but by the mid-late 1950S average landings were 500–600 t per year; however, this declined to under 50 t by 1983. 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 relatively large quantities from the early 1970s, with a decline in the mid-1980s where landings decreased to around 200 t, with the number of boats in the targeted fishery also declining at this time. After this, catches fluctuated between ca. 200–500 t, with a peak of 640–840 t between 1993 and 1995.

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 captures in demersal fleets are required).

Other countries such as the UK, Faroes and Germany land smaller quantities. The number of French vessels landing more than 5 t has been below ten since 1990, fluctuating between three and five vessels (Biais and Vollette, 2009 WD).

High seas fisheries also take porbeagle and Japan reported 2–3 t in 1996–1997. Given the absence of accurate landings/catch data for high seas fisheries, ICCAT has attempted to estimate landings (see below).

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. 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 has 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.kg^{-1} of dressed porbeagle. Between 2002 and 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 2008

No new information.

Launched by the National Fishing Industry Organization Committee (CNPMEM), the French NGO Association Pour l'étude et la Conservation des Sélaciens (APECS, 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. This project is continuing into 2009.

6.2.3 ICES advice applicable

In 2008, ICES gave the following advice for porbeagle:

'Given the state of the stock, no targeted fishing for porbeagle should be permitted and bycatch should be limited and landings of porbeagle should not be allowed.

Porbeagles are particularly vulnerable to fishing mortality, because the population productivity is low (long-lived, slow-growing, high age-at-maturity, low fecundity, and a protracted gestation period) and they have an aggregating behaviour. Therefore, risk of depletion of reproductive potential is high. It is recommended that exploitation of this species should only be allowed when indicators and reference points for stock status and future harvest have been identified and a management strategy, including appropriate monitoring requirements has been decided upon and is implemented.'

In addition, ICES added the following management considerations: "there may be potential benefits to the stock by protecting mature females… If a non-zero TAC is set, ICES recommends the introduction of a maximum landing length (MLL). This is expected to deter fisheries targeting areas where large females occur. Although there are no studies to define an MLL that would be most beneficial to the stock, the length at first maturity of females may serve as a preliminary MLL which would be at ~210 cm fork length".

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). In 2009, the TAC was reduced to 436 t (a decrease of 25%) and regulations stated that "*A maximum landing size of 210 cm (fork length) shall be respected*" (CEC, 2009).

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. A revised nomination for CITES listing is undergoing consultation and will be debated at the next meeting of the Conference of Parties in March 2010.

6.3 Catch data

6.3.1 Landings

Tables 6.1a, b, 6.2 and Figures 6.2–6.3 demonstrate the historical landings of porbeagle in the Northeast Atlantic. The major landings have been made by Denmark, Norway and France. These data need to be treated as underestimates and with some tion. 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).

Spain has provided estimated catch data for an extended time-series, as species-specific data only covered recent years and some historical catches are thought to refer to shortfin mako. Most of the Spanish catches are from pelagic fisheries for tuna and tuna-like species, with porbeagle catches mostly from ICES Subareas VII–IX. Landings data from Spain (Basque Country) indicate that lamnids are taken in other mixed demersal fisheries (Table 6.2), and better estimates of porbeagle catches by Spanish demersal fisheries are required.

Portuguese landings data were updated during the joint meeting with ICCAT.

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 1999–2008. 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). An example of the seasonal variation in catches (for 2000) is illustrated in Figure 6.5.

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.

Observers on the French fishery (EPPARTIY programme) have noted that some live porbeagle over the MLL have been released, with the traces being cut. Some fish >MLL have been retained, and this may be as a result of either trip success (i.e. there is more reluctance to discard fish if only few fish have been caught,) or difficulties in gauging the size of fish in the water. Studies to identify a body dimension (e.g. inter-dorsal space, or length of dorsal fin) that is correlated with total/fork length and that can be measured more easily in the field are required.

6.3.3 Quality of catch data

Landings data are incomplete and further studies are required to better collate or estimate 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, 1984).

French targeted fishery landings are thought to be correctly documented from 1984 onwards. Prior to this period, there are discrepancies between the national data supplied to WGEF and data on the ICES catch statistics, especially in the 1970s. Further studies to check, confirm and harmonize datasets are needed.

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

Data are lacking for some other high seas fleets (e.g. Japan).

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 still needs to be evaluated.

6.4 Commercial catch composition

Only limited length frequency data are available for porbeagle taken in the northern parts of the stock area (e.g. Gauld, 1989), although recent data on the length composition of porbeagle taken in the French fishery have been provided to WGEF (see below). The length–frequency and sex ratio of commercially caught porbeagle taken in other fisheries have only been collected and reported on sporadically (e.g. Mejuto, 1985; Ellis and Shackley, 1995).

Measurement of the length of porbeagle shark catches is an important parameter for assessing population structure, size composition and growth of the stock. It is therefore important that there is a standardized approach to reporting size measurements. This is not easily achieved with larger elasmobranchs, and inaccuracies/inconsistencies 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 1.11.5.

The length distribution (Fork length over the body) by sex of porbeagle measured during the EPPARTIY programme between April and July 2008 were presented by Jung, 2008; Figure 6.6. Mean average length of porbeagle landed by month and sex are presented Figure 6.7. 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, and 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 species including blue shark (5.2%), common thresher (0.3%), spurdog (<0.1%), as well as occasional teleosts (e.g. *Brama brama* and *Regalecus 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

6.5.1 Previous studies

Preliminary analyses of data from the French fishery were undertaken in 2006 (see Section 6 of ICES, 2006, 2008), based on data supplied in Biseau, 2006, WD. 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 were presented in annual number of hooks (Figure 6.8) 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. A nominal cpue index was calculated from the individual vessel landings for the top 12 vessels presented in Table 6.7 (1993–2007). Annual variation ranged from 1 kg/hook (1994) to 0.73 kg/hook (2007) across the time-series, with a peak cpue of around 1.5 kg/hook in 1999, and a low of 0.54 kg/hook in 2005, however there is much variance. Further studies were requested to clarify this trend. Consequently, a longer time-series of logbook data was presented to the 2009 WG to allow a better interpretation of cpue trends (Figure 6.9).

Mean average length-by-sex (Figure 6.6) shows landings of higher length frequency porbeagle 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.

More detailed analyses of commercial cpue data are described below.

6.5.2 Standardised cpue series for the French and Spanish fleets

Standardised cpue series were constructed for the French target fishery (1972–2008) and for the Spanish longline fleet (1986–2007). For further information on these estimates, see the ICCAT, 2009 Report.

There was a declining trend in standardized cpue for the French fleet occurring at the end of the 1970s (Figure 6.10). Since then, cpue has varied between 400–900 kg per day (total trip length, including search time) without displaying any trend (Biais and Vollette, 2009 WD).

Spanish data were more variable, possibly as porbeagle is only a bycatch in this fishery, and so the fleet may operate in areas where there are fewer porbeagle.

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 (1–18°C, 0–370 m), and is more common on continental shelves (Stevens *et al.*, 2006a). Campana and Joyce, 2004 reported 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.

A more recent study has used archival tags on four porbeagle caught off the SW England (Pade *et al.*, 2009). During July and August the sharks occupied areas of about 8602–90 153 km^2 within the Celtic Sea. One individual was tracked during autumn, and this shark moved to deeper waters off the continental shelf before moving northwards. Sharks occupied a bathymetric range of 0–552 m and water temperatures of 9–19°C.

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 larger than 205 cm long (curved fork length over the body), were released alive.

Samples of vertebrae (n=48) collected during the EPPARTIY have been read, and a new set of growth parameters were presented. This study indicated that NE Atlantic porbeagle are slower growing than NW Atlantic porbeagle. Further age and growth studies are needed, and revised growth parameters will hopefully be provided next year.

The maturity estimates provided by Jensen *et al.*, 2002 for NW Atlantic porbeagle (see Table 6.8) have been used in assessments for NE Atlantic in the absence of appropriate, recent data for NE Atlantic porbeagle.

Estimates of natural mortality include 0.18 (Aasen, 1963), 0.1–0.2 for immature and mature fish (Campana *et* al., 2001) and 0.114 (E. Cortes, unpublished).

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

Exploratory assessments were undertaken in the joint ICES/ICCAT meeting using a Bayesian Surplus Production (BSP) model and an age structured production model (Campana *et al*., 1999; 2001).

The BSP model was used to estimate status and project population trends for NE Atlantic porbeagle. This model was used in previous ICCAT assessments for blue shark and shortfin mako in 2004 and 2008. An informative prior was developed for the rate of population increase (*r*) based on demographic data, but the prior for K was weakly informative. Catch and standardized cpue data (see Section 6.5.2 and ICCAT, 2009) were used in this model, and the outputs are described in more detail in ICCAT, 2009.

An age-structured production model was also applied to the NE Atlantic stock of porbeagle to provide contrast with the BSP model, but using the same input data. The model dynamics are age-structured, incorporating age-specific parameters for survival, fecundity, maturity, growth, and selectivity. The stock–recruitment function is also parameterized in terms of maximum reproductive rate at low density. More detailed information and the outputs are described in more detail in ICCAT, 2009.

6.8.3 Stock projections

The projections (using the BSP model) were that sustained reductions in fishing mortality would be required if there is to be any stock recovery. Recovery of this stock to BMSY under zero fishing mortality would take ca. 15–34 years. Although model outputs suggested that the current TAC (436 t) may allow the stock to remain stable, at its current depleted biomass level, under most credible model scenarios, catches of

200 t or less resulted in higher probabilities of recovery to B_{MSY} within 25–50 years under nearly all model scenarios.

6.9 Quality of assessments

The assessments (and subsequent projections) conducted at the joint meeting with ICCAT and that will be presented in the ICCAT report of this meeting should be considered exploratory assessments.

However it must be noted that:

- Catch data are considered underestimates, as not all nations have reported catch data throughout the time period.
- The projections were based on the BSP model, which was generally more optimistic than the age-structured production model
- The cpue index for the French fleet is for a targeted fishery that actively seeks areas where catch rates of porbeagle are higher. Furthermore, the index (catch per day) does not allow many factors to be interpreted, such as fishing strategies, including searching behaviour and patterns, fleet dynamics (e.g. more vessels may operate when good catches are made), changes in numbers of vessels, number of lines and line deployments per day, and the number of hooks. Hence, this series may not be reflective of stock abundance.

Hence, model outputs should be considered highly uncertain (ICCAT report) and subsequent management advice should account for both the uncertainty in the input parameters for this assessment and the low productivity of the stock. If the model outputs are used for advice, it should also ensure that any fishery is closely monitored and assessed at frequent intervals.

6.10 Reference points

No reference points have been proposed for this stock.

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

6.11 Management considerations

WGEF considered all available data in 2009. 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.

WGEF reiterates that this species has a low productivity, and is highly susceptible to overexploitation.

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. 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.

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

The maximum landing length (MLL) may constitute a useful management measure in targeted fisheries, as it should deter targeting areas with mature females. The benefits of such measures still need to be better evaluated. Given the difficulties in measuring (live) sharks, studies to identify a body dimension (e.g. inter-dorsal space, or length of dorsal fin) that is correlated with total/fork length and that can be measured more easily in the field are required.

Further ecological studies on porbeagle, as highlighted in the scientific recommendations of ICCAT, 2009 would help further develop management for this species.

Further studies on porbeagle bycatch and post-release survivorship of any discarded porbeagle are required.

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).

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Table 6.1a. Porbeagle in the NE Atlantic. Working Group estimates of porbeagle landings data (tonnes) by country (1926–1970). Data derived from ICCAT, ICES and national data. Data are considered an underestimate.

Year	Estimated Spanish data	Denmark	Norway (NE Atl)	Scotland
1926			279	
1927			457	
1928			611	
1929			832	
1930			1505	
1931			1106	
1932			1603	
1933			3884	
1934			3626	
1935			1993	
1936			2459	
1937			2805	
1938			2733	
1939			2213	
1940			104	
1941			283	
1942			288	
1943			351	
1944			321	
1945			927	
1946			1088	
1947			2824	
1948			1914	
1949			1251	
1950	4.49	1900	1358	
1951	3.00	1600	778	
1952	3.00	1600	606	
1953	3.74	1100	712	
1954	0.95	651	594	
1955	1.92	578	897	
1956	1.16	446	871	
1957	3.11	561	1097	
1958	2.59	653	1080	7
1959	3.42	562	1183	9
1960	2.24	362	1929	10
1961	5.28	425	1053	9
1962	7.15	304	444	20
1963	3.11	173	121	17
1964	5.60	216	89	5
1965	4.45	165	204	8
1966	9.32	131	218	6
1967	8.36	144	305	7
1968	11.04	111	677	7
1969	10.89	100	909	3
1970	9.82	124	269	5

Table 6.1b. Porbeagle in the NE Atlantic. Working Group estimates of porbeagle landings data (tonnes) by country (1971–2008). Data derived from ICCAT, ICES and national data. Data are considered an underestimate. Estimated Spanish catch is used to estimate total landings, and reported data are excluded.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Denmark	311	523	158	170	265	233	289	112	72	176	158	84	45	38
Faroe Is	1		5			1	5	9	25	8	6	17	12	14
France	550	910	545	380	455	655	450	550	650	640	500	480	490	300
Germany			6	3	4	.	.	.	.	.	.	.	.	.
Iceland			2	2	4	3	3	.	1	1	1	1	1	1
Ireland			.	.	.	.	.	.	.	.	.	.	.	.
Netherlands			.	.	.	.	.	.	.	.	.	.	.	.
Norway	111	293	230	165	304	259	77	76	106	84	93	33	33	97
Portugal			.	.	.	.	.	.	.	.	.	.	.	.
Spain			.	.	.	.	.	2087	.	.	.	.	.	.
Spain	11	10	12	9	12	9	10	11	8	12	12	14	28	20
Sweden			.	.	3	.	.	5	1	8	5	6	5	9
UK (E,W, Nl)		4	14	15	16	25	.	.	1	3	2	1	2	5
UK (Scot)	7	15	13	.	.	.	.	.	.	.	.	.	.	.
Japan			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	991	1755	985	744	1063	1185	834	763	864	932	777	636	616	484

	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	12	12	33	14	14	14	7	20	76	48	44	8
France	196	208	233	341	327	546	306	466	642	824	644	450
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	.	.	.	.	.	.	.	.	.	.	.	31
Spain (est)	23	26	30	61	40	26	46	15	21	49	17	39
Sweden	10	8	5	3	3	2	2	4	3	2	2	1
UK (Eng,Wal & Nl)	12	6	3	3	15	9	.	.	.	.	0	.
UK (Scot)	.	.	.	.	.	.	.	.	.	.	.	.
			0									
Japan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3
TOTAL	383	373	359	410	422	664	436	614	841	998	811	601

Table 6.1b. (continued). Porbeagle in the NE Atlantic. Working Group estimates of porbeagle landings data (tonnes) by country (1971–2008). Data derived from ICCAT, ICES and national data. Data are considered an underestimate. Estimated Spanish catch is used to estimate total landings, and reported data are excluded.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Denmark	69	85	107	73	76	42	21	20	4	3	2	2
Faroe Is	9	7	10	13	8	10	14	5	19	21	13	0
France	495	435	273	361	339	439	394	374	246	185	347	221
Germany	.	2	0	17	1	3	5	6	5	0		0
Iceland	2	3	3	2	4	2	0	1	0	1	0	0
Ireland	.	.	8	2	6	3	11	18	3	4	8	7
Netherlands	.	.	.	0			0		0		0	0
Norway	19	28	34	23	17	14	19	24	11	27	10	12
Portugal	1	1	0	15	4	11	4	57	10	6	2	1
Spain	45	31	15	17	43	98	49	12	7	25		13
Spain (est)	23	22	15	11	23	49	22	9	10	26	6	32
Sweden	1	1	1	1	1	.	.	5	0	.	1	0
UK (Eng,Wal & NI)	.	1	6	7	10	7	25	24	24	11	26	12
UK (Scot)	.	.	.	.	1	.	.	.	.	.	.	1
Japan	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
TOTAL	622	584	457	526	490	580	516	544	334	284	415	288

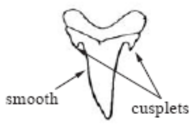
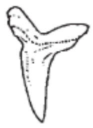
Table 6.2. Porbeagle in the NE Atlantic. Landings of Porbeagle and Shortfin mako (*Lamnidae*) from Spain (Basque Country).

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 (adapted from Compagno, 1984).

	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 2007 (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
Female mean length (LF)	108 cm		NW Atlantic	Kohler *et al.*, 2002

Parameter	Values	Sample Size	Area	Reference
	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 t_0 = -5.78		NW Atlantic	Harley, 2002
Female growth parameters	l_{∞} = 309.8 k = 0.061 t_0 = -5.90		NW Atlantic	Harley, 2002
Combined sex growth parameters	l_{∞} = 289.4 k = 0.066 t_0 = -6.06		NW Atlantic	Harley, 2002; Natanson *et al.*, 2002
	l_{∞} = 267.6 ± 9.3 k = 0.084 ± 0.009 t_0 = -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			Campana *et al.*, 2003
Generation time (years)	~ 18		NW 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
Trophic level	4.2	115 (stomachs)	various (4 studies)	Cortes, 1999
Total mortality coefficient	0.18		NW Atlantic	Aasen, 1963

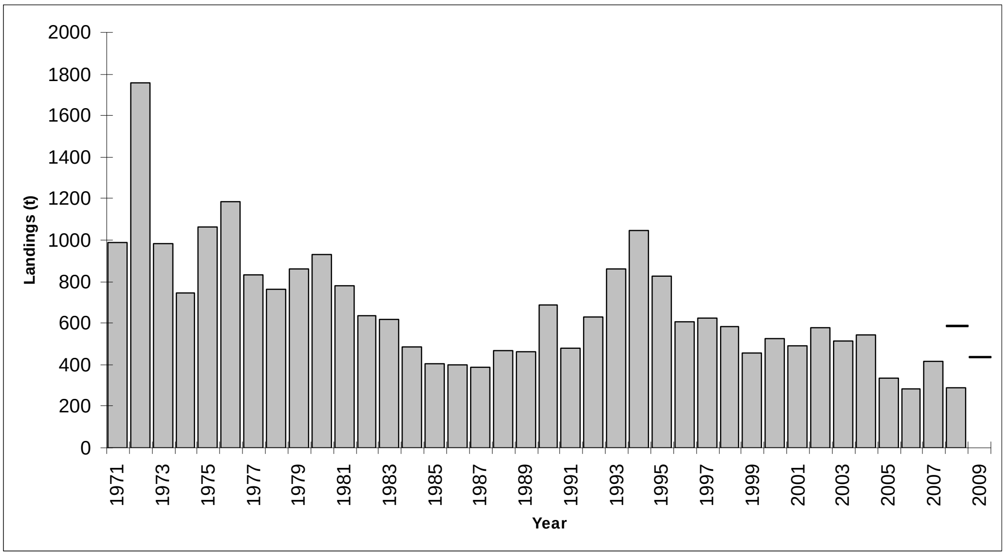
*** Cited in Francis *et al.*, 2008**

Porbeagle Shark Recaptures

NOS TAGGED TO DEC. '06	74
NOS RECAPTURED TO DEC. '06	7

DAYS AT LIBERTY	71 - 3947
DISTANCE TRAVELLED	89 - 2300
RECAPTURE RATE	9.45%

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



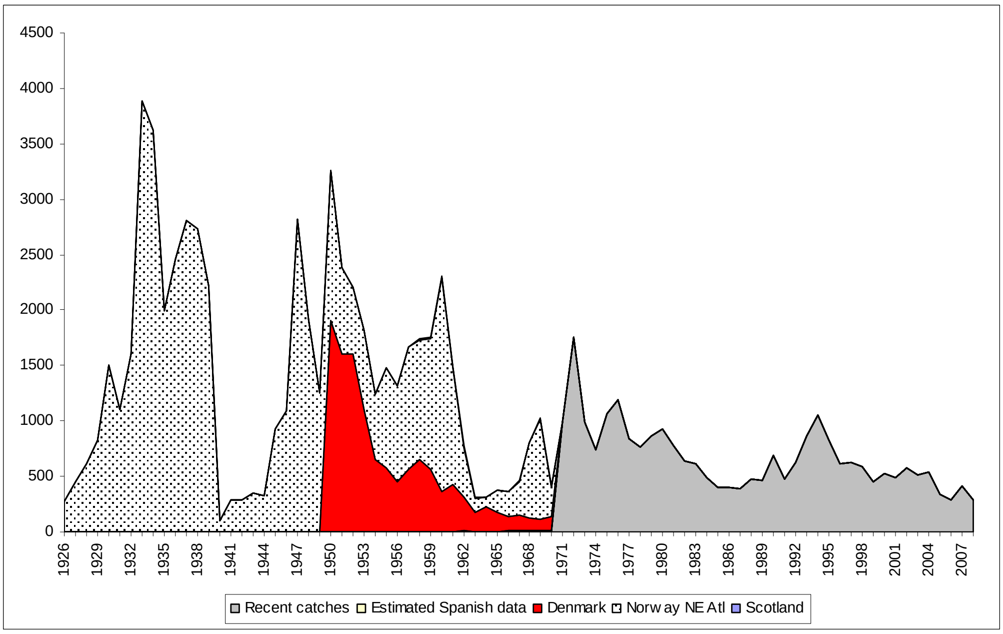


Figure 6.2. Porbeagle in the NE Atlantic. Working Group estimates of landings of porbeagle in the NE Atlantic for 1971–2008 (top, black lines indicates 2008 and 2009 TAC) and longer term trend in landings (1926–1970) for those fleets reporting catches.

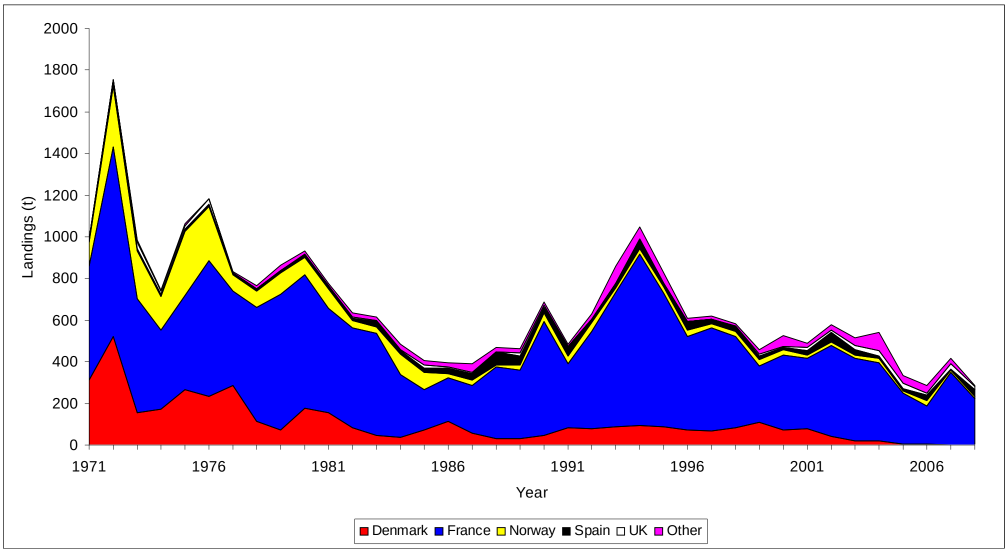
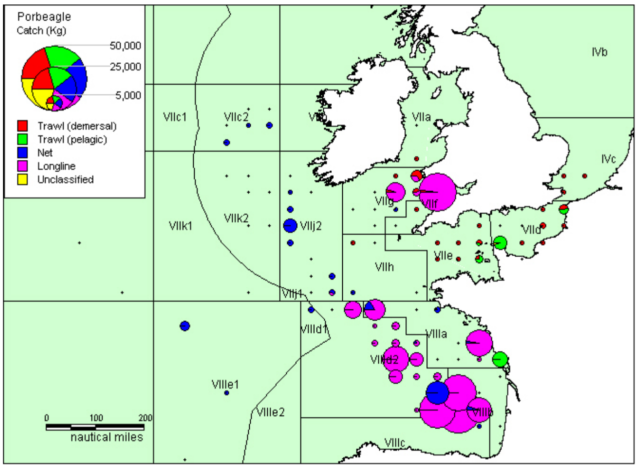
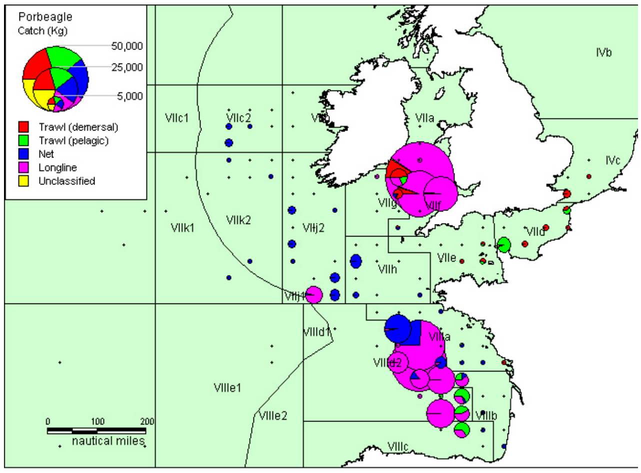


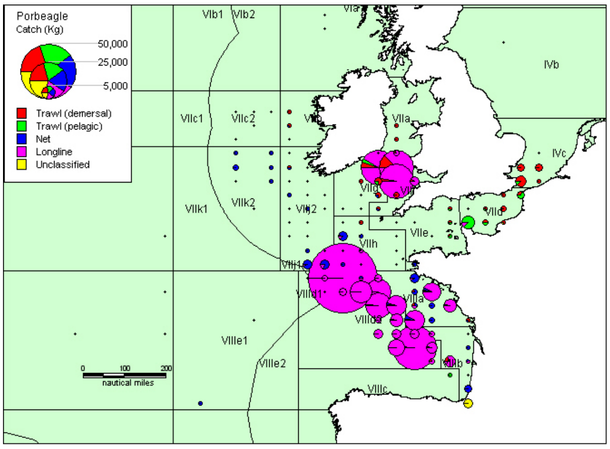
Figure 6.3. Porbeagle in the NE Atlantic. Working Group estimates of landings of porbeagle in the NE Atlantic for 1973–2007 by country.



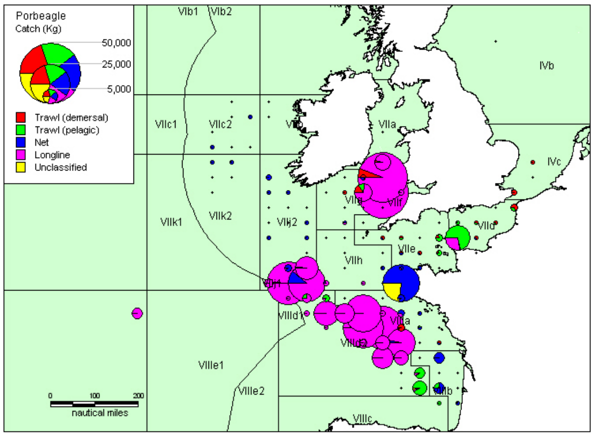
1999



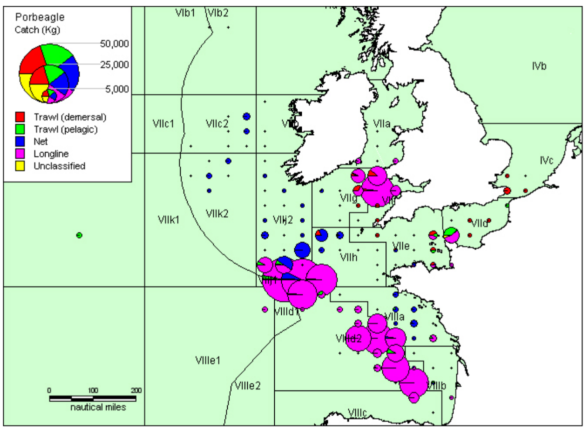
2000



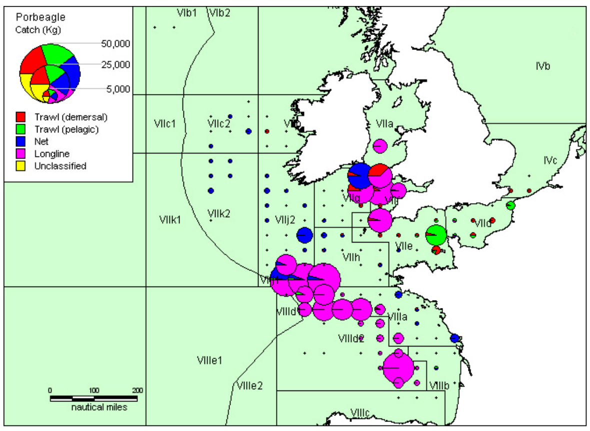
2001



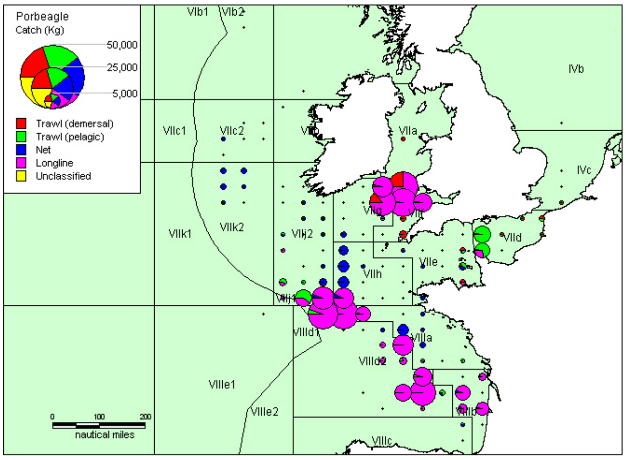
2002



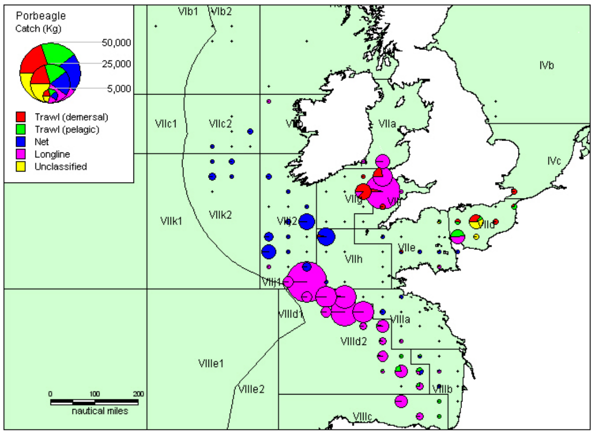
2003



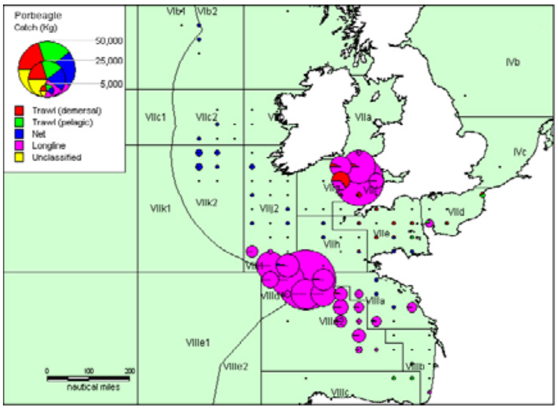
2004



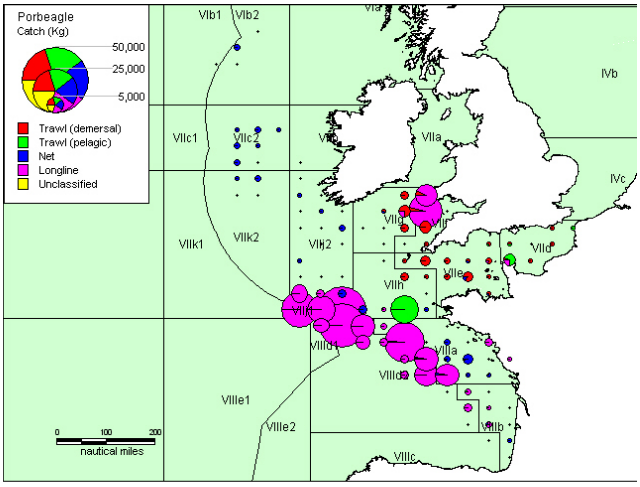
2005



2006

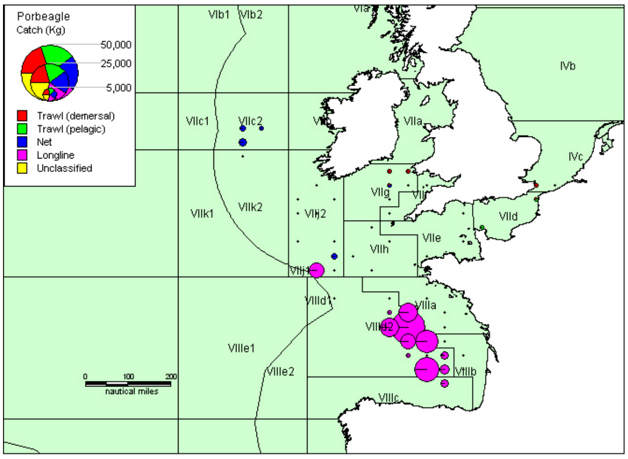


2007

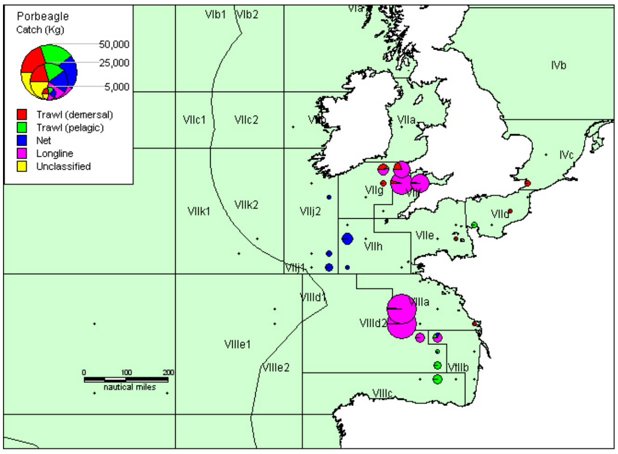


2008

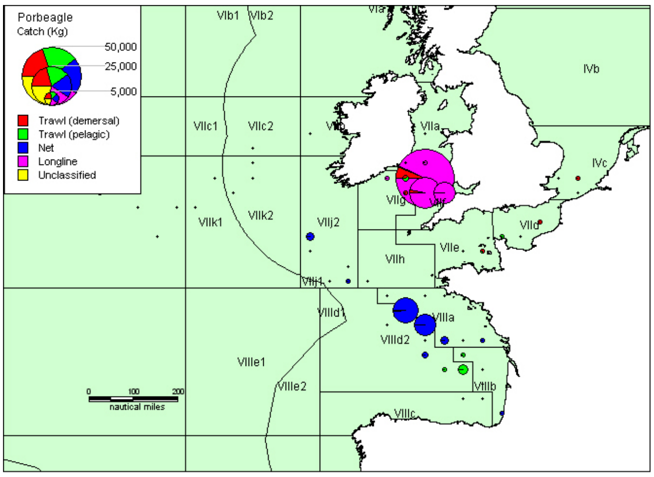
Figure 6.4. Porbeagle in the NE Atlantic. Annual distribution of Porbeagle (*Lamna nasus*) catch by gear and ICES statistical rectangles, 1999–2008.



April–May 2000



June–July 2000



August–September 2000

Figure 6.5. Porbeagle in the NE Atlantic. Seasonal distribution of Porbeagle (*Lamna nasus*) catch by gear and ICES statistical rectangles (2000).

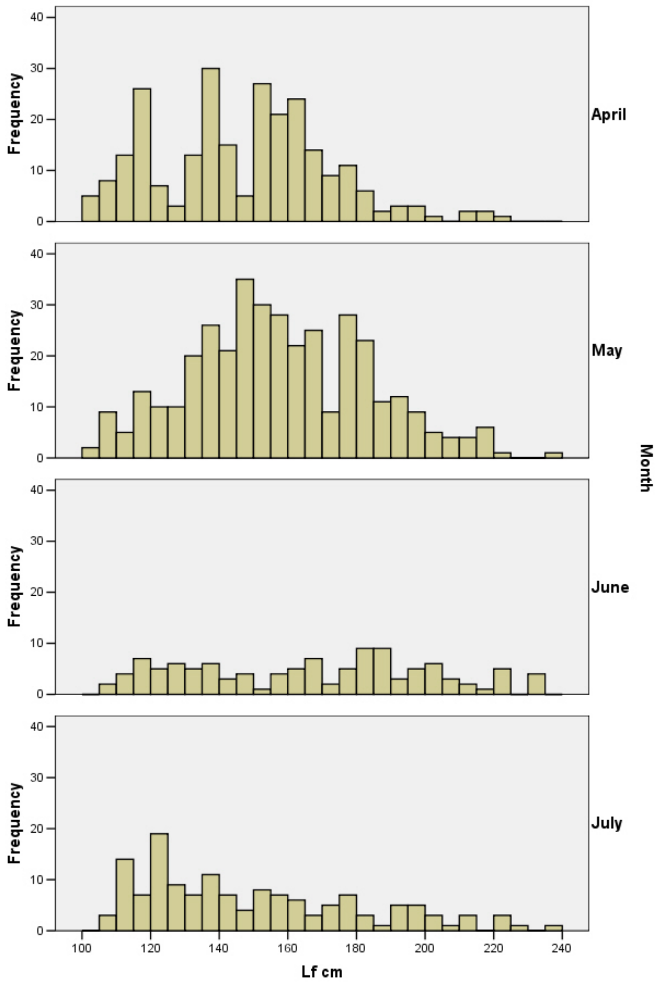


Figure 6.6. Porbeagle in the NE Atlantic. Length–frequency distribution of the landings of the Yeu porbeagle targeted fishery by month in 2008 (April, n = 164; May, n = 350; June, n = 113; July, n = 142) 2008. Source: Jung, 2008.

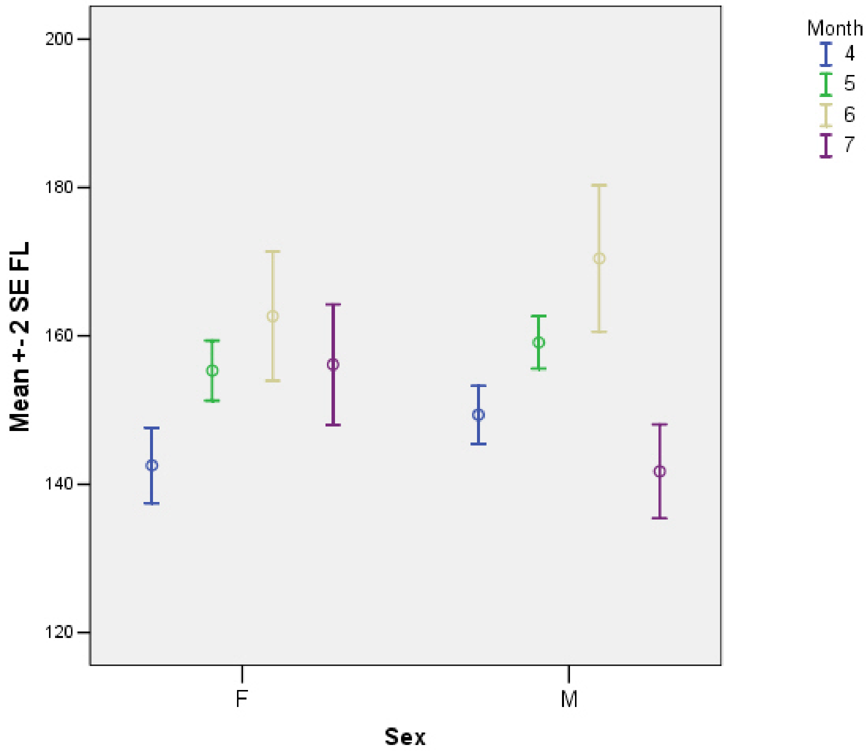


Figure 6.7. Porbeagle in the NE Atlantic. Mean average length of the porbeagle landed in the French targeted fishery by sex for April (blue), May (green), June (yellow) and July (purple). Source: Jung, 2008.

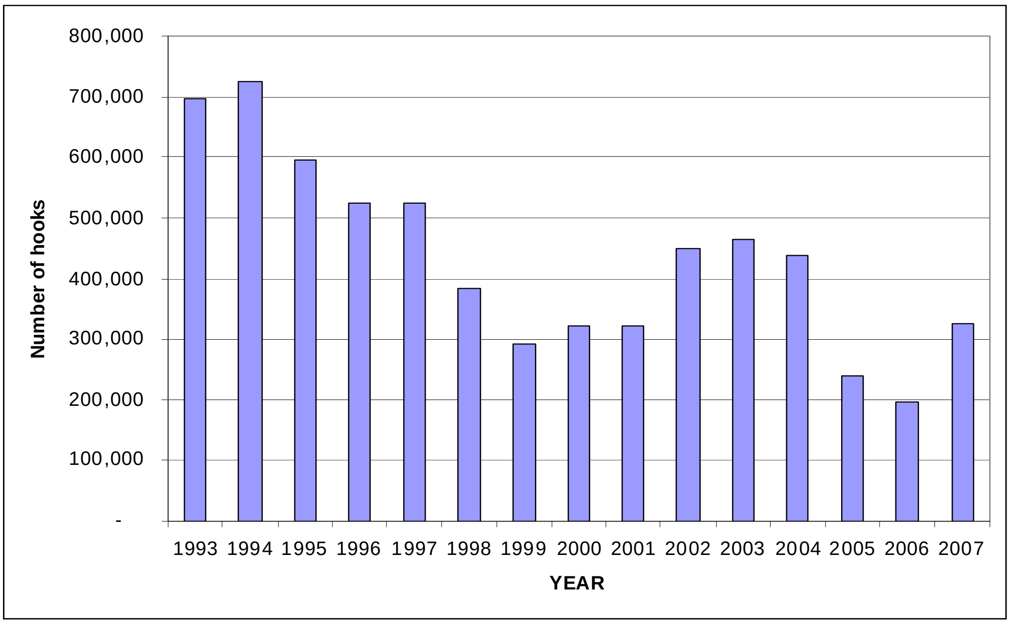


Figure 6.8. Porbeagle in the NE Atlantic. Temporal trend in estimated effort (number of hooks per year) in the French porbeagle fishery, 1993–2007.

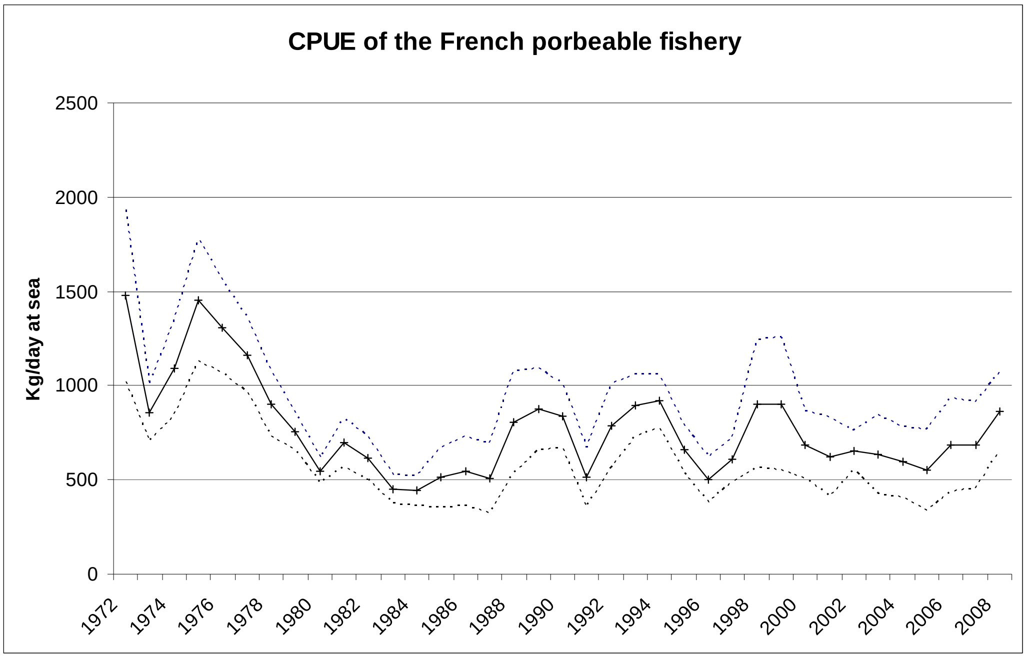


Figure 6.9. Porbeagle in the NE Atlantic. Nominal cpue (kg/day at sea) for porbeagle taken in the French fishery (1972–2008) with confidence interval (± 2 SE of ratio estimate). From Biais and Vollette, 2009, WD.

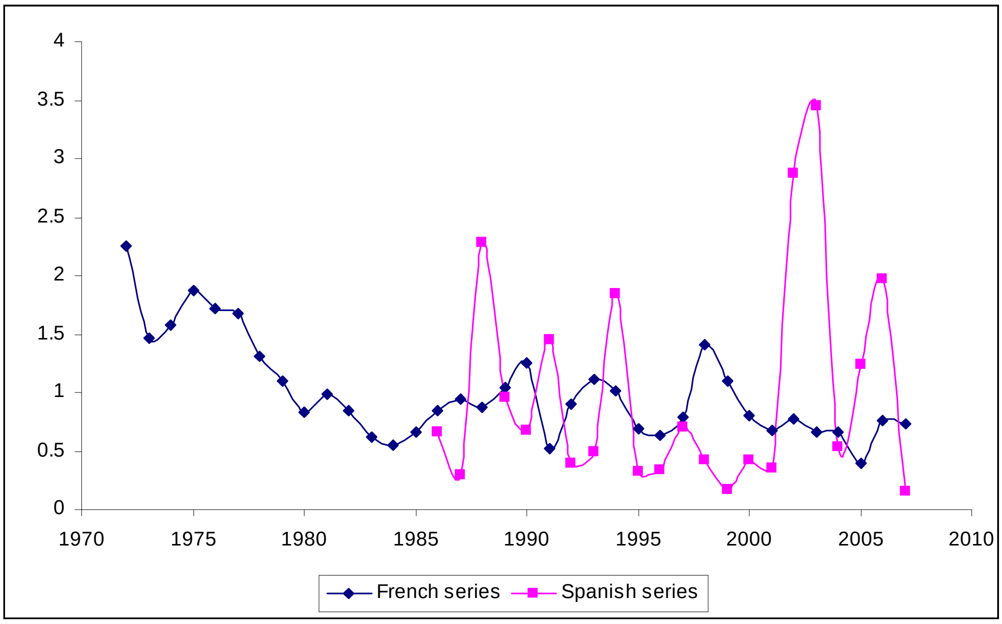


Figure 6.10. Porbeagle in the NE Atlantic. Temporal trends in standardized cpue for the French target longline fishery for porbeagle (1972–2007) and Spanish longline fisheries in the NE Atlantic (1986–2007).

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

7.1 Stock distribution

WGEF considers that basking shark *Cetorhinus maximus* in the ICES area exist as a single management unit. There is no information on transatlantic migrations. A genetic 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 claims it started before 1750 in northern 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 further 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 finished by 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, 1982–1983). 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 subsequently 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 there was a decline in catch records 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 1961–1965, then about 50–60 individuals *per annum* for the remaining years of the fishery.

Fairfax, 1998 summarized 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 basking shark full time during summer, and others were 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 1974–1975, 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 7.1).

More recent data on the price changes for basking shark fins are from the Norwegian Directorate of Fisheries, and cover the period from 1979 to 2008. This reveals 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 after 2005 (Figure 7.2). The inflation adjusted value of fins varied from 18 NOK per kg to 253 NOK per kg during 1990–2007, but has decreased considerably after 2005.

7.2.2 The fishery in 2008

There was no directed fishery for basking sharks in Norway, UK or Ireland in 2008.

In 2008 the Norwegian bycatch of basking sharks was 3.9 t (one individual), which was lower than in 2007 (26.1 t). In both years the landed basking sharks were taken as bycatch in gillnets.

7.2.3 ICES advice applicable

The 2008 advice was the same as the advice given in 2006: "No targeted fishing for basking shark should be permitted and additional measures should be taken to prevent bycatch of basking shark in fisheries targeting other species. A TAC should cover all areas where basking sharks are caught in the Northeast Atlantic. This TAC should be set at zero."

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 2007–2009. Live specimens caught as bycatch have to be released immediately, although dead or dying specimens have to be landed. From 2009, if basking shark is landed, both number of individuals and weight has to be reported.

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 1977–2008 are presented in Table 7.1, and Figure 7.3. These data were extracted from FishStat Plus database for 1977–2008. The Table and Figure include landings from Portugal (1991–2005), France (2005–2008) and landings data from Norway (1977–2008). 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 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 of basking shark from 1977–2008.

Table 7.3 demonstrates the proportions (%) of basking sharks caught by various gears as reported to the Directorate of Fisheries in Norway from 1990–2008. 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

According to Norwegian regulations (applicable for the Norwegian Economic Zone and ICES Area I–XVI since 2006) live specimens of basking shark caught as bycatch have to be released immediately, although dead or dying specimens have to be landed. From 2009, if basking shark is landed, both number of individuals and weight has to be reported.

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 2008 applying the revised conversion factors 4.64 for liver and 40.0 for fins (Table 7.2) The official Norwegian catch statistics will not be changed between 1977 and 1999, but from 2000–2008 the revised catch figures are 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 7.4). 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 7.5). 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 7.4). 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. E.g. the weight of an individual with a length of 800 cm is estimated at 2583 kg. More historical data on lengths and weights of basking shark and other biological data should be collated by WGEF. Life-history information for basking shark will be collated and provided in the form of a Stock Annex next year.

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.

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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 1977–2008.

	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	2008
I & II	31	117	80	54	128	72	87	6	26	4
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	5

Table 7.2. Norwegian landings of liver (kg) and fins (kg) of basking shark (Cetorhinus maximus) during 1977–2008, calculated official landings in live weight applying conversion factors of 10.0 for liver (1977–1995) and 100.0 and 40.0 for fins during 1996–1999 and 2000–2008, respectively, revised landings in live weight (ICES WGEF 2008) applying conversion factors of 4.64 for liver (1977–1992) and 40.0 for fins (1993–2008), 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. 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.

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	117.0	0.2	117.0	41
2001	0	1997.5	79.9	0.0	79.9	28
2002	0	1351.5	54.1	0.0	54.1	19
2003	0	3191.5	127.7	0.0	127.7	45
2004	0	1808.3	72.3	0.0	72.3	25
2005	0	2180.5	87.2	0.0	87.2	30
2006	0	160	6.4	0.0	6.4	2
2007	0	653	26.1	0.0	26.1	9
2008	0	98	3.9	0.0	3.9	1

Table 7.3. Basking sharks in the Northeast Atlantic. Proportions (%) of basking sharks caught in different gears as reported to the Norwegian Directorate of Fisheries from 1990–2008.

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
2008	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.**

Table 7.4. 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

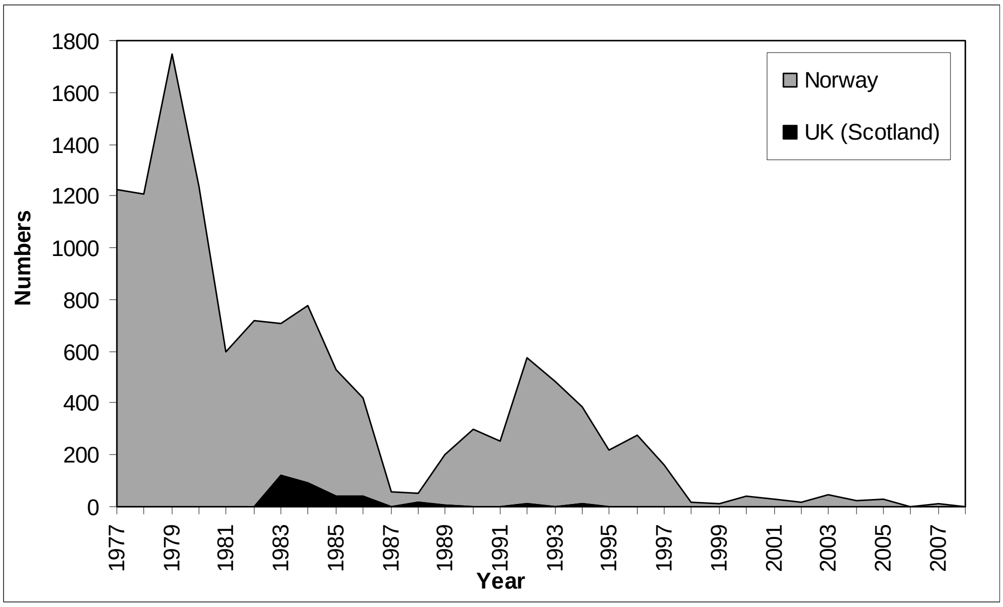


Figure 7.1. Basking sharks in the Northeast Atlantic. Numbers of basking sharks caught by Norway and Scotland from 1977–2007 in ICES Areas I–XIV from 1977–2007.

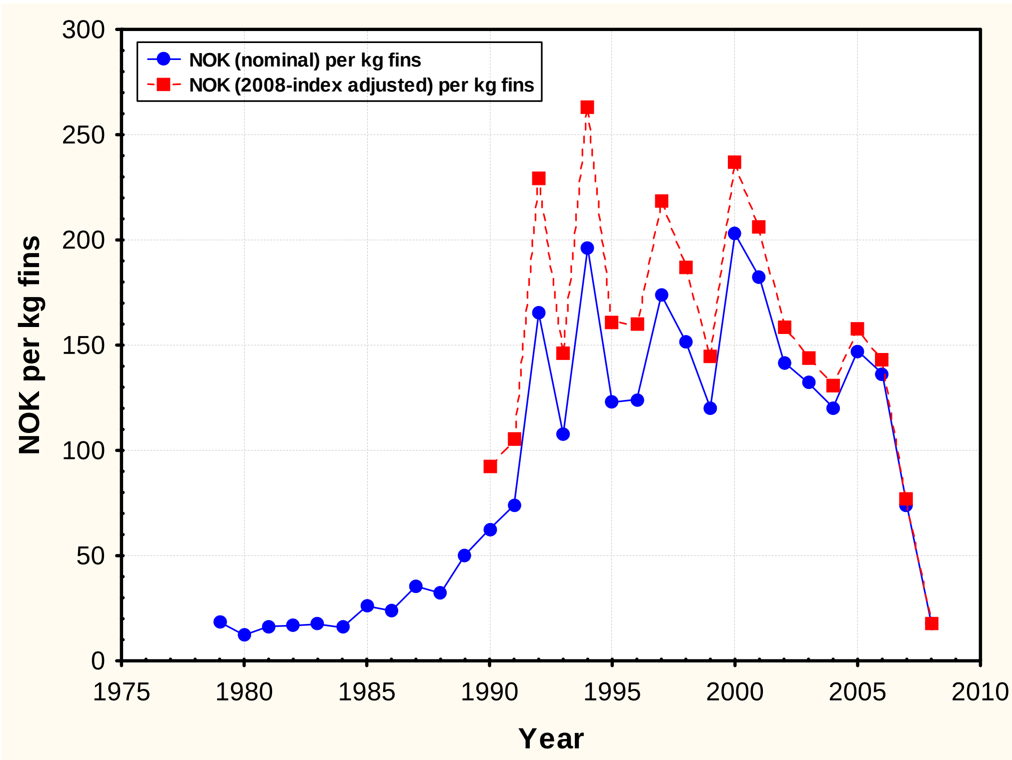


Figure 7.2. Development in nominal and inflation adjusted prices (NOK per kg) paid to fishermen for fins of basking shark during 1979–2008. The data were provided by the Norwegian Directorate of Fisheries.

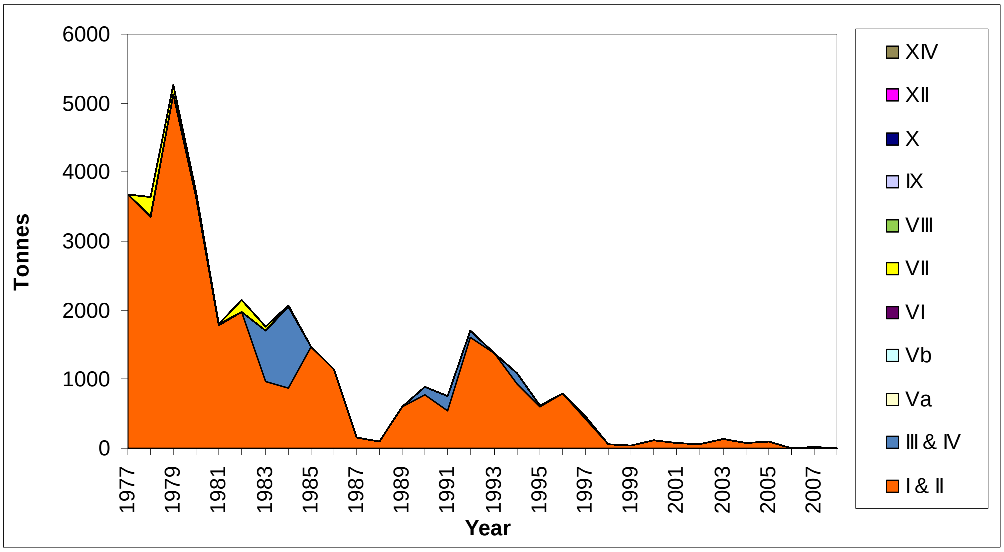
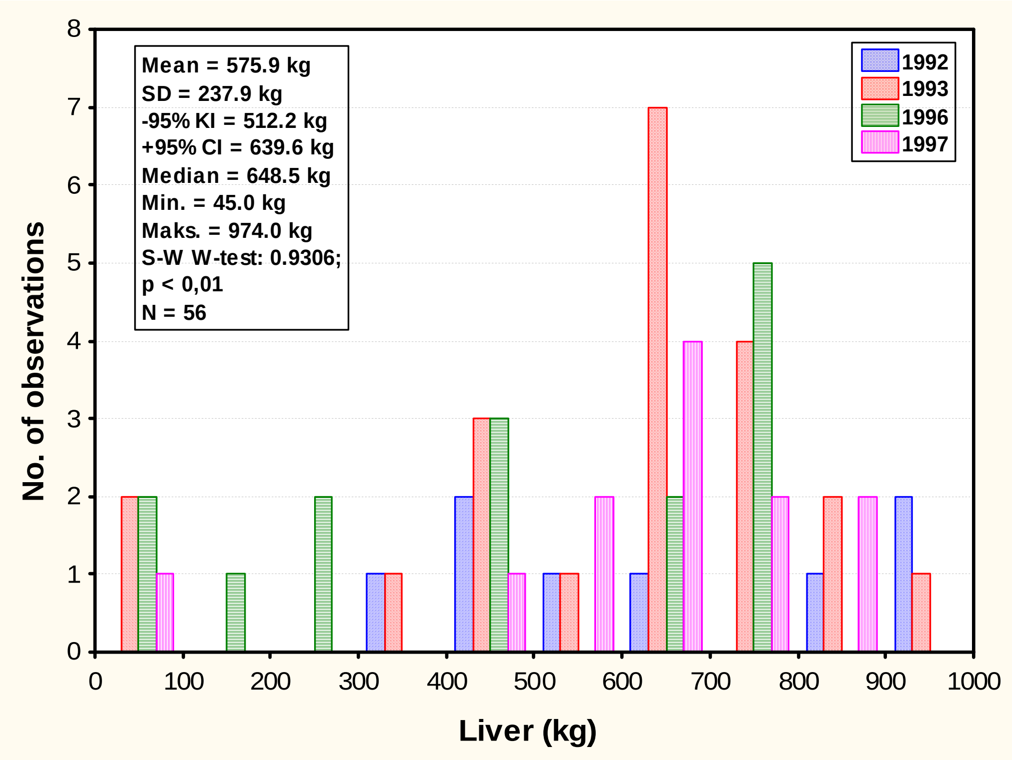


Figure 7.3. Basking sharks in the Northeast Atlantic. Total landings (t) of basking sharks in ICES Areas I–XIV from 1977–2007.



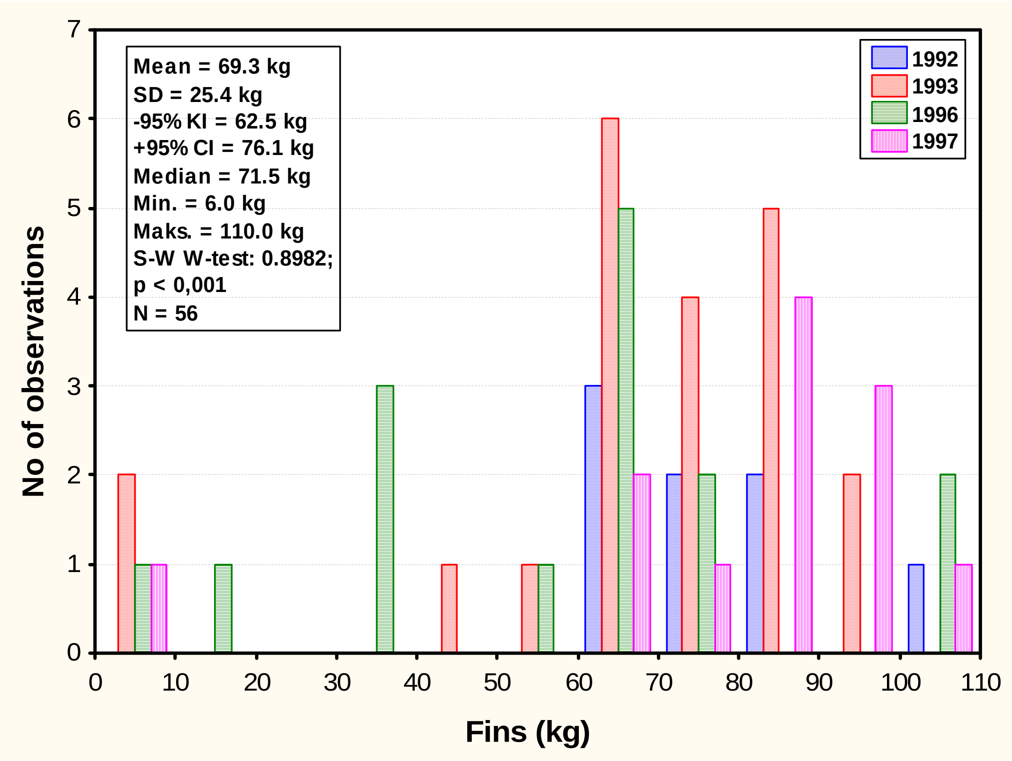


Figure 7.4. Liver (A) and fin weights (B) (kg) of 56 probable individual basking sharks landed in 1992, 1993, 1996 and 1997. The distributions of liver and fin weights were different from a normal distribution (Shapiro-Wilk's W-test; p <0.004).

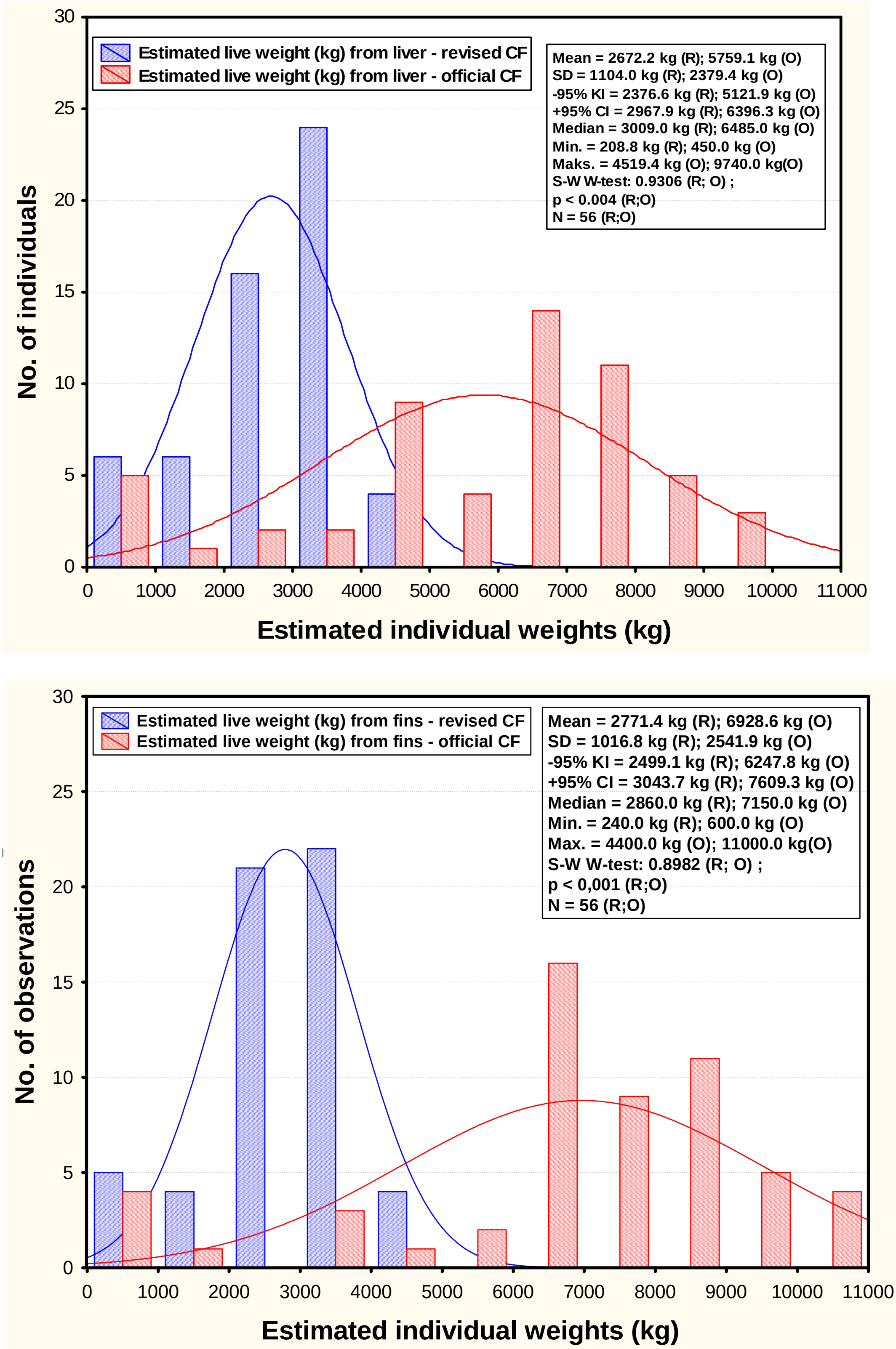


Figure 7.5. Comparison of estimated weight (kg) of 56 probable individual basking sharks landed in Norway in 1992, 1993, 1996 and 1997 applying A. the revised (4.64) and old (10.0) conversion factors for liver, and B. revised (40.0) and old (100.0) conversion factors for fins. The distributions of weights differed from a normal distribution (Shapiro-Wilk's W-test; p <0.004).

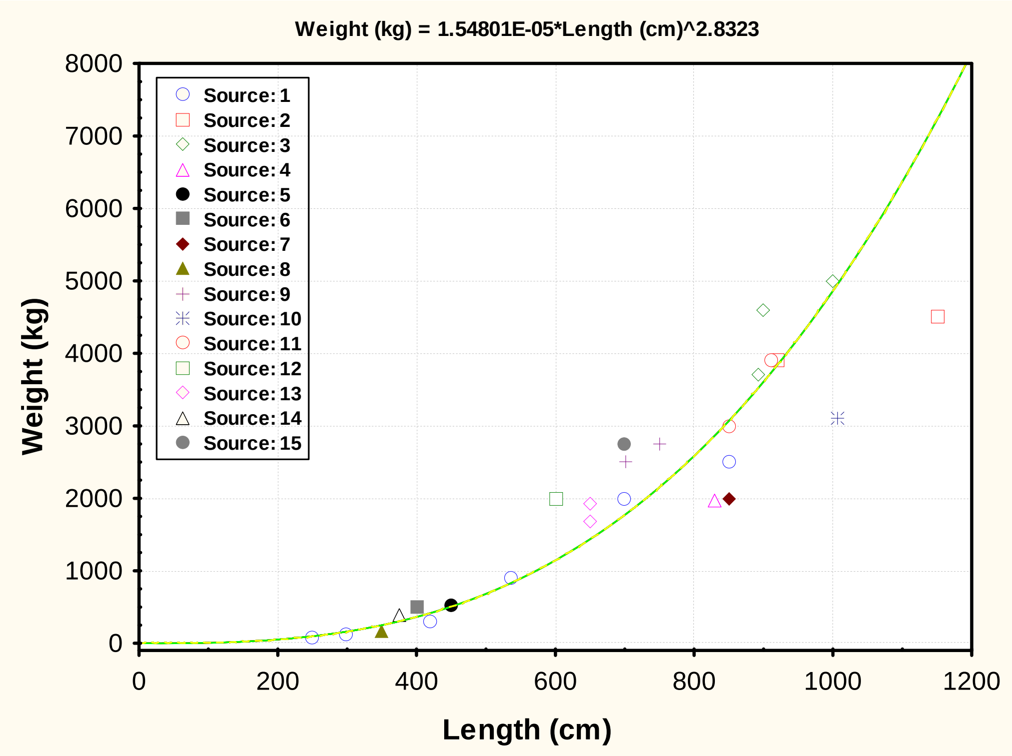


Figure 7.6. Length-weight regression of basking shark based on various published and unpublished (websites on basking shark and information from newspapers) data on measured lengths and weights. The original log length-log weight regression equation was given as: log Weight = -11.075953 + 2.8323*log Length; R^2 = 0.939; N = 26.

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 assessment process 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 and thereby exceed the actual catch of targeted species (ICCAT, 2005).

Since 1998 there has been a Basque artisanal longline fishery targeting blue shark and other pelagic sharks in the Bay of Biscay (Díez *et al.*, 2007). This fishery takes place from June to November and historically has involved between 3 and 5 vessels. As a consequence of changes in local fishing regulations the number of vessels has been reduced to two since 2008.

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 2008

No new information.

Reported catches in 2008 by ICES member nations were minimal to zero and are therefore not included in the catch table.

8.2.3 Advice applicable

ACOM 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, reported landings underestimate real 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 the ICCAT assessment of 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 and the fin trade index. The tuna ratio estimates derive from logged observations of shark catches relative to tuna catches and are considered conservative by ICCAT because they do not consider all fisheries (ICCAT, 2008). The fin trade index is inferred from systematic trade observations of shark fins in the Asian market and used to calculate caught shark weights based on catch effort data from the ICCAT database (Clarke *et al*., 2006; 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; the Atlantic as a proportion of total sea area, the Atlantic catch of tuna and billfish to total catch thereof, the 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 at between 27 000 t and 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 the market. The most valuable parts of the blue shark are 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, generally referred to as finning. 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 63–1136 t.year^{-1}, averaging about 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, 2008).

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 rate 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, 2008). 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). This species is thought 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 from 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 live weight or 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, 2005; Hareide *et al.*, 2007), however the discussion about a useful ratio is still ongoing.

8.5 Commercial catch-effort data

In 2008, the following cpue series were available 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 (Hueter *et al.*, 2008), there are no scientific fishery-independent data from the NE Atlantic. A Survey from 1977–1994 conducted by the US NMFS documented a decline among juvenile males blue sharks by 80%, however this decline did not display among juvenile female animals, which also occur in fewer numbers in the area, the Western North Atlantic off the coast of Massachusetts (Hueter *et al.*, 2008). The authors concluded that vulnerability to overfishing in blue sharks is present despite their enhanced levels of fecundity relative to other carcharhinid sharks.

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) (Kohler *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 conducted by ICCAT (ICCAT, 2008 and references cited therein): a Bayesian surplus production model, an age structured model that did not require catch data (catch-free model), 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 be 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 some 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 considerably high. Further analyses are required before any firm conclusions can be drawn about stock status for this species.

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} depend 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 highly unreliable. Some cpue series are existent, 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.

The catch data are obviously incomplete. Besides unaccounted discards and the substantial 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 high degree of susceptibility to longline fishing and 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. Reported Data for 2008 are not complete.

Fishing area	Country	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
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	Senegal	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Spain	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	Channel Islands	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Denmark	-	-	8	2	4	3	3	4	2	2	1
Atlantic, Northeast	France	4	12	12	.	9	8	14	39	50	67	91
Atlantic, Northeast	Ireland	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	Netherlands	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	Portugal	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Spain	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	UK	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	Basque											
Atlantic, Northwest	Canada	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Northwest	Portugal	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northwest	Spain	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Western Central	Portugal	.	.	.	.	.	.	-	-	-	-	-
Atlantic, Western Central	Spain	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Western Central	Trin & Tob	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Western Central	Venez, Bolivia	.	.	.	.	.	.	.	.	.	.	.
	Total	4	12	20	2	13	11	17	43	52	69	92

Table 8.1. cont.

FISHING AREA	COUNTRY	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Atlantic, Eastern Central	Benin	.	.	.	.	.	.	.	.	6	4
Atlantic, Eastern Central	China	-	-	-	-	.	.	.	.	.	.
Atlantic, Eastern Central	Liberia	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Panama	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Portugal	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Russia	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Senegal	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Spain	-	-	-	-	-	-	-	-	12183	9541
Atlantic, Northeast	Channel Islands	.	.	.	.	.	.	.	.	.	1
Atlantic, Northeast	Denmark	2	2	1	1	<0.5	1	2	3	1	1
Atlantic, Northeast	France	79	130	187	276	322	350	266	278	213	163
Atlantic, Northeast	Ireland	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	Netherlands	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	Portugal	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Spain	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	UK	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	Basque										
Atlantic, Northwest	Canada	-	-	-	-	-	-	-	12	11	21
Atlantic, Northwest	Portugal	.	.	.	.	.	.	.	.	.	.
Atlantic, Northwest	Spain	-	-	-	-	-	-	-	-	-	-
Atlantic, Western Central	Portugal	-	-	-	-	-	-	-	-	-	17
Atlantic, Western Central	Spain	-	-	-	-	-	-	-	-	1700	418
Atlantic, Western Central	Trin & Tob	.	.	.	.	.	.	.	.	.	.
Atlantic, Western Central	Venez, Bolivia	.	.	.	.	.	.	.	.	.	.
	Total	81	132	188	277	322	351	268	293	14 114	10 166

Table 8.1. cont.

Fishing area	Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Atlantic, Eastern Central	Benin	27	.	.	.	9	7	6	6	5	.
Atlantic, Eastern Central	China	.	.	750	420	600	.	.	.	472	.
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	2170	.
Atlantic, Eastern Central	Russia	-	-	-	-	-	-	1	-	-	.
Atlantic, Eastern Central	Senegal	.	.	.	456	.	.	.	.	43	.
Atlantic, Eastern Central	Spain	9225	7820	7958	7159	10 080	9955	8448	8008	6325	.
Atlantic, Northeast	Channel Islands	<0.5	-	-	-	-	1	-	-	-	.
Atlantic, Northeast	Denmark	1	2	1	13	6	1	<0.5	1	1	.
Atlantic, Northeast	France	230	395	205	112	134	103	120	134	168	76
Atlantic, Northeast	Ireland	67	31	66	11	2	<0.5	<0.5	-	<0.5	0,24
Atlantic, Northeast	Netherlands	-	-	-	-	-	-	-	-	1	.
Atlantic, Northeast	Portugal	887	1.133	1006	1209	2169	1514	1990	2627	2821	476
Atlantic, Northeast	Spain	.	.	.	.	.	4828	1942	1399	1753	.
Atlantic, Northeast	UK	-	12	9	6	4	6	5	3	6	5,8
Atlantic, Northeast	Basque										433
Atlantic, Northwest	Canada	54	624	581	836	346	965	1134	977	843	.
Atlantic, Northwest	Portugal	.	169	-	-	48	-	-	11	71	.
Atlantic, Northwest	Spain	-	-	-	-	-	-	1150	1387	-	.
Atlantic, Western Central	Portugal	-	-	-	8	-	-	3	1	2	.
Atlantic, Western Central	Spain	.	.	.	.	1015	-	1310	1972	2034	.
Atlantic, Western Central	Trin & Tob	.	.	.	6	3	2	1	1	<0.5	.
Atlantic, Western Central	Venez, Bolivia	.	.	.	.	.	9	26	10	18	.
	Total	10 744	10 629	11 133	10 904	15 708	18 077	17 576	18 545	16 733	991

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
$L_F = 1.076\ L_S + 1.862$ (n=1043)	$L_F = 1.080\ L_S + 1.552$ (n=1276)	$L_F = 1.079\ L_S + 1.668$ (n=2319)
$L_T = 1.249\ L_S + 7.476$ (n=1043)	$L_T = 1.272\ L_S + 4.466$ (n=1272)	$L_T = 1.262\ L_S + 5.746$ (n=2315)
$L_{UC} = 0.219\ L_S + 4.861$ (n=1038)	$L_{UC} = 0.316\ L_S + 2.191$ (n=1264)	$L_{UC} = 0.306\ L_S + 3.288$ (n=2302)
$L_T = 1.158\ L_F + 5.678$ (n=1043)	$L_T = 1.117\ L_F + 2.958$ (n=1272)	$L_T = 1.167\ L_F + 4.133$ (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	$L_F = (0.8313)\ L_T + 1.3908$	572	Kohler *et al.*, 1995
NE Atlantic	$L_F = 0.8203\ L_T - 1.061$		Castro and Mejuto, 1995
NW Atlantic	$L_F = -1.2 + 0.842\ L_T$	792	Campana *et al.*, 2005
NW Atlantic	$L_T = 3.8 + 1.17\ L_F$	792	Campana *et al.*, 2005
NW Atlantic	$L_{CF} = 2.1 + 1.0\ L_{SF}$	782	Campana *et al.*, 2005
NW Atlantic	$L_{SF} = -0.8 + 0.98\ L_{CF}$	782	Campana *et al.*, 2005
NW Atlantic	$L_F = 23.4 + 3.50\ L_{ID}$	894	Campana *et al.*, 2005
NW Atlantic	$L_{ID} = -4.3 + 0.273\ L_F$	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)	

Parameter	Values	Sample Size	Area	Reference
	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
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

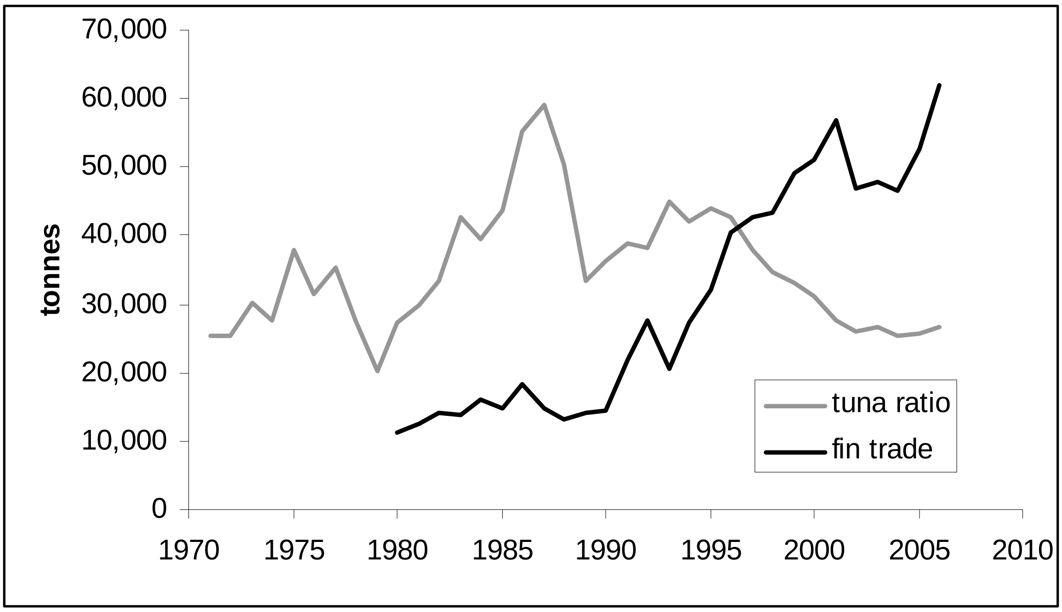

Figure 8.1. Blue Shark in the North Atlantic. Two estimates of catch, as presented by ICCAT 2008. Tuna ratio: resulting from application of the method of estimating catches using the ICCAT reported data and the ratio of tunas to shark catch; fin trade: based on the medians scaled to effort partitioned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

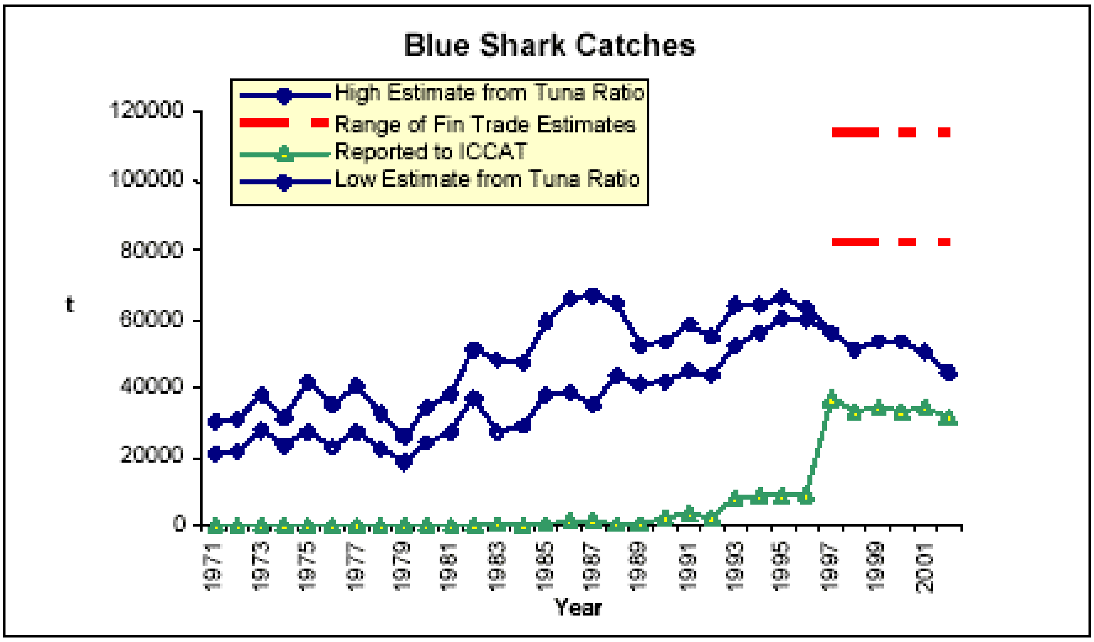

Figure 8.2. Blue shark in the Atlantic. Comparison of shark catch reported to ICCAT with estimates resulting from tuna to shark ratios and from fin trade data for blue sharks in the Atlantic. Source: ICCAT.

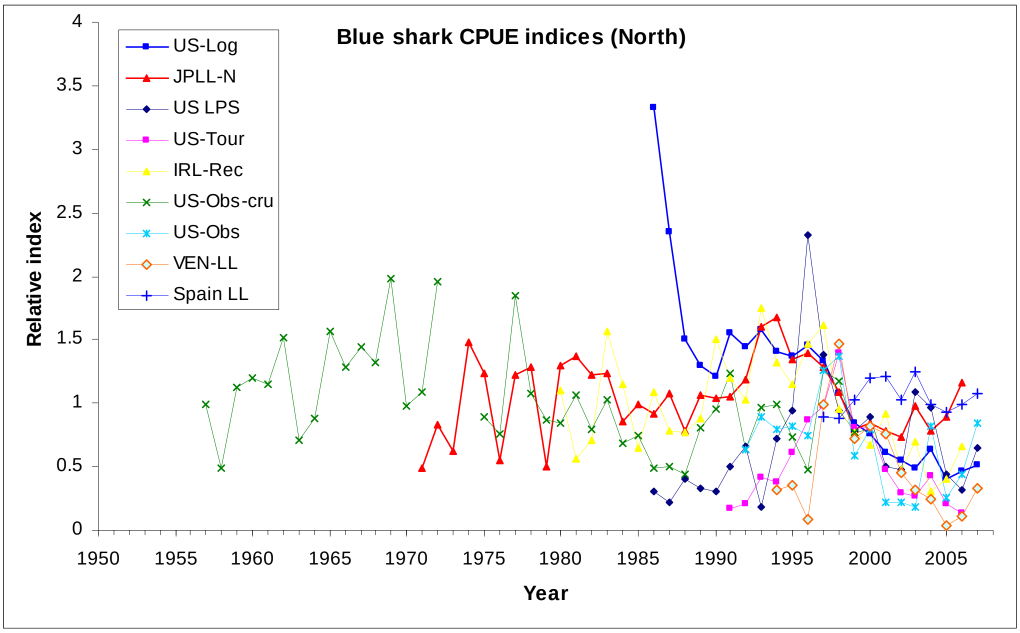

Figure 8.3. Blue Shark in the North Atlantic. Cpue indices used in ICCAT assessment in 2008. Indices presented on a relative scale.

9 Shortfin mako in the North Atlantic (North of 5°N)

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. In all 730 (11.6%) recaptures were made, of which transatlantic movements were recorded. Genetic studies (Heist *et al.*, 1996; Schrey and Heist, 2002) 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 5°N, 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 2008

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, 2008). Given that there can be confusion between shortfin mako and porbeagle; further studies to clarify the northern range of shortfin mako are required.

At recent ICCAT Assessment Meetings regarding also the shortfin mako, two other estimates of landings for this stock were prepared (Figures 9.1 and 9.2), the tuna ratio and the fin trade index. These figures depict the order of magnitude the estimates deviate and are much higher than actual reported landings. The tuna ratio estimates derive from logged observations of shark catches relative to tuna catches and are considered conservative by ICCAT because they do not consider all fisheries (ICCAT, 2008). The fin trade index is inferred from systematic trade observations of shark fins in the Asian market and used to calculate caught shark weights based on catch effort data from the ICCAT database (Clarke *et al*., 2006; ICCAT, 2005 and 2008).

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, 2005 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; Hueter *et al*., 2008). 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 of the USA 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 in highly productive areas, based on the majority of reports, with 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 (*Pomatomus saltatrix*) is the most important prey species and comprises about 78% of the diet (Stillwell and Kohler, 1982). These authors 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 and the assumptions underlying the model need to be optimized 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

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} depend on model assumptions and results and are not presented by ICCAT for advisory purposes.

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).

The shortfin mako was listed as Lower Risk Near Threatened until 2008 when it was listed as Vulnerable both globally and regionally in the NE Atlantic in the IUCN Red List (Gibson *et al*., 2008)

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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. Reported Data for 2008 are not complete.

FISHING AREA	COUNTRY	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Atlantic, Western Central	Mexico	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Western Central	Portugal	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Western Central	Spain	-	-	-	-	-	-	-	-	-	-	73
Atlantic, Western Central	Trin & Tob	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Western Central	USA	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Western Central	Venez. & Boliv.	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northwest	Canada	-	-	-	-	-	-	-	-	-	67	110
Atlantic, Northwest	Portugal	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northwest	Spain	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Northwest	USA	6	2	7	20	64	59	71	115	5	-	-
Atlantic, Northeast	Portugal	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Northeast	Spain	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Northeast	UK	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Benin	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	China	-	-	-	-	-	-	34	45	23	27	19
Atlantic, Eastern Central	Côte d'Ivoire	.	.	.	.	.	.	.	.	.	15	.
Atlantic, Eastern Central	Panama	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Philippines	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Portugal	.	.	.	.	.	.	.	.	.	.	.
Atlantic, Eastern Central	Spain	-	-	-	-	-	-	-	-	-	-	-
Atlantic, Eastern Central	Vanuatu	-	-	-	-	-	-	-	-	-	-	-
	Total	6	2	7	20	64	59	105	160	28	109	202
Mediterranean Sea	Portugal	-	-	-	-	-	-	-	-	-	-	-
Mediterranean Sea	Spain	-	-	-	-	-	-	-	-	-	-	6

Table 9.1. Cont.

Fishing area	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Atlantic, Western Central	Mexico	.	.	10	16	.	10	6	9	5	8	.
Atlantic, Western Central	Portugal	<0.5	-	-	-	-	-	-	-	-	-	.
Atlantic, Western Central	Spain	33	.	.	.	134	63	-	94	105	127	.
Atlantic, Western Central	Trin & Tob	.	1	.	1	2	3	1	2	1	1	.
Atlantic, Western Central	USA	-	-	5	5	-	-	5	-	-	-	.
Atlantic, Western Central	Venez. & Boliv.	.	.	.	.	.	.	58	20	6	11	.
Atlantic, Northwest	Canada	69	70	78	69	78	73	80	91	71	72	.
Atlantic, Northwest	Portugal	.	.	10	-	-	9	-	1	<0.5	30	.
Atlantic, Northwest	Spain	-	-	-	-	-	-	-	212	212	-	.
Atlantic, Northwest	USA	-	-	19	19	20	16	33	14	10	52	.
Atlantic, Northeast	Portugal	.	160	183	186	107	541	328	603	729	1.222	482
Atlantic, Northeast	Spain	-	-	-	-	-	-	254	93	91	119	.
Atlantic, Northeast	UK	<0.5	2	3	2	1	1	1	<0.5	<0.5	-	.
Atlantic, Eastern Central	Benin	.	.	3	1	.	.	.	1	.	.	.
Atlantic, Eastern Central	China	74	126	191	22	208	260	.	.	.	99	.
Atlantic, Eastern Central	Côte d'Ivoire	.	10	9	15	15	30	15	14	22	25	.
Atlantic, Eastern Central	Panama	-	25	1	-	-	-	-	-	<0.5	2	.
Atlantic, Eastern Central	Philippines	-	3	-	-	-	-	-	.	-	-	.
Atlantic, Eastern Central	Portugal	.	.	42	42	68	151	42	216	225	165	.
Atlantic, Eastern Central	Spain	-	-	-	-	-	-	468	523	604	420	.
Atlantic, Eastern Central	Vanuatu	-	-	-	-	-	-	52	12	13	1	.
	Total	176	397	554	378	633	1157	1343	1905	2094	2354	482
Mediterranean Sea	Portugal	-	-	1	6	-	<0.5	31	15	5	-	.
Mediterranean Sea	Spain	7	5	3	2	2	2	2	2	5	1	.

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 L_T				Strasburg, 1958
Cuba	W = 1.193 x 10–6 x L_T 3.46	C	23	160–260 (L_T)	Guitart, 1975
Australia	W = 4.832 x 10–6 x L_T 3.10	C	80	58–343 (L_T)	Stevens, 1983
South Africa	W = 1.47 x 10–5 x L_{PC} 2.98	C	143	84–260 (L_{PC})	Cliff *et al.*, 1990
NW Atlantic	W_R = (5.2432 x 10–6) L_F 3.1407	C	2081	65–338 (L_F)	Kohler *et al.*, 1995.
NW Atlantic	W = 7.2999 x L_T (m) 3.224	C	63	2.0–3.7 m (L_T)	Mollet *et al.*, 2000
southern hemisphere	W = 6.824 x L_T (m) 3.137	C	64	2.0–3.4 m (L_T)	Mollet *et al.*, 2000
NE Atlantic	W_D = (2.80834 x 10–6) L_F 3.20182	C	17	70–175 (L_F)	García-Cortés and Mejuto, 2002
Tropical east Atlantic	W_D = (1.22182 x 10–5) L_F 2.89535	C	166	95–250	García-Cortés and Mejuto, 2002
Tropical central Atlantic	W_D = (2.52098 x 10–5) L_F 2.76078	C	161	120–185	García-Cortés and Mejuto, 2002
Southwest Atlantic	W_D = (3.1142 x 10–5) L_F 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
L_F = 1.086 L_S + 1.630 (n=852)	L_F = 1.086 LS + 1.409 (n=911)	L_F = 1.086 L_S + 1.515 (n=1763)
L_T = 0.817 L_S + 0.400 (n=852)	L_T = 1.209 LS + 0.435 (n=681)	L_T = 1.207 L_S + 0.971 (n=1533)
L_{UC} = 3.693 L_S + 13.094 (n=507)	L_{UC} = 3.795 L_S + 10.452 (n=477)	L_{UC} = 3.758 L_S + 11.640 (n=1054)
L_T = 1.106 L_F + 0.052 (n=853)	L_T = 1.111 LF – 0.870 (n=911)	L_T = 1.108 L_F – 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.

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**

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

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 (L_T)	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
	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 (T_L)	195 cm			Stevens, 1983
Male length-at-maturity (T_L)	197–202 cm (median)	215	New Zealand	Francis and Duffy, 2005
	180 cm (L_F)		NE Atlantic (Portugal)	Maia *et al.*, 2007
	200–220		Worldwide	Pratt and Casey, 1983; Mollet *et al.*, 2000
Female length-at-first maturity (T_L)	265–280 cm			Cliff *et al.*, 1990
Female length-at-maturity (T_L)	301–312 (median)	88	New Zealand	Francis and Duffy, 2005
	270–300 cm (L_T)		Worldwide	Pratt and Casey, 1983; Mollet *et al.*, 2000

Parameter	Values	Sample Size	Area	Reference
Age-at-recruitment (year)	0–1			Stevens and Wayte, 1999
Male maximum length (T_L)	296 cm			Compagno, 2001
Female maximum length (T_L)	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
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 T_D (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

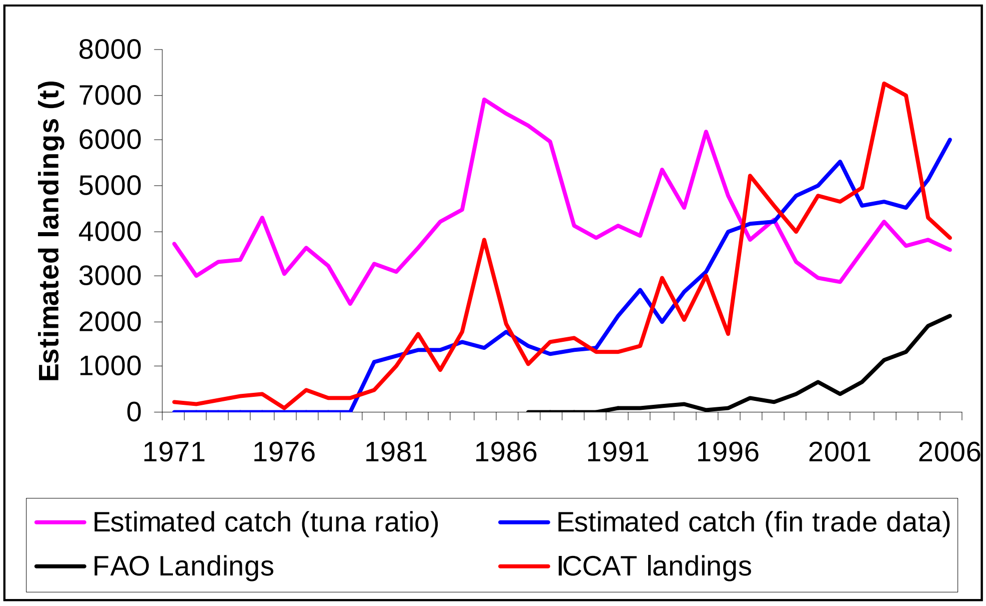

Figure 9.1. Shortfin mako (*Isurus oxyrinchus*) in the North Atlantic. Available landings (tonnes) from North Atlantic by FAO Areas 27, 21 and 34. Reporting was minimal for the years 2005 and 2006. (Source: ICCAT)

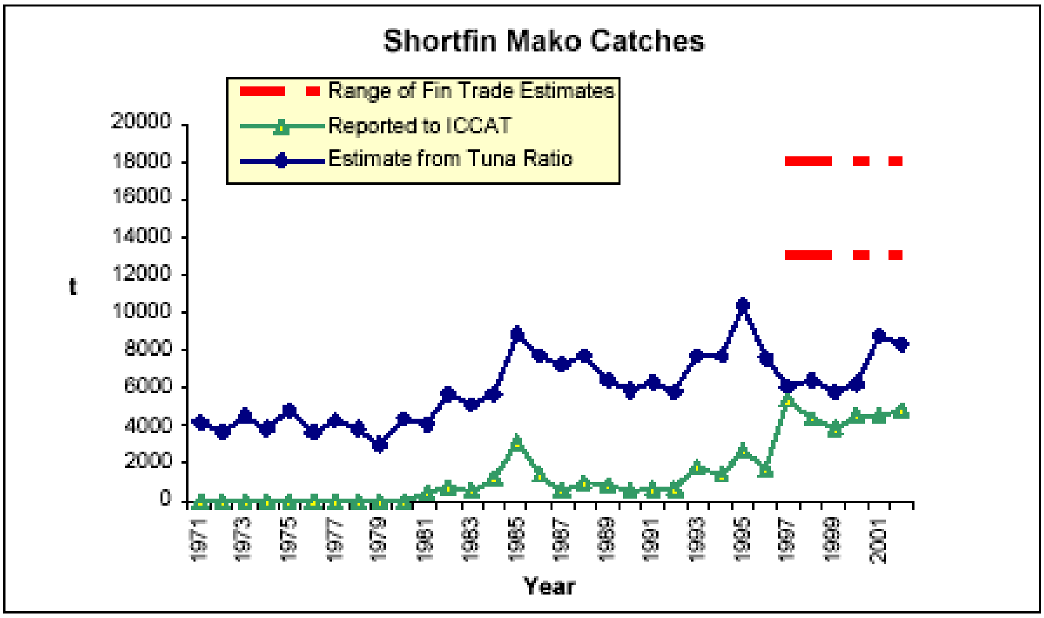

Figure 9.2. Shortfin mako (*Isurus oxyrinchus*) in the North Atlantic. Comparison of landed weights from data reported to ICCAT, from data raised to catches of tunas and from fin trade estimates (ICCAT 2005).

10 Tope in the North East Atlantic and Mediterranean

10.1 Stock distribution

WGEF considers there to be a single-stock of tope (or school shark, *Galeorhinus galeus*) in the ICES area. This stock is distributed from Scotland and southern Norway southwards to the coast of northwestern 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). The stock also extends to the Mediterranean Sea (Subareas I–III) and northern part of the CECAF area.

The information used to identify the stock unit is summarized in the Stock Annex.

10.2 The fishery

10.2.1 History of the fishery

Currently there are no targeted commercial fisheries for tope in the NE Atlantic. Tope are taken as a bycatch in trawl, gillnet and longline fisheries, including demersal and pelagic set gears. Though tope are discarded in some fisheries, 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.

10.2.2 The fishery in 2008

There were no major changes to the fishery noted in 2008.

10.2.3 ICES Advice applicable

ICES have not 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 some recent data were not available for Spanish fisheries, other than for the Basque fleet.

Landings data for 2008 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 recent trends.

10.3.2 Discards

Though some discards information is available from various nations, data are limited for most nations and fisheries. Preliminary studies have indicated 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.

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 in the North Sea.

More recently, Q4 IBTS surveys in the Celtic Seas ecoregion have been observed to sample small numbers of tope, with some nations tagging and releasing specimens where possible (ICES, 2008). 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.

10.6.2 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.

10.6.3 Length distributions

No new data were presented.

10.7 Life-history information

Much biological information is available for tope in European seas and elsewhere in the world. These are summarized in the Stock Annex.

Pupping and nursery grounds: 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 10.2). 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).

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.

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 at the present time.

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 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. Evidence from these fisheries (see Stock Annex and references cited therein) suggests that targeted fisheries would need to be managed conservatively.

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

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.

Punt, A. E., Pribac, F., Walker, T. I., Taylor, B. L. and Prince, J. D. 2000. Stock assessment of school shark *Galeorhinus galeus* based on a spatially-explicit population dynamics model. *Marine and Freshwater Research*, 51: 205–220.

Punt, A. E., and Walker, T. I. 1998. Stock assessment and risk analysis for the school shark (*Galeorhinus galeus*) off southern Australia. *Marine and Freshwater Research*, 49: 719–731.

Xiao, Y. and Walker, T. I. 2000. Demographic analysis of gummy shark (*Mustelus antarcticus*) and school shark (*Galeorhinus galeus*) off southern Australia by applying a generalized Lotka equation and its dual equation. *Canadian Journal of Fisheries and Aquatic Sciences*, 57: 214–222.

Table 10.1. Tope in the North East Atlantic and Mediterranean. Reported species-specific landings (Tonnes) for the period 1978–2008. These data are considered 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 Northwest African waters.

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

Table 10.1. (continued). Tope in the North East Atlantic and Mediterranean. Reported species-specific landings (Tonnes) for the period 1978–2008. These data are considered underestimates 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	1991	1992	1993	1994	1995	1996	1997	1998	1999
Denmark	-	-	-	-	-	-	-	-	3
France	16	10	11	12	8	11	5	11	
Sweden	-	-	-	-	-	-	-	-	-
UK	21	15	15	19	25	14	22	12	14
UK (Scotland	-	-	-	-	-	-	-	-	-
Total (IIIa–IV)	37	25	26	31	33	25	27	23	17
ICES Division V–VII									
France	391	235	240	235	265	314	409	312	
Ireland	na	na	na	na	na	na	na	na	na
Spain	na	na	na	na	na	na	na	na	na
Spain (Basque country)	-	-	-	-	-	-	-	-	-
UK	47	53	48	49	38	39	34	41	62
Total (VI–VII)	438	288	288	284	303	353	443	353	62
ICES Division VIII									
France	38	34	40	54	44	78	40	46	+
Spain	na	na	na	na	na	na	na	na	na
Spain (Basque country)	-	-	-	-	-	-	-	-	-
UK					0	0	0	0	0
Total (VIII)	38	34	40	54	44	78	40	46	0
ICES Division IX									
Spain	na	na	na	na	na	na	na	na	na
Total (IX)									
ICES Division X									
Portugal	81	80	115	116	124	80	104	128	129
Total (X)	81	80	115	116	124	80	104	128	129
Other									
France	-	-	-	-	-	-	-	-	386
UK	-	-	-	+	+	-	-	-	-
CECAF area									
Portugal	-	-	-	-	-	-	-	-	-
TOTAL LANDINGS	593	427	469	485	504	536	615	551	593

Table 10.1. (continued). Tope in the North East Atlantic and Mediterranean. Reported species-specific landings (Tonnes) for the period 1978–2008. These data are considered underestimates 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	2000	2001	2002	2003	2004	2005	2006	2007	2008
Denmark	8	4	5	5	5	8	6	3	4
France	11	11	6	6	3	3	6	6	6
Sweden	-	-	-	-	-	+	0	0	0
UK	13	10	13	11	8	10	13	5	2
UK (Scotland	-	-	-	-	-	-	-	0	0
Total (IIIa–IV)	32	25	24	22	16	21	25	14	12
ICES Division V–VII									
France	368	394	324	284	209	181	293	155	187
Ireland	na	4	1	6	4	na	7	3	4
Spain	na	+	242	3	na	na	na	na	60
Spain (Basque country)	-	+	+	3	15	10	.	.	.
UK	98	72	60	55	65	65	74	44	26
Total (VI–VII)	466	470	627	351	293	256	374	202	277
ICES Division VIII									
France	71	58	49	60	16	29	40	28	35
Spain	na	9	13	10	na	na	na	na	21
Spain (Basque country)	-	9	6	10	10	14	12	1	12
UK		1		3	8	6	5	0	0
Total (VIII)	71	77	68	83	34	49	57	29	69
ICES Division IX									
Spain	na	na	na	na	76	na	na	na	96
Total (IX)					76				96
ICES Division X									
Portugal	142	82	77	69	51	45	45	na	na
Total (X)	142	82	77	69	51	45	45	0	0
Other									
France	-	2	-	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	-	-
CECAF area									
Portugal	2	1	2	98	na	na	na	na	na
TOTAL LANDINGS	713	656	798	622	470	371	502	245	454

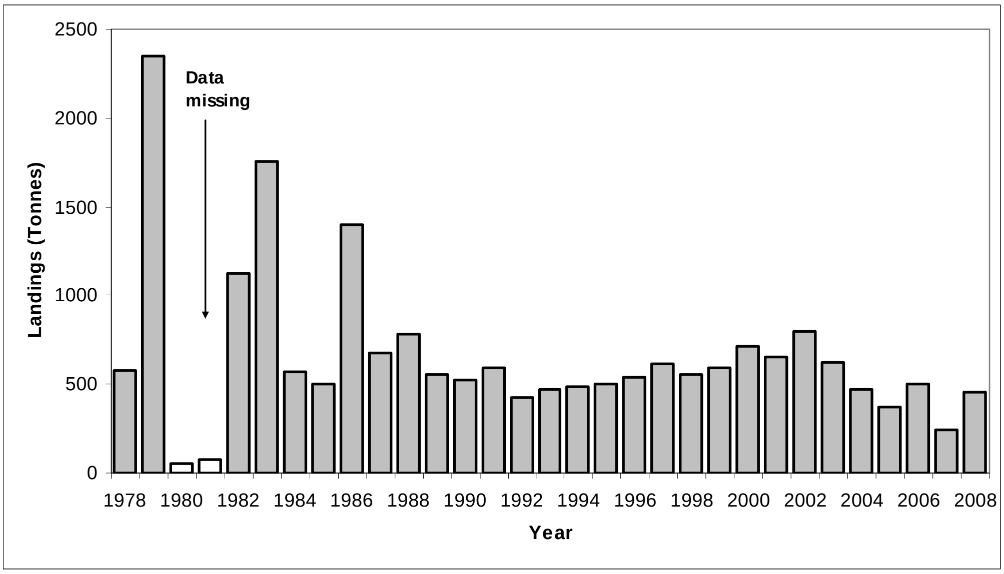

Figure 10.1. Tope in the North East Atlantic and Mediterranean. Annual landings of tope. These data are considered underestimates as some tope are landed under generic landings categories, and no species-specific landings data are available for the Mediterranean Sea and North-west African waters. Not all data are available for recent years.

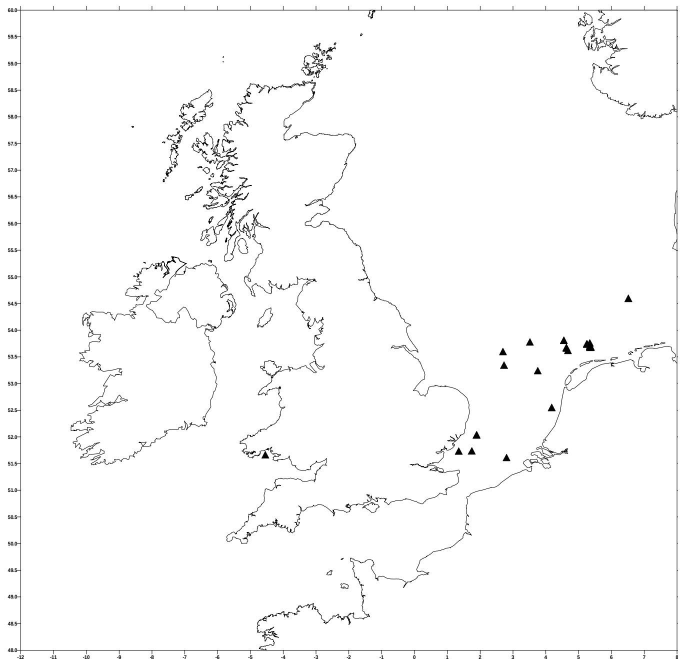

Figure 10.2. Tope in the North East Atlantic and Mediterranean. Sites where tope pups (24–45 cm total length) have been reported during UK surveys.

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, and WGEF assumes there to be a single NE Atlantic and Mediterranean stock of *A. vulpinus*. This stock probably extends into the CECAF area. The presence of a nursery ground in the Alboran Sea provides the rationale for including the Mediterranean Sea within the stock area.

Further information on the stock identity is included in the Stock Annexe.

11.2 The fishery

11.2.1 History of the fishery

There are no target fisheries for thresher sharks in the NE Atlantic; although they are taken as a bycatch in longline and driftnet fisheries. 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.

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).

In terms of Mediterranean fisheries, there are no targeted fisheries but they are taken as a bycatch in various fisheries, including the Moroccan driftnet fishery in the southwest Mediterranean. Additional bycatch of these sharks will occur in the Straits of Gibraltar.

11.2.2 The fishery in 2008

No new information.

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 38–248 t in the NE

Atlantic and the Mediterranean Sea (ICCAT and national data; Tables 11.1–11.2; Figure 11.1). The main landing nations are Portugal, Spain and France, although the large quantities apparently reported by Portugal need to be verified.

Thresher sharks are taken occasionally in Subarea IV, but the main catches seem to occur in Subareas VII–IX (Table 11.2).

During 2003, some landings of thresher sharks were recorded by Denmark, however, this was under 0.5 t, and is likely to be negligible before or after this record. Similarly, the UK had a <0.5 t landing record in 2005, yet nothing beforehand. Ireland, has reported annual landings of <0.5 t most years since 2003. The countries with more consistent estimated landings are France, Portugal and Spain. The landings of thresher sharks in French waters have typically ranged from 2–22 t, however in 2000 and 2001, reported landings increased to 107–112 t. Portuguese (ICES Area VII–IX) estimated landings began in 1986, at 7 t, peaked two 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.

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*'.

11.4 Commercial catch composition

Some length frequency distributions for *A. vulpinus* have been collected under the Data Collection Regulation (DCR) program by observers on board French vessels between 2003 and 2009 (Figure 11.2).

11.5 Commercial catch-effort data

There are very limited cpue data available for the ICES area. ICES and ICCAT could usefully cooperate to collate and interpret commercial catch data from high seas fisheries.

11.6 Fishery-independent surveys

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

11.7 Life-history information

Various aspects of the life history of these species are included in the Stock Annex.

No new data are available.

11.7.1 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). Moreno *et al.*, 1989 describe other potentially important habitats for *A. vulpinus*.

11.7.2 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):

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)

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

Bigeye thresher: $W = 9.1069 \times 10^{-6}\ L_F^{\ 3.080}$ ($r^2 = 0.91$)

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.

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 consider that *Alopias* spp. are particularly vulnerable to over-exploitation and in need of close monitoring because of their high vulnerability resulting from its low fecundity and relatively high age of sexual maturity.

In 2006, the IUCN Red List classified thresher shark as Data Deficient (IUCN, 2006), but their status was re-evaluated in 2007 (Camhi, 2008; Camhi *et al*., 2009), and both species are now listed as Vulnerable.

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

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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 2008 (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 (3)	12	+			119
2007	12	32	na	44	153	3	156 (3)	9	1			210

(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.

(3) These landings require verification

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	VI–VIII	VII–IX	W Africa	VII–IX	IV–VII		
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		17		13	+				20
1997		22		37	1	53			104
1998		18		24	2	54			87
1999		13		12	+	36			69
2000		107		15		1			132
2001		112		25					138
2002		4		21					32
2003	+	3	+	17		3			31
2004		3	+	33		84			130
2005		9		80		54	+		152
2006		12	+				+		12
2007		12	+				1		9
2008		7	+				1		

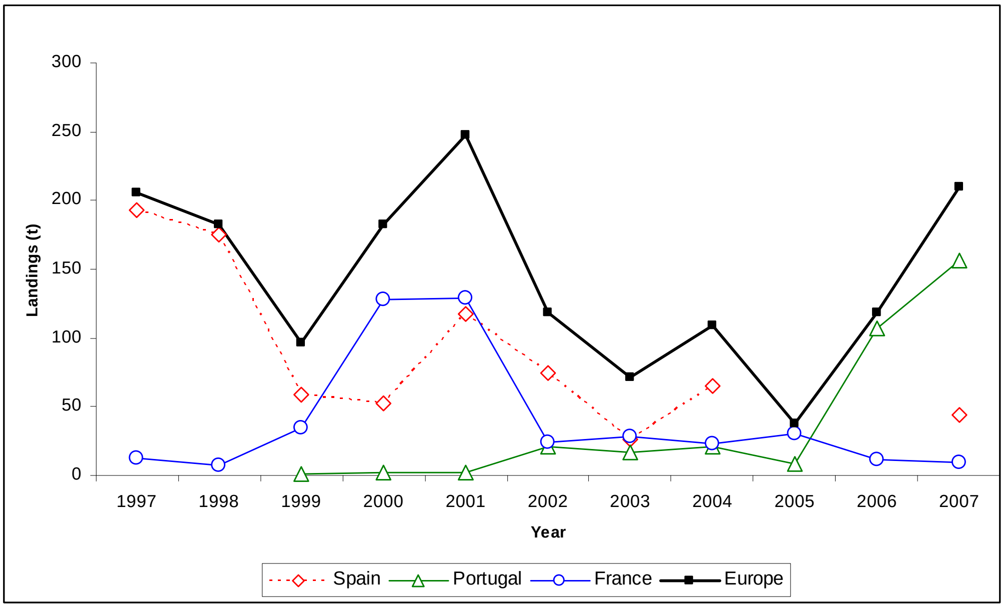

Figure 11.1. Thresher sharks in the North East Atlantic and the Mediterranean Sea. Reported landings of thresher sharks by Spain, Portugal and France (1997–2007, ICCAT and national data). Spanish data (2005–2006 are lacking, and recent Portuguese landings need verification.

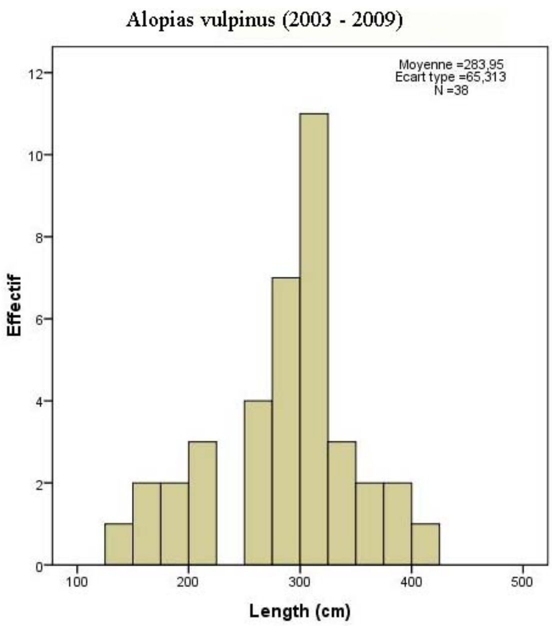

Figure 11.2. Length frequency distributions for *Alopias vulpinus* sampled in the Divisions VIIIabcd in the framework of the Data Collection Regulation program by observers on board French vessels between 2003 and 2009 (Lengths are fork length over the body).

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. Some of these species also occur in the Mediterranean Sea.

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 2008

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 43/2009 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; and also prohibits third-country fishing vessels to fish for, to retain on board, to tranship and to land white shark in all 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. In the ICCAT database, these records are very few; Spain reported 326 t of pelagic sharks in 2000. 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; but since 2005, the national data do not record any of these sharks. Since 1997, landings are also recorded in the ICCAT database (Table 12. 2) for the NE Atlantic mainly 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 5–158 t for the period 1997–2007. 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 3–28 t for the period 1997–2007. 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 is 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 individuals/1000 hooks in 1996 to 0.35 ind./1000 hooks in 1997.

12.6 Fishery-independent surveys

No fishery-independent data are available for these species.

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, 2008), silky shark (Bonfil, 2008), oceanic whitetip (Bonfil *et al*., 2008) and pelagic stingray (Neer, 2008).

Other biological information is available in Branstetter, 1987, 1990; Stevens and Lyle, 1989; Shungo *et al*., 2003 and Piercy *et al*., 2007.

12.8 Stock assessment

12.8.1 Previous studies

No previous assessments have been made of these stocks in the NE Atlantic. Cortés *et al*., in press have undertaken an Ecological Risk Assessment for eleven pelagic elasmobranchs (blue shark, shortfin mako, longfin mako, bigeye thresher, common thresher, oceanic whitetip, silky, porbeagle, scalloped and smooth hammerhead, and pelagic stingray. Comparable analyses for the NE Atlantic pelagic species could usefully be undertaken.

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 from 1999 to 2004; no records have been reported since 2004.

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 has 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
2007	103			2	105							29	5	139

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
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

	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
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 Ecoregion 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).

Eight species have also been reported 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 2008

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 2008

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

Norway has a discards ban that applies to skates and sharks, as well as other fishes, in the Norwegian Economic Zone.

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

There is a lack of species-specific data in the landings categories. Landing data do not reflect the true catches of skates in the commercial fishery in the Barents Sea as some fleets discard skates of low commercial value.

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.

There is no data for several years regarding Russian catches.

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).

13.5 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 Russian surveys

For the offshore areas, data from October–December 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, 2008 (see also 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 Norwegian deep-water survey

Vollen, 2009 WD reported on elasmobranch catches from 3185 deep trawl hauls (400–1400 m) along the continental slope (62–81°N). The area investigated covers the Norwegian Sea Ecoregion, as well as the border between the Norwegian Sea and Barents Sea Ecoregions. Results are reported in the Norwegian Sea Ecoregion (Section 14).

13.6.4 Joint Russian-Norwegian surveys

Two joint Russian-Norwegian surveys are conducted in the Barents Sea during February (in the southern Barents Sea northwards to the latitude of Bear Island) and August–September (practically the whole of the Barents Sea, including waters near Spitsbergen and Franz Josef Land). All skate species are recorded during these surveys and data on length distributions as well as some biological data (on board of Russian vessels) are collected. Analyses of data from these surveys have not yet been conducted, but the general species composition should be similar to the species composition in the Russian surveys.

13.6.5 Quality of survey data

There are concerns regarding the accuracy of skate species identification with regard to Norwegian Survey data. This is particularly relevant to confusion between *A. radiata* and *R. clavata*, and possibly other species. To improve future sampling, the Institute of Marine Research have arranged several workshops to educate staff as well as improve guides and keys used for species identification. A preliminary version of one of these, the "Guide to the identification of skates (*Chondrichthyes*: *Rajidae*)" (Lynghamar, 2009), was made available to the WGEF.

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, 1973–2008. 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	.	.	.	.	.	.	.
USSR/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	.	.	.	.	.	.	.	.	.	.	.	.
USSR/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	2008
Belgium	.	.	.	.	.	n.a.	n.a.	n.a.				0
France	.	.	.	.	.	.	.	.	.			0
Germany	.	.	.	.	.	n.a.	n.a.	n.a.				0
Iceland	1	.	.	4	.	n.a.	n.a.	n.a.				n.a.
Norway	3	13	21	12	30	26	2	1	4	13	4	72
Portugal	.	.	.	.	.	n.a.	n.a.	n.a.	.			0
USSR/Russian Federation	399	790	568	502	218	173	38	n.a.	n.a.	n.a.	24	n.a.
Spain	.	.	.	.	.	n.a.	n.a.	n.a.	.			0
UK - England & Wales	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	.			0
UK – Scotland	.	.	.	.	.	n.a.	n.a.	n.a.	.		0	0
Total	403	803	589	518	248	199	40	1	4	13	28	72

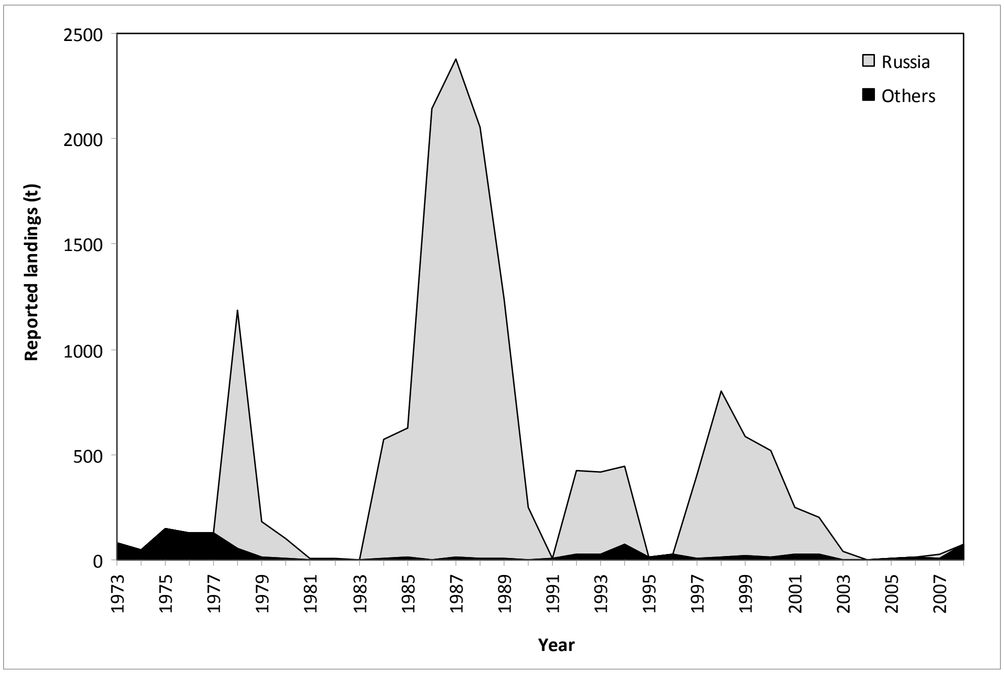

Figure 13.1. Demersal elasmobranchs in the Barents Sea. Skates and rays from ICES Area 27, Subdivision 1, 1973–2008. Total landings (tonnes). The absence of landings in recent years may be the lack of declared catches, rather than a decrease in fishing.

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 the Norwegian coastal area included in the Norwegian Sea ecoregion (Table 14.1). Nine of these species were also found in deep trawl hauls at the continental slope (400–1400 m) by Vollen, 2009 WD Figure 14.1.

In the coastal areas, thorny skate *Amblyraja radiata* is the most abundant skate species (Williams *et al.*, 2007 WD). While more abundant in the north, this species does occur in fairly large numbers at all latitudes along the coast. Long-nose skate *Dipturus oxyrinchus* is distributed mainly 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 spinytail skate *Bathyraja spinicauda* (see also Stehmann and Bürkel, 1984).

In deeper areas of the Norwegian Sea, thorny skate *Amblyraja radiata* and arctic skate *A. hyperborea* are the two most numerous species, but spinytail skate *Bathyraja spinicauda* and round skate *Rajella fyllae* also occur regularly (Skjaeraasen and Bergstad, 2001; Vollen, 2009 WD). These species of skates are particularly abundant north of 70°N (Vollen, 2009 WD). Other skates also occur in some parts of this ecoregion, such as *D. linteus, D. batis, D. nidarosiensis, D. oxyrinchus, L. circularis, L. fullonica* and *R. clavata*.

Sharks in the Norwegian Sea Ecoregion 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* (Williams *et al.*, 2007 WD; Vollen, 2009 WD).

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 Norwegian coastal area have been included within the adjacent 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 various teleost species. Landings data for skates are demonstrated in Table 14.2 and Figure 14.2 for the years 1973–2008.

14.2.2 The fishery in 2008

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.

The Norwegian ban on discarding (which applies to skates and sharks) covers the Norwegian Economic Zone.

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 14.2 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 (not resolved to species level) have been provided by Norway, France and Scotland in recent years.

14.3.2 Discard data

No information.

14.3.3 Quality of catch data

Catch data are not species disaggregated.

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

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

14.6.1 Norwegian coastal survey

The distribution and diversity of elasmobranchs in North-Norwegian coastal areas have been summarized (see Williams, 2007; Williams *et al.*, 2007 WD; 2008).

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 illustrated in Fiskeridirektoratet, 2004). Data for this assessment were taken from demersal trawl surveys carried out annually during autumn from 1992–2005. 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 were 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 14.3 and 14.4. A more robust assessment is necessary to better identify temporal trends in abundances.

14.6.2 Norwegian deep-water survey

Vollen, 2009 WD reported on elasmobranch catches from 3185 deep trawl hauls (400–1400 m) at the continental slope (62–81°N), the Barents Sea and Skagerrak. Data were combined from multiple deep-water surveys during the period 2003–2009. Data from the Skagerrak are excluded in this section, whereas parts of the Barents Sea ecoregion are included.

In all nine elasmobranch species was recorded, six species of skate, and three species of shark (Figure 14.1). Thorny skate and arctic skate were the two dominant species, followed by spinytail skate and round skate. These four species were recorded all along the continental slope, but were most abundant north of 70°N.

Thorny skate was found in all depths, but was most numerous at 600–700 m depth, and individuals ranged in length from 8–78 cm, with most recordings within the range 30–55 cm. There may be some uncertainty regarding some of these records, especially of fish >62 cm length.

Arctic skate was found in all depths, but the highest catches were from 700–900 m. In general, the distribution seemed to be deeper than that of thorny skate. Arctic skate ranged in length from 10 to 103 cm, with most individuals 40–80 cm long. Individuals smaller than 20 cm were almost exclusively found in Area IIb. Arctic skate and Jensen's skate (*Amblyraja jenseni*) are not easily distinguished, and historically have both been recorded as Arctic skate.

Spinytail skate was caught at all depths, with a depth distribution similar to that of Arctic skate. At the deepest stations, the catch rate of the spinytail skate was higher than the catch rate of any other elasmobranch species. Lengths ranged from 14–145 cm, although only occasional specimens exceeded 100 cm.

Round skate was caught at all depths, but catch rates seemed to decrease with increasing depth. Individual fish ranged from 9–75 cm length. Once again, the validity of the records of larger fish (>60 cm) is questionable. Three sailrays were recorded in area IIb, two specimens at 797 m depth, and one at 1165 m depth.

15 specimens of common skate were recorded from 400–1000 m depth. Specimens ranged in length from 68–160 cm. It was suspected that large specimens of several species of skate might have been misclassified as common skate. No clear conclusion can be drawn from the data, but the depth distribution seems to be in agreement with

that found for common skate in the Barents Sea (Dolgov *et al.*, 2005a; 2005b).

Velvet belly *Etmopterus spinax* was caught south of 70°N, mainly at 400–500 m depth. In addition, there was one record from 78°N, at 1000 m depth, which may be doubtful. Fish lengths ranged from 12 to 53 cm.

Spurdog and blackmouth dogfish occurred only sporadically in hauls at 400–500 m in Area IIb.

In addition, there were 65 recordings of thornback ray, mainly in the area 70–75°N. These recordings are considered erroneous, and a result of misidentifications of other species. Thornback ray is normally not found in the Barents Sea but thought to be a sporadic visitor to the north coast of Norway (Williams *et al.*, 2008; Dolgov, 2005a), and confusion between thornback ray and thorny skate is already known from Norwegian surveys (Williams *et al.*, 2008). The geographic distribution of the recordings matches well with that of thorny skate. However, the depth distributions indicate that thornback ray may also be confused with other species.

14.6.3 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 WD, 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 appropriate identification literature, needs to be put in place. To improve future sampling, the Institute of Marine Research has arranged several workshops to educate staff as well as improve guides and keys used for species identification. A preliminary version of one of these, the "Guide to the Identification of skates (*Chondrichthyes*: *Rajidae*)" (Lynghamar, 2009), was made available to the WGEF.

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 and IIb from 1973–2008.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
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.	n.a.
Faroe Islands				5	2	1	1					
France			1	68	61	18	2	1	12	109	2	6
Germany		1	52	12	59	114	84	85	53	7	2	112
Iceland												
Netherlands							2					
Norway	201	158	89	34	99	82	126	191	137	110	96	150
Portugal				34	39							
USSR/Russian Federation						302	99	39				537
Spain											28	
UK - Eng+Wales +N.Irl	65	18	14	20	90	10	6	2				5
UK - Scotland	2	1			1							
Total of Submitted Data	268	178	157	173	351	527	320	318	202	226	128	810
	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Belgium												
Estonia	n.a.	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	5	11	21	42	8	56	11	15	9	7	8	6
Germany	124	102	95	76	32	52						
Iceland												
Netherlands												
Norway	104	133	214	112	148	216	235	135	286	151	239	198
Portugal									22	11		10
USSR/Russian Federation	261	1633	1921	1647	867	208		181	112	257		
Spain	17	5		9							3	
UK - Eng+Wales +N.Irl	1	2	4		2	1		1			1	4
UK - Scotland			2	1								
Total of Submitted Data	512	1890	2257	1902	1057	575	246	334	429	426	251	218
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Belgium						n.a.	n.a.	n.a.	0			0
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	5	n.a.	n.a.				n.a.
Faroe Islands				n.a.		n.a.	2	n.a.				0
France	8	5	n.a.	5	4	7	2	7	8		4	2
Germany				2		2	2	7	0			0
Iceland					4		n.a.	n.a.				n.a.
Netherlands						n.a.	n.a.	n.a.				0
Norway	169	214	239	244	233	118	111	135	133	146	189	214
Portugal	28	46	10	6	3	n.a.	8	n.a.	.			0
USSR/Russian Federation	77	139	247	400	113	38	6	n.a.				n.a.
Spain	3	15	6		7	11	32	n.a.	.			0
UK - Eng+Wales +N.Irl			1			n.a.	n.a.	n.a.	.	0	0	0
UK - Scotland			1	1	1	3	3	n.a.	.	4	1	1
Total of Submitted Data	285	419	504	658	365	184	166	149	141	150	194	217

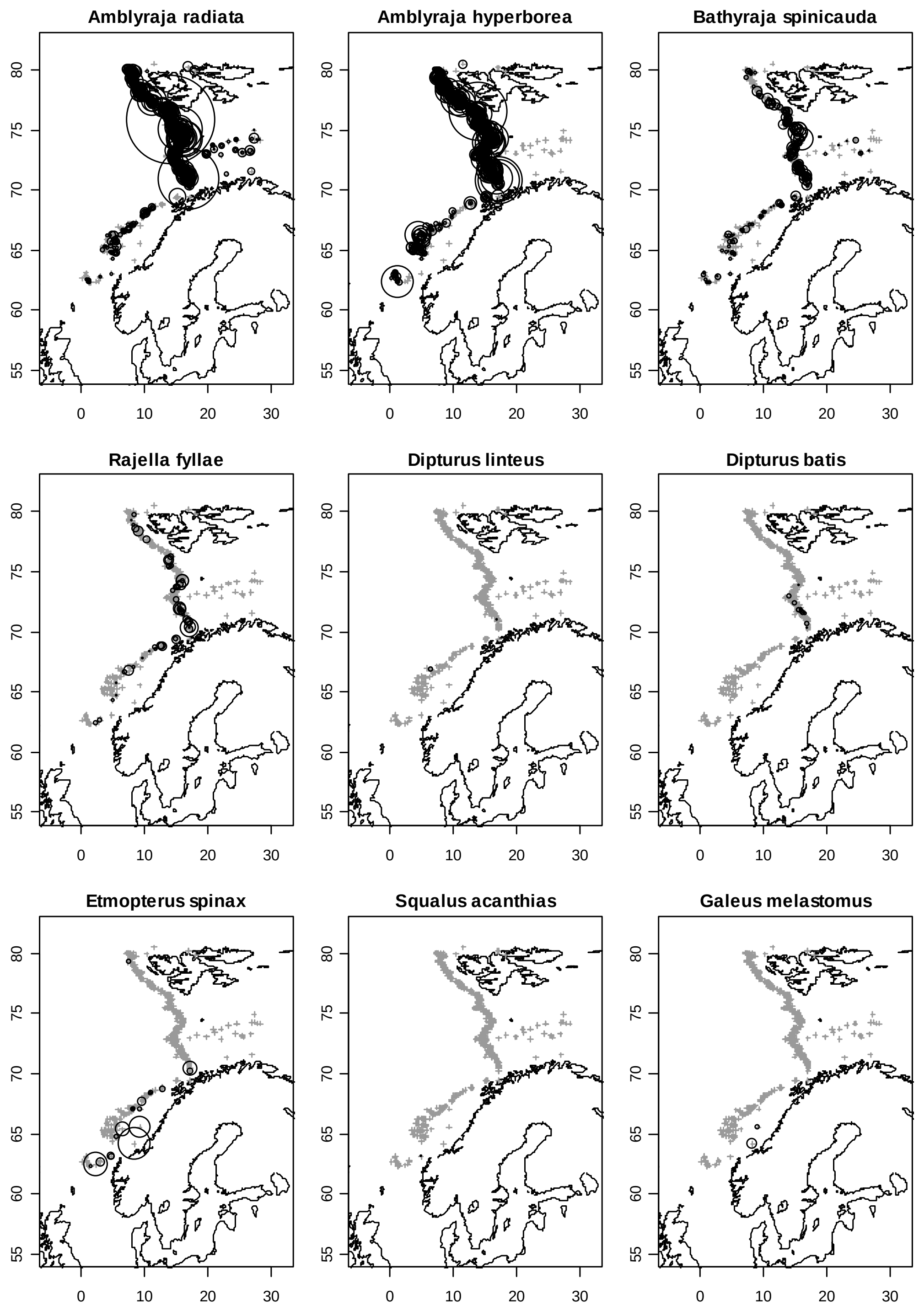

Figure 14.1. Distribution of species recorded in Norwegian deep-sea waters. Grey crosses indicate trawl hauls. Black circles are catches, and catch rate (# per nm) is proportional to area of circle.

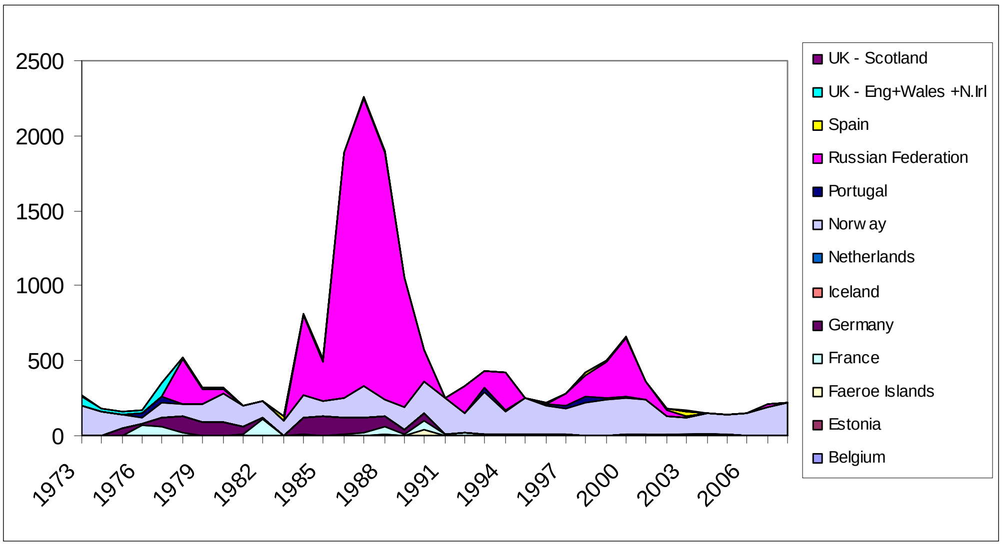

Figure 14.2. Demersal elasmobranchs in the Norwegian Sea. Total landings (t) of skates and rays from ICES Area 27 Subdivisions II, IIa and IIb from 1973–2008.

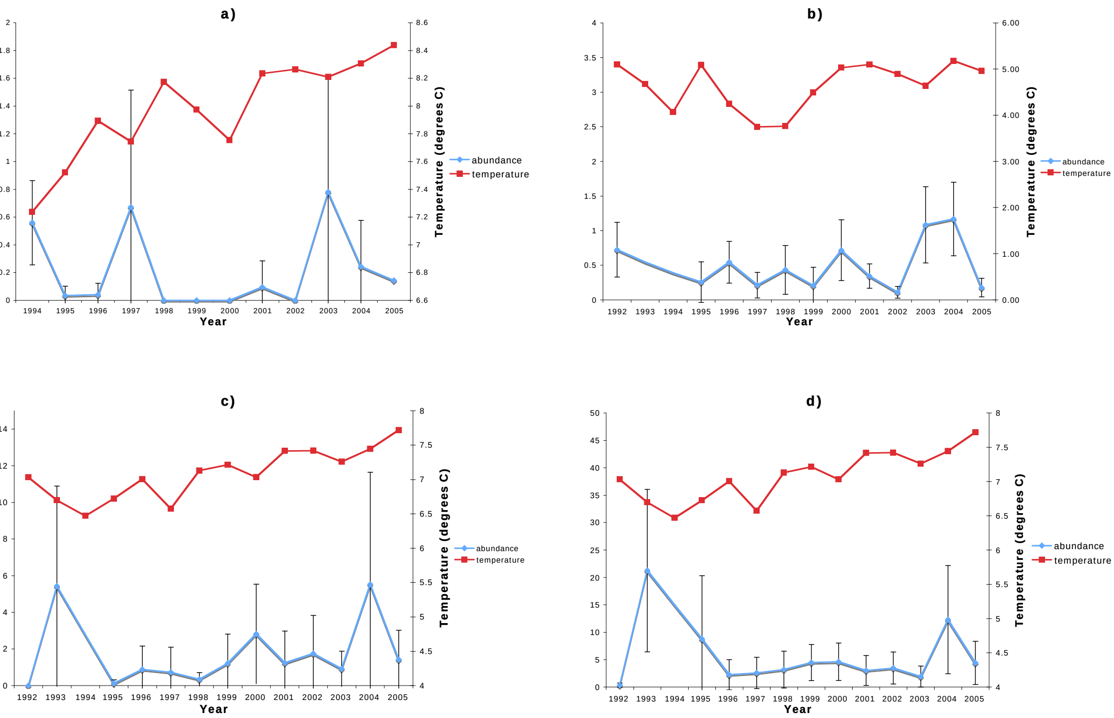

Figure 14.3. Demersal elasmobranchs in the Norwegian Sea. Species abundance with 95% confidence intervals against temperature for a) *Dipturus oxyrinchus* in the area 62°N, b) *Amblyraja radiata* in area East (69–71°N), c) velvet-belly in area West (69–71°N) and d) *Chimaera monstrosa* in area West (69–71°N). See Williams *et al.*, 2007, WD for description of areas.

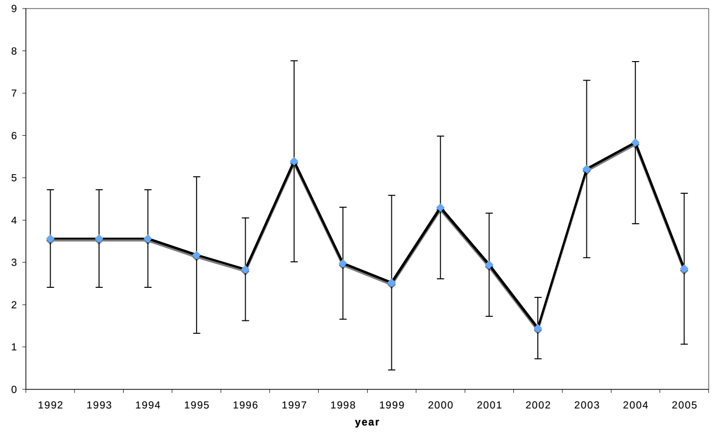

Figure 14.4. Demersal elasmobranchs in the Norwegian Sea. Average annual mean densities in number km^{-2} (with 95% confidence intervals) for *Amblyraja radiata* (1992–1994 given as a combined average).

15 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel

15.1 Ecoregion 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. 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*).

Raja clavata in the Greater Thames Estuary (southern part of ICES Division IVc) are known to move into the eastern English Channel (VIId). For most other demersal species/stocks 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 lesser-spotted dogfish *Scyliorhinus canicula* probably continue into the waters west of Scotland (and for *R. montagui,* lesser-spotted dogfish also into the eastern English Channel). The stock boundary of common skate *Dipturus batis* is likely to continue to the west of Scotland and into the Norwegian Sea. Blonde ray *R. brachyura* has a patchy distribution in the North Sea. The stock boundaries of smooth hound *Mustelus mustelus* and starry smooth hound *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).

The 25% bycatch ratio brought in by the EC (see also Section 15.2.4) has restrained some fisheries and has likely resulted in misreporting in 2007, both of area and species composition.

15.2.2 The fishery in 2008

Landings tables for the relevant species are provided in Tables 15.1–15.9.

WGFTFB (ICES, 2007c) mentioned in their report 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. This is discussed further in Section 1.7.7.

15.2.3 ICES advice applicable

In 2008 ICES provided advice for 2009 and 2010 for these stocks, stating that "Target fisheries for common skate *D. batis* and undulate ray *R. undulata* should not be permitted, and measures should be taken to minimize bycatch". Furthermore no fisheries should be permitted for angel shark *Squatina squatina*. Status quo catch was advised for spotted ray *R. montagui*, starry ray *A. radiata*, cuckoo ray *L. naevus*, thornback ray *R. clavata* in division IVc, smooth hound *Mustelus* spp. and lesser-spotted dogfish *S. canicula*. No advice was given for blonde ray *R. brachyura*, and thornback ray *R. clavata* in division IVa, b.

15.2.3.1 State of the stocks

In the absence of defined reference points, the status of the stocks of demersal skates and rays and demersal sharks cannot be assessed. Therefore a qualitative summary of the general status of the major species based on surveys and landings was given (ICES, 2008):

Common skate *D. batis* – is depleted. It was formerly widely distributed over much of the North Sea but is now found only rarely, and only in the northern North Sea. The distribution extends into the west of Scotland and the Norwegian Sea.

Thornback ray *R. clavata* – distribution area and abundance have decreased over the past century, with the stock concentrated in the southwestern North Sea where it is the main commercial skate species. Its distribution extends into the eastern Channel. Survey catch trends in Division IVc have been stable/increasing in recent years. The status of *R. clavata* in Divisions Iva, b is uncertain.

Spotted ray *R. montagui* – stable/increasing. The area occupied and abundance has fluctuated without trend.

Starry ray *A. radiata* – stable. Survey catch rates increased from the early 1970s to the early 1990s and have decreased slightly since then.

Cuckoo ray *L. naevus* – uncertain. Since 1990 the area occupied has fluctuated without trend. Abundance has decreased since the early 1990s, but has been stable in recent years.

Blonde ray *R. brachyura* – uncertain. This species has a patchy occurrence in the North Sea. It is at the edge of its distributional range in this area.

Undulate ray *R. undulata* – uncertain, reason for concern. Mainly limited to Division VIId where it merges with Division VIIe. Occasional vagrants in Division IVc. The biology of the species and recent disappearance from surveys give rise to concern. It has a patchy and localized distribution, possibly forming discrete stocks which make the undulate ray sensitive to local depletion. Additionally, the species has disappeared from the English beam trawl survey in Division VIId in the last two years (2006–2007).

Lesser-spotted dogfish *S. canicula* – abundance and area occupied are increasing.

Smooth hound *Mustelus* spp. – abundance appears to have been increasing in recent years both in survey catches and in commercial and recreational fisheries, but the stock status is uncertain. Identification by species is considered unreliable in the surveys.

Angel shark *S. squatina* – is now extirpated in the North Sea. It may still occur in Division VIId.

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, a 25% reduction on the 2007 TAC. 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.

The TAC for 2009 was set at 2755 t, which includes a shared TAC of 1643 t for areas IIa and IV, a TAC of 1044 t for VIId and a TAC of 68 t for IIIa. The TAC does not apply for *S. squatina, D. batis*, and *R. undulata* in Area VIId. "Catches of these species may not be retained on board and shall be promptly released unharmed to the extent practicable". For Areas IIa and IV the TAC was indicated to contain a "bycatch quota" for vessels over 15 m length overall and "these species shall not comprise more than 25% by live weight of the catch retained on board".

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*, *R. clavata,* and rabbit fish *Chimaera monstrosa*. Furthermore, since 2004 fishing for and landing of lesser-spotted dogfish, *R. clavata* and *D. batis* is prohibited and since 2008 rays and skates should be landed whole for easier identification. However, there is no good field identification guide for skates and rays occurring in Swedish waters which makes it likely that a lot of species-specific data are missing.

15.3 Catch data

15.3.1 Landings

The landings tables for all skates and rays combined (Table 15.1–15.4) were updated. Some of the French landings were changed retrospectively, based on updated data provided to the group. Since 2008 species-specific landings data are also available for rays and skates (Tables 15.5–15.7). Landings data of lesser-spotted dogfish and smooth hound are presented in Tables 15.8–15.9.

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.

Spatial analyses of landings are planned to be presented at the 2010 WG.

15.3.2 Discard data

Information on discards in the different demersal fisheries is being collected by several countries. During the discard sampling programme of the Dutch beam trawl fleet for the period 2002–2008 the main discarded ray species were *A. radiata* and *R. clavata*. The length frequency distribution of both species is presented in Figure 15.2.

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

Improved species-specific landings data are available since 2008. The landings for each country have been analysed to determine the percentage of landings that have been reported to species-specific level. It can be seen that this percentage varies between countries (Tables 15.5–15.7). Belgium and the Netherlands demonstrate a consistent high level of species-specific declaration for the different ICES areas; for Areas IV and VIId 67% and 66% of Belgian landings and 88% and 67% of Dutch landings were declared up to species level respectively. For UK (E, W & NI) and Norway the percentage of species-specific declaration differs by area. Norway declared 0% and 75% of its landings to species level for Areas IIIa and IV respectively and UK (E, W & NI) declared 50% and 19% of its landings to species level for Areas IV and VIId respectively. Overall, France and UK (Scotland) demonstrate a low level of species-specific declaration. France declared 5% and 14% of its landings to species level for Areas IV and VIId respectively. UK (Scotland) mainly landed rays and skates from Area IV for which only 2.1% was reported down to species-specific level.

Several nations have market sampling and discard observer programmes that can also 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

From 2008 onwards all countries are obliged to register species-specific landings. In the past, only France and Sweden provided landings data by species based on information from logbooks and auction. However, the accuracy of the data provided remains doubtful.

Data for the landings by species by the Dutch beam trawl fleet based on market sampling for 2000–2007 are presented in Table 15.10. UK (England and Wales) provides data by gear and by species (Table 15.11).

In Tables 15.12 and 15.13 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

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.

For 2008 improved species-specific landings are available. Such data can be compared with market sampling and observer programmes to determine whether species identification has occurred correctly. For example, the Dutch landings data reveal that *R. montagui* and *R. clavata* are the most common species. This in contrast to the market sampling of the Dutch beam trawl fishery which demonstrates that *R. montagui* is generally the most common species landed followed by *R. clavata* and *R. brachyura* (Table 15.10). It is possible that misidentification has occurred (especially between *R. ontagui* and *R. brachyura*). This probably affects most nations reporting these species. More robust protocols for ensuring correct identification are needed, both at sea and in the market. The species-specific landings data also demonstrate that most nations still report a considerable proportion of unidentified rays and skates landings for 2008. For a critical review on the species-specific landings data for demersal elasmobranchs for the different nations, see also Section 21.1.

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 (Figure 15.1). 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

No new analyses were undertaken this year. Updated analyses of these and other demersal elasmobranch stocks within the ICES area are planned for the 2010 WG.

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 smooth hounds have increased markedly. *A. 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*. *D. batis* demonstrated an overall decline, supporting the findings of ICES, 2006. *R. 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. Smooth-hounds caught by the gear tend to be juveniles. For a description of the survey see Ellis *et al.*, 2005 and Parker-Humphreys, 2005.

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) Figure 15.3.

Although *R. brachyura* have generally increased over the period, there are only low catch rates for this species (Figure 15.3a). Catch rates for *R. montagui* have declined in recent years (Figure 15.3b). 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 (Figure 15.3c). 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 (Figure 15.3d).

15.6.3 Changes in abundance and spatial variation

In 2007 two methods, the GAM method and SPANdex modelling methods, 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 15.4). 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. 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*).

Density surfaces (distribution based strata) were created using potential mapping in SPANS (Anon., 2003). 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 15.5: *R. clavata*). The area occupied (AO) illustrated in the distribution maps of the species changes over time (Figure 15.6) and their relative abundance has been maintained or increased (Figures 15.7A, 15.8A). The relationship between total AO and abundance differed between the species (Figures 15.7B, 15.8B). It appeared that for all species the high density area occupied corresponded more closely to observed abundance changes (Figures 15.7C, 15.8C). 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 *R. clavata* were 38–66 eggs over the course of the egg-laying season (Ellis, unpublished), 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 *R. 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 elasmobranch 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. Up to 2008 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. Further sampling of commercial catches to validate species-specific landings is required, particularly to better differentiate between *R. montagui* and *R. brachyura.*

Since a TAC was introduced for North Sea "skates and rays" in 1999 it has generally been higher than the landings (Table 15.14 and Figure 15.1), although landings have been at or above the TAC since 2006 and may have become restrictive for some fisheries.

There has been a gradual reduction in TAC up to 2008: from 2005 to 2006 by 15%, from 2006 to 2007 by 20% and from 2007 to 2008 by 25%. WGEF mentioned in its 2006 Report, that the 2006 TAC might become restrictive for some countries and that discarding was therefore expected to increase.

The 2008 TAC was considerably less than the landings and if fishers do not change, their practices must either lead to an increase of discarding and/or to misreporting. WGEF therefore stated in its 2008 Report that "the current TAC should not be reduced any further at this time".

Discard survivorship could be high for inshore trawlers in the SW North Sea, as tow duration tends to be relatively short and line fisheries should also have a high discard survival (Ellis *et al*., 2008a, b). Discard survival from gillnet catches will likely be affected by soak-time. Discard survival from offshore fleets is unknown. The survival of *S. canicula* is considered high (Revill *et al*., 2005).

From 2008 onwards, species-specific landings data for the major skate species have been required. Information on the catches of the next couple of years should demonstrate what effect the small TAC will have on the fisheries.

As a consequence of 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 because only a part of IIa belongs to the present North Sea ecoregion.

Technical interactions of fisheries in this ecoregion are demonstrated in Table 15.15.

15.12 References

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Table 15.1. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Total landings of skates (Rajidae) in ICES Division IIIa.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	.	.	.	.	.	.	.		0	0		0.3
Denmark	16	7	11	41	56	22	36	129	65	26	8	5
Germany	.	+	.	.	.	+			.	1		
Iceland	.	.	.	.	.		.					
Netherlands	n.a.	.	.	.	.	.			0	0	0	0
Norway	160	134	208	123	154	159	163	85	94	51	13	23
Sweden	5	1	2	2	12	13	9		10	18	11	6
UK (E, W_& NI)	.	.	.	.	.	.	.	.	0	0	0	0
UK (Scotland)	.	.	.	.	.	.	.	.	0		0	0
Total of submitted data	181	142	221	166	222	194	208	214	169	95	32	34

Table 15.2. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Total landings of skates (Rajidae) in ICES Subarea IV.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	428	373	336	332	370	436	323	276	327	350		371
Denmark	33	20	45	93	65	34	33	25	23	26	27	23
Faroe Islands	.	.	.	n.s.	n.s.							
France	52	47	41	31	60	62	36	43	42	15	56	67
Germany	35	9	16	23	11	22	21	17	29	16		
Iceland	.	.	.	.	.		.			0		
Ireland	.	.	.	.	.		.		0	0	0	0
Netherlands	n.a.	609	515	693	834	805	686	561	680	603	721	565
Norway	106	180	152	161	173	83	113	77	87	96	71	97
Poland	.	.	.	.	.							
Sweden	+	+	+	+	+	+	+	20	0	0	0	0
UK (E, W_& NI)	1009	794	618	516	476	500	537	550	434	348	329	392
UK (Scotland)	1494	1381	965	860	822	853	741	512	404	374	364	343
Total of submitted data	3157	3413	2688	2709	2811	2794	2490	2081	2026	1828	1569	1859

Table 15.3. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Total landings of skates (Rajidae) in ICES Division VIId.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	117	66	93	69	79	113	153	96	94	109		174
France	896	738	558	693	589	725	796	788	754	687	792	710
Germany	.	.	.	+	.	.	.	0	.	0		
Ireland	.	.	.	.	.	.	2	0	0	0	0	0
Netherlands	na	.	.	.	.	.	.	.		13	21	13
Spain	na	na	na	na	na	na	na	+	0			
UK (E, W_& NI)	213	246	437	355	169	140	186	157	147	139	188	199
UK (Scotland)	+	+	.	.	.	.	.	.	0	2	2	6
Total of submitted data	1226	1050	1088	1117	837	978	1137	1041	995	948	1004	1102

Table 15.4. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Total landings of skates (Rajidae) in the North Seas ecoregion (IIIa, IV, VIId).

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	545	439	429	401	449	548	476	372	422	459	n.s.	546
Denmark	49	27	56	134	121	56	69	154	88	52	35	28
Faroe Islands	.	.	.	n.s.	n.s.	.	.	.	0	0	0	0
France	948	785	599	724	649	725	796	831	796	701	848	777
Germany	35	9	16	23	11	22	21	17	29	17	0	0
Iceland	.	.	.	.	.	.	.	.	0	0	0	0
Ireland	.	.	.	.	.	.	2	0	0	0	0	0
Netherlands	n.a.	609	515	693	834	805	686	561	680	615	742	578
Norway	266	314	360	284	327	242	276	162	181	147	84	120
Poland	.	.	.	.	.	.	.	.	0	0	0	0
Spain	na	na	na	na	na	na	na	+	0	0	0	0
Sweden	5	1	2	2	12	8	9	20	10	18	11	6
UK (E&W and NI)	1222	1040	1055	871	645	640	723	707	580	487	517	591
UK (Scotland)	1494	1381	965	860	822	853	741	512	404	375	366	349
Total of submitted data	4564	4606	3997	3992	3870	3899	3799	3336	3190	2872	2605	2995

Table 15.5. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Species-specific landings and species composition of skates (Rajidae) from ICES Division IIIa in 2008.

AREA IIIA	SPECIES CATEGORIES	WEIGHT (T)	% OF NATIONAL CATCH	% EXCLUDING GENERIC CATEGORIES
Belgium	*Raja brachyura*	0.2	62.9%	77.9%
	Raja clavata	0.0	11.8%	14.6%
	Raja montagui	0.0	6.1%	7.5%
	Raja species	0.1	19.2%	
	Total:	0.3	100.0%	
Percent of catch as species-specific landings:		81%		
Denmark	Rajidae	5		
	Total:	5		
Percent of catch as species-specific landings:		0%		
Norway	Rajidae	23		
	Total:	23		
Percent of catch as species-specific landings:		0%		
Sweden	Rajidae	6		
	Total:	6		
Percent of catch as species-specific landings:		0%		

Table 15.6. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Species-specific landings and species composition of skates (Rajidae) from ICES Subarea IV in 2008.

Area IV	Species Categories	Weight (t)	% of national catch	% excluding generic categories
Belgium	*Dipturus batis*	0.00	0.0%	0.0%
	Raja brachyura	69.20	18.6%	27.8%
	Raja clavata	147.15	39.6%	59.2%
	Raja montagui	29.24	7.9%	11.8%
	Leucoraja naevus	3.02	0.8%	1.2%
	Amblyraja radiata	0.11	0.0%	0.0%
	Skates and rays	122.67	33.0%	
	Total:	371.38	100.0%	
Percent of catch as species-specific landings:		67.0%		
Denmark	Rajidae	23		
	Total:	23		
Percent of catch as species-specific landings:		0.0%		
France	*Dipturus batis*	0.03	0.0%	0.9%
	Dipturus oxyrinchus	0.65	1.0%	19.4%
	Raja clavata	2.06	3.1%	61.1%
	Leucoraja naevus	0.47	0.7%	14.0%
	Raja montagui/R. brachyura	0.12	0.2%	3.5%
	Dasyatis pastinaca	0.01	0.0%	0.3%
	Leucoraja fullonica	0.03	0.0%	0.9%
	Skates and rays	64.01	95.0%	
	Total:	67.37	100.0%	
Percent of catch as species-specific landings:		5.0%		
Netherlands	*Raja clavata*	192.78	34.1%	39.0%
	Raja brachyura	16.22	2.9%	3.3%
	Unknown rajids	0.10	0.0%	
	Raja montagui	285.62	50.6%	57.7%
	Leucoraja naevus	0.15	0.0%	0.0%
	Skate	0.05	0.0%	
	Skates and rays	70.03	12.4%	
	Total:	564.94	100.0%	
Percent of catch as species-specific landings:		87.6%		
Norway	*Dipturus batis*	72.65	75.2%	
	Skates and rays	23.99	24.8%	
	Total:	96.64	100.0%	
Percent of catch as species-specific landings:		75.2%		
Sweden	Skates and rays	0.40		
	Total:	0.40		
Percent of catch as species-specific landings:				

Table 15.6 (continued). Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Species-specific landings and species composition of skates (Rajidae) from ICES Subarea IV in 2008.

Area IV	Species categories	Weight (t)	% of national catch	% excluding generic categories
UK (E, W & NI)	Skates and rays	194.72	49.7%	
	Leucoraja circularis	0.00	0.0%	0.0%
	Leucoraja naevus	0.19	0.0%	0.1%
	Raja brachyuran	11.51	2.9%	5.8%
	Raja clavata	182.61	46.6%	92.8%
	Raja montagui	2.57	0.7%	1.3%
	Total:	391.60	100.0%	
Percent of catch as species-specific landings:		50.3%		
UK (Scotland)	*Raja brachyuran*	6.80	2.0%	95.0%
	Dipturus batis	0.36	0.1%	5.0%
	Skates and rays	336.12	97.9%	
	Total:	343.28	100.0%	
Percent of catch as species-specific landings:		2.1%		

Table 15.7. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Species-specific landings and species composition of skates (Rajidae) from ICES Division VIId in 2008.

VIId	Species Categories	Weight (t)	% of national catch	% excluding generic categories
Belgium	*Raja brachyura*	46.27	26.5%	40.1%
	Raja clavata	60.84	34.9%	52.7%
	Raja montagui	7.43	4.3%	6.4%
	Leucoraja naevus	0.53	0.3%	0.5%
	Amblyraja radiate	0.39	0.2%	0.3%
	Skates and rays	58.93	33.8%	
	Total:	174.39	100.0%	
Percent of catch as species-specific landings:		66.2%		
France	*Dipturus batis*	0.17	0.0%	0.2%
	Raja clavata	56.40	7.9%	55.4%
	Leucoraja naevus	24.19	3.4%	23.7%
	Raja montagui/R. brachyura	18.14	2.6%	17.8%
	Dasyatis pastinaca	0.03	0.0%	0.0%
	Leucoraja circularis	0.00	0.0%	0.0%
	Raja microocellata	2.93	0.4%	2.9%
	Unidentified ray	0.51	0.1%	
	Skates and rays	607.35	85.6%	
	Total:	709.73	100.0%	
Percent of catch as species-specific landings:		14.4%		
Netherlands	*Raja clavata*	8.23	63.4%	94.5%
	Raja montagui	0.48	3.7%	5.5%
	Skates and rays	4.28	32.9%	
	Total:	12.99	100.0%	
Percent of catch as species-specific landings:		67.1%		
UK (E, W & NI)	*Dipturus batis*	0.01	0.0%	0.0%
	Dipturus oxyrinchus	0.42	0.2%	1.1%
	Leucoraja fullonica	0.00	0.0%	0.0%
	Raja brachyura	10.85	5.5%	29.5%
	Raja clavata	21.48	10.8%	58.4%
	Raja microocellata	0.74	0.4%	2.0%
	Raja montagui	1.68	0.8%	4.6%
	Raja undulate	1.59	0.8%	4.3%
	Skates and rays	162.16	81.5%	
	Total:	198.93	100.0%	
Percent of catch as species-specific landings:		18.5%		
UK (Scotland)	Skates and rays	5.89		
	Total:	5.89		
Percent of catch as species-specific landings:		0%		

Table 15.8. 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	2008
Belgium	NA	NA	NA	NA	226	238	265	n.s.	338
France	1633	1811	1899	1777	1472	1614	1492	1459	1406
UK (E,W&NI)	NA	NA	NA	13	57	92	118	94	102
UK (Scotland)	.	.	1	5	3	22	6	3 [1)]	2 [1)]
	1633	1811	1900	1795	1758	1966	1881	1556	1848

[1)] **Registered as spotted dogfish.**

Table 15.9. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Landings of smooth-hounds in IIIa, IV and VIId.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium					12	13	10	n.s.	12
France	146	261	478	459	587	630	722	787	668
UK (E,W&NI)						169		123	114
	146	261	478	459	598	811	731	910	794

Table 15.10. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel: quantification of species composition (%) for North Sea skates and rays in Dutch beam trawl fishery based on market sampling.

YEAR	A. RADIATA	L. NAEVUS	R. BRACHYURA	R. CLAVATA	R. MONTAGUI
2000	0.2	0.5	19.6	38.2	41.5
2001	0.2	0.5	13.8	37.7	47.8
2002			31.1	28.1	40.8
2003			26.9	27.0	46.1
2004			20.7	38.7	40.6
2005	0.2	0.2	29.8	23.3	46.5
2006			25.3	40.9	33.8
2007			28.9	33.6	37.4

Table 15.11. 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 15.12. 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	2008	2000	2001	2005	2006	2007	2008	2000	2001	2005	2006	2007	2008
25																		
30	0.6	1.9	3.0	0.3	1.0	0.5	3.5	0.5	0.9	0.5		0.2						
35	9.4	11.2	7.8	8.6	7.1	3.0	34.2	6.3	4.7	2.5	0.4	0.2	1.2	1.0	0.3	1.5		
40	16.8	19.9	14.2	13.4	30.5	4.0	75.6	33.5	14.0	15.8	9.7	6.3	1.2	1.5	2.1	5.5	3.8	
45	17.5	20.3	11.2	26.2	27.2	8.5	85.9	60.3	36.9	52.5	32.2	16.1	1.2	3.3	6.0	3.9	7.2	0.1
50	23.0	36.4	18.2	40.0	36.0	15.2	58.3	72.5	47.6	59.6	52.6	45.4	2.7	5.6	7.7	3.5	3.8	0.6
55	16.0	35.3	12.9	26.6	30.9	17.7	42.7	54.6	49.9	34.6	50.8	58.9	3.1	4.9	9.6	7.7	5.1	0.7
60	12.1	22.8	14.7	20.0	19.1	16.6	26.1	42.4	44.2	25.3	40.5	71.7	0.6	5.3	6.8	7.5	5.1	0.8
65	5.3	15.3	5.7	16.7	17.5	14.9	10.4	16.1	13.7	4.7	12.4	26.1	1.0	3.6	8.0	7.6	6.1	0.7
70	5.3	5.2	6.2	11.8	12.3	14.6	2.0	2.3	0.9	1.1	0.5	1.2	1.6	2.1	6.1	4.5	5.9	0.5
75	4.7	5.5	5.2	8.1	6.9	9.8	0.3		0.1				1.8	2.7	3.1	5.4	6.8	0.8
80	3.7	3.5	2.2	3.7	5.4	5.0							1.6	1.9	4.2	5.1	8.2	0.5
85	3.4	2.3	1.8	1.9	1.8	2.9							1.1	1.5	3.1	2.3	6.0	0.5
90	1.2	0.6	0.7	0.9	1.0	0.9							0.5	1.9	2.4	2.0	2.8	0.4
95	0.8	0.3	0.1		0.1	0.4							0.1	0.6	1.6	1.2	2.6	0.2
100						0							0.1		0.2	0.3	0.1	0.0
105															0.3			0.0
110	0.1																	
sum	119.8	180.5	103.9	178.2	197	114.0	339.2	288.4	212.9	196.6	199.2	226.1	17.7	35.8	61.5	58.0	63.5	5.8

Table 15.13. 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 15.14. 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	3637
2000	6060	3708
2001	4848	3543
2002	4848	3657
2003	4121	3523
2004	3503	3174
2005	3220	3009
2006	2737	2725
2007	2190 [1)]	2521
2008	1643 [2)]	2875
2009	2755 [3)]	

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 montagui*), Starry ray (*Amblyraja radiata*) and Common skate (*Dipturus batis*) shall be reported separately.

3) This includes a shared TAC of 1643 t for Areas IIa and IV; a TAC of 1044 t for VIId and a TAC of 68 t for IIIa.

Table 15.15. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Technical interactions.

Main gears	Cod 347d	Cod katt.	Had 34	Whg 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
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																		

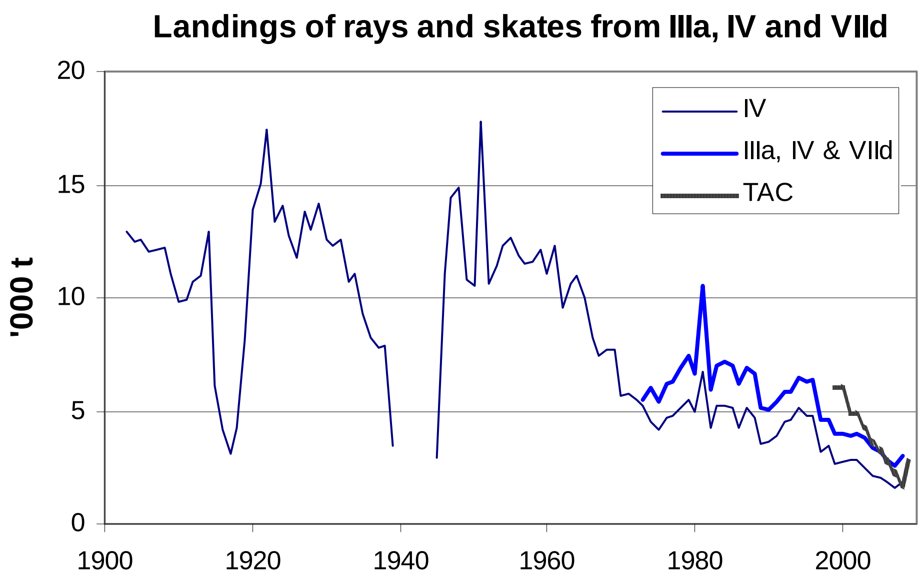


Figure 15.1. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel: total international landings of rays and skates since 1903. From 1973 based on WG estimates. TAC for the North Sea (Area IV and part of II) is added. The 2009 TAC incorporates includes a shared TAC of 1643 t for areas IIa and IV; a TAC of 1044 t for VIId and a TAC of 68 t for IIIa.

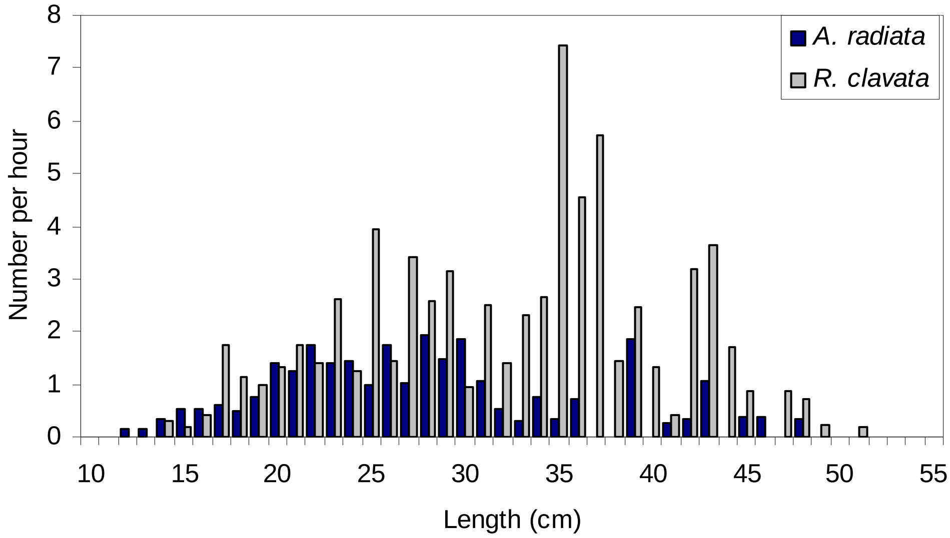


Figure 15.2. Length frequency distribution of the average number of *A. radiata* and *R. clavata* discarded per hour by Dutch beam trawl vessels for the period 2002–2008.

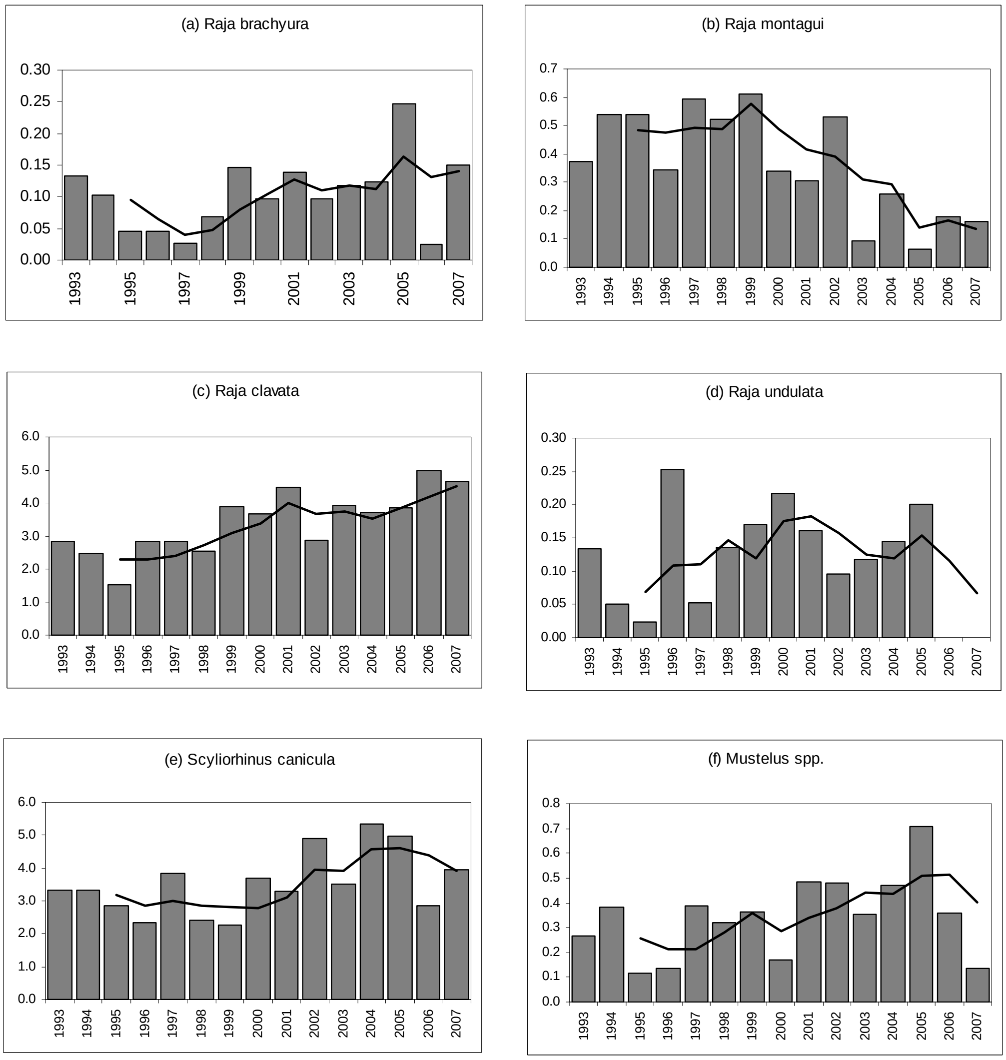


Figure 15.3. Catch rates of the Cefas beam trawl survey in the Irish Sea and Bristol Channel 1993–2007 for *R. brachyura*, *R. montagui*, *R. clavata*, *R. undulata*, *S. canicula* and *Mustelus* spp.

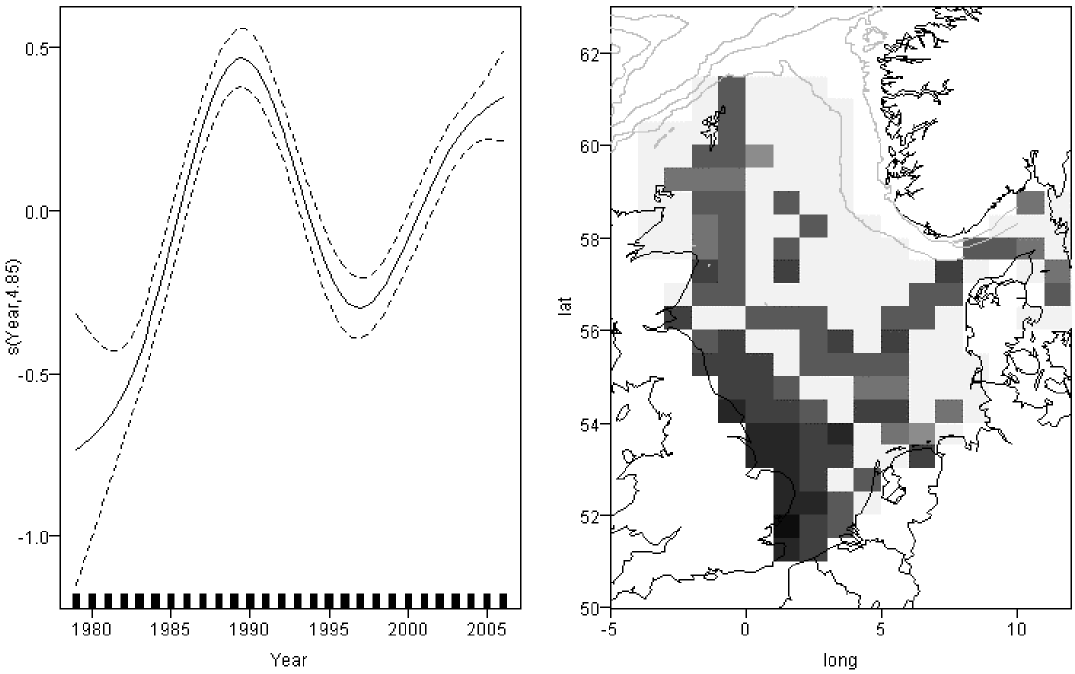


Figure 15.4. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Thornback ray in the North Sea. Results of GAM analysis of the 'filtered' Q1 IBTS data. Estimated year effects and spatial effects are on a log scale. Statistical rectangles with zero catch rates are shaded very pale grey (Source: ICES, 2007a).

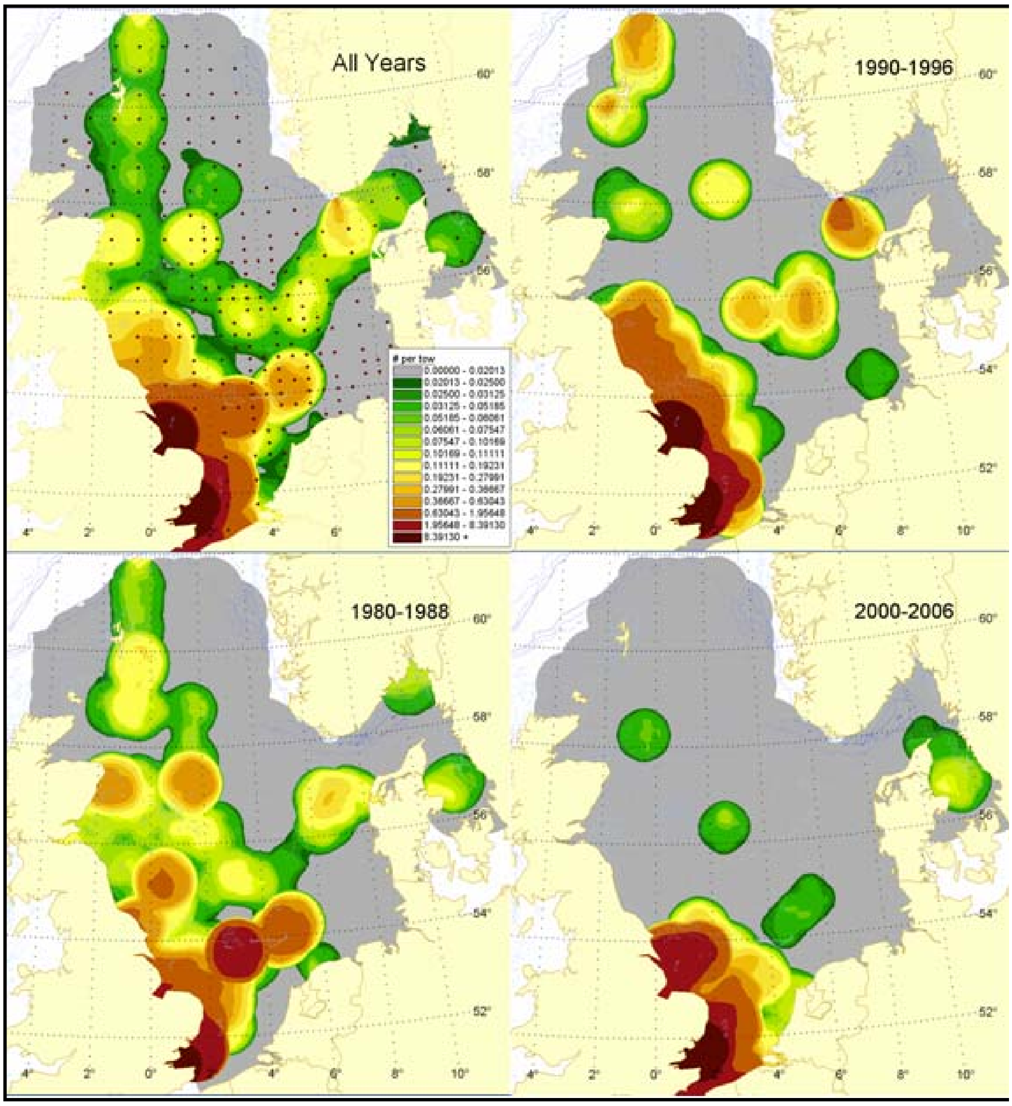


Figure 15.5. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Distribution of *Raja clavata* during four periods and averaged over the entire survey period (1980–2006). Density strata are expressed as mean number per tow. Points on "All Years" map are grid averaged survey location (Source: ICES, 2007a).

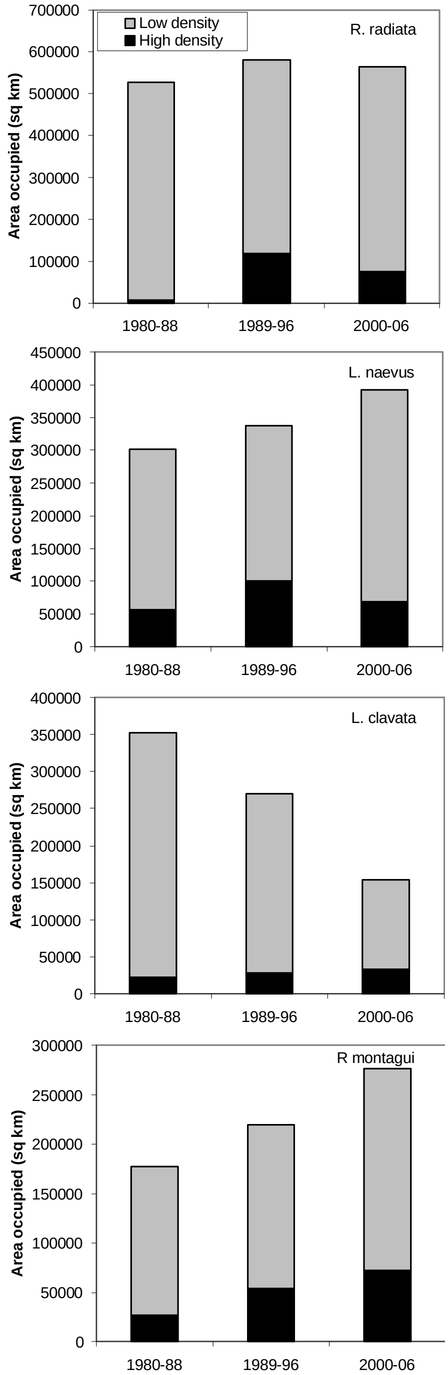


Figure 15.6. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Area occupied during three periods illustrated in the distribution maps for *Amblyraja radiata, Leucoraja naevus, Raja clavata* and *R. montagui* (Source: ICES, 2007a).

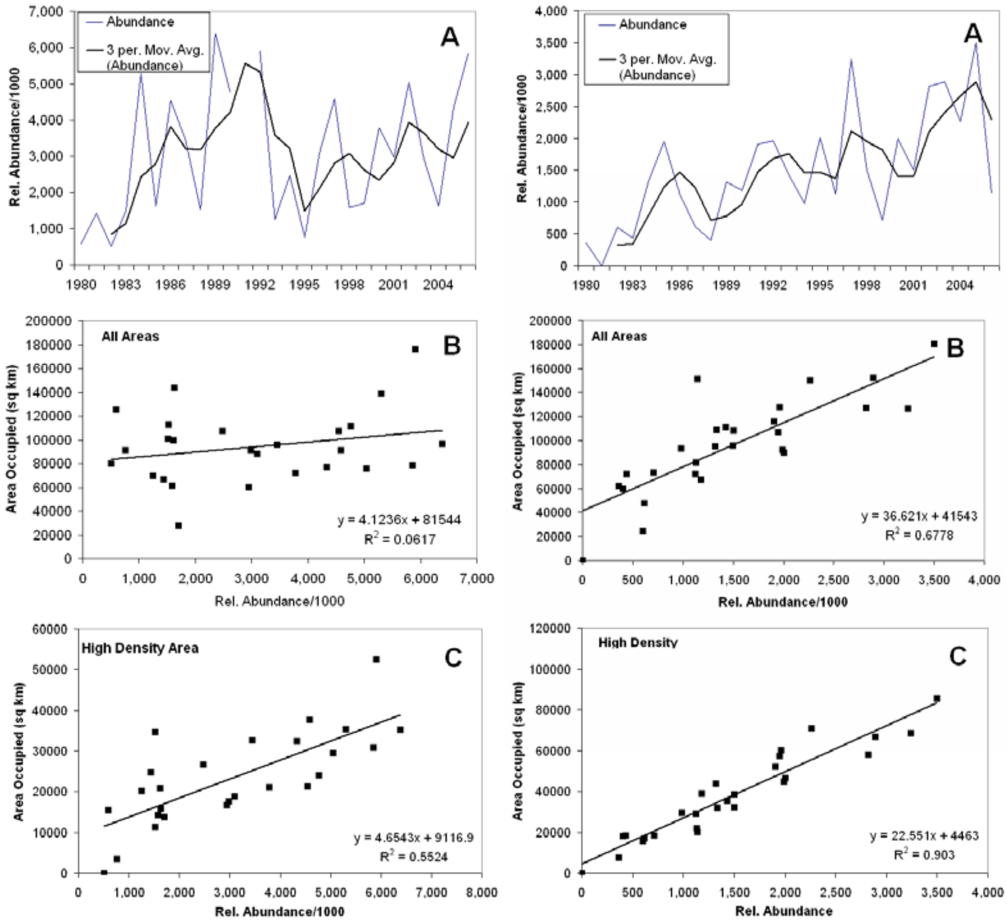


Figure 15.7. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Spatial patterns observed for *R. clavata* and *R. montagui* in the North Sea. A-Annual estimates of relative abundance using SPANdex. A 3 year running average is represented to smooth the high interannual 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).

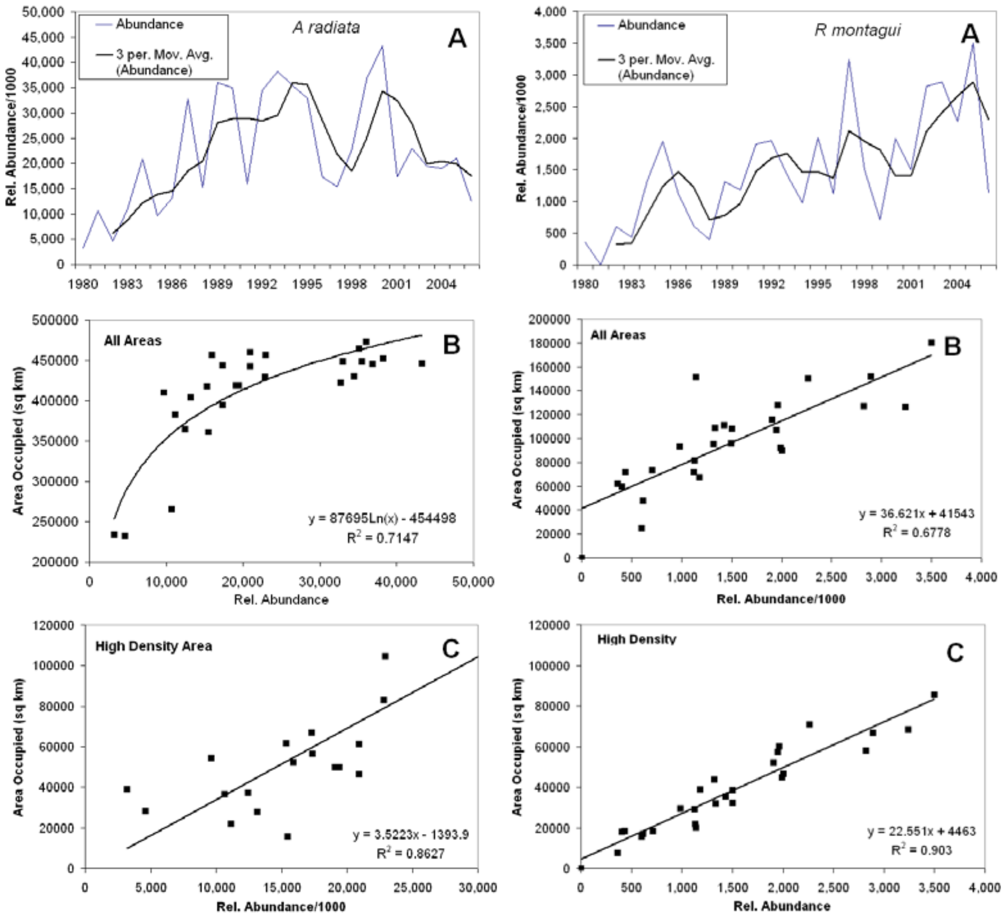


Figure 15.8. Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel. Spatial patterns observed for *A. radiata* and *L. naevus* in the North Sea. A-Annual estimates of relative abundance using SPANdex. A 3 year running average is represented to smooth the high interannual variation 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 Ecoregion and stock boundaries

The elasmobranch fauna off Iceland and Greenland is little studied and comprises relatively few species. The number of species decreases as the water temperature gets colder, and only a few elasmobranch species are common in Icelandic waters. 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 Jensen's skate *Amblyraja jenseni*, Norwegian skate *Dipturus nidarosienis* shagreen ray *Leucoraja fullonica,* common skate *Dipturus batis* and sailray *D. linteus* also recorded off Iceland.

Dogfish and sharks in this ecoregion include spurdog (Section 2), Portuguese dogfish and leafscale gulper shark (Section 3), birdbeak dogfish *Deania calcea*, black dogfish *Centroscyllium fabricii*, Iceland catshark *Apristurus laurussonii*, smalleye catshark *Apristurus microps*, mouse catshark *Galeus murinus*, longnose velvet dogfish *Centroselachus crepidater*, smallmouth velvet dogfish *Scymnodon obscurus*, Greenland shark *Somniosus microcephalus* and velvet dogfish *Zameus squamulosus* (Section 5), porbeagle (Section 6) and basking shark (Section 7).

Chimaeras (rabbitfish *Chimaera monstrosa*, spearnose chimaera *Rhinochimaera atlantica,* large-eyed rabbitfish *Hydrolagus mirabilis,* smalleyed rabbitfish *Hydrolagus affinis,* narrownose chimaera *Harriotta raleighana*), all occur in the Area.

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. Common skate is taken with a variety of fishing gears throughout the year, and catches peak in May and June. They used to be fairly common in Icelandic waters, but landings are now only about 10% of what was landed 50 years ago. A large part of the catch goes to local consumption as common skate is a traditional food in Iceland.

Starry ray has always been a bycatch in a variety of fishing gears around Iceland but until recently were usually discarded. The increase in landings in recent years can therefore mostly be explained by increased retention. The landed catch has grown from virtually nothing in 1980 to more than 1000 t annually since 1995. Catches have declined again in recent years. A relatively large share goes to local consumption.

16.2.2 The fishery in 2008

No new information.

16.2.3 ICES advice applicable

ACOM has not provided advice on these stocks.

16.2.4 Management applicable

There is no TAC for demersal skates in these areas.

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 1970s 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 is 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 (22 sharks, 15 skates and six chimaeras). 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* has 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

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

Jørgensen, O. A. 2006. Elasmobranchs at East Greenland, ICES Division 14B. Working paper ICES Elasmobranch WG. June 2006.

Electronic references:

http://www.fisheries.is/main-species/cartilaginous-fishes/

http://www.fisheries.is/main-species/cartilaginous-fishes/grey-skate/

http://www.fisheries.is/main-species/cartilaginous-fishes/starry-ray/

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.

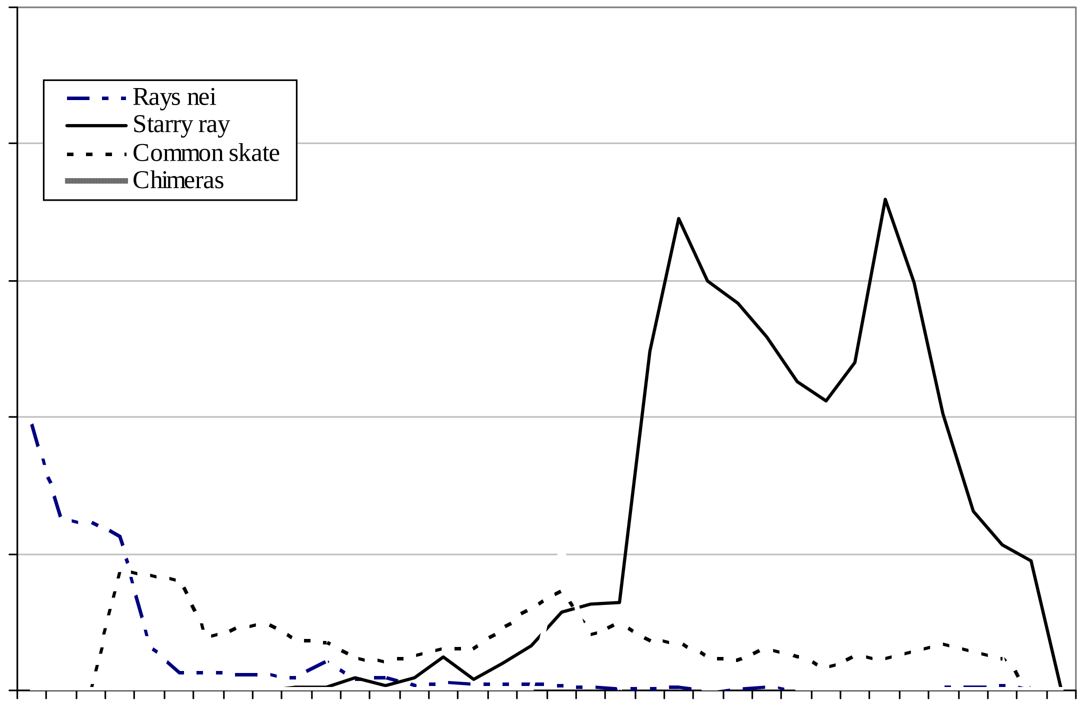
WG Estimates of Landings (t) of elasmobranchs in ICES Area Va														
		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Common skate	Iceland	183	176	123	112	151	121	84	125	147	169	140	117	na
Sailray	Iceland	.	.	.	.	.	.	.	1	8	20	8	7	na
Shagreen ray	Iceland	19	16	12	21	27	37	32	17	23	17	18	17	na
Starry ray	Iceland	1498	1416	1296	1132	1058	1200	1796	1491	1013	657	530	472	na
Raja rays nei	Belgium	.	.	.	.	.	.	.	.	.	.			
	Faroe Islands	2	2	7	5	n/a	2	1	n/a.	8	9	16	7	
	Germany [1]	.	.	2	1	1	1	.	1	1	.	1		
	Iceland	.	.	.	.	.	.	.	.	.	.			
	Norway	.	.	.	.	.	.	.	.	.	.		.	.
	Portugal	.	1	.	.	.	.	.	.	.	.		.	.
	UK: EngWalesN.Irl.	.	.	.	.	.	1	.	.	1	.		.	.
	UK: Eng&Wales	.	.	.	.	.	.	.	.	.	.	1	.	.
	UK: Scotland	.	.	.	.	.	.	.	.	.	.	0	.	.
Raja rays nei	Total	2	3	9	6	1	4	1	1	10	0	1	0	0
Rabbitfish	Iceland	.	15	29	3	5	1	.	1	.	.	.	.	.
Total	.	1702	1626	1469	1274	1242	1363	1913	1636	1201	864	698	613	0
WG Estimates of Total Landings (t) of elasmobranchs in ICES Area XIV														
Raja rays nei	Faroe Islands	.	.	.	.	.	.	.	.	.	.	.	.	
	Germany	.	.	.	.	.	.	.	.	.	.	.	.	
	Norway	.	.	.	.	.	.	.	.	.	.	.	.	
	Portugal	.	.	.	.	.	1	.	.	.	.	.	.	
	UK: Engl&Wales	.	.	.	.	.	.	.	.	.	.	.	.	
	UK: Scotland	.	.	.	.	.	.	.	1	.	.	.	.	
Total	.	0	0	0	0	0	1	0	1	0	0	0	0	0
WG Estimates of Total Landings (t) of elasmobranchs in ICES Area XIVa														
Raja rays nei	Germany	.	.	.	.	7	.	.	.	.	.	.	.	
	Norway	.	.	.	.	.	.	.	1	.	.	.	.	
	UK: Eng&Wales	.	.	.	.	.	.	.	.	.	.	.	.	
Total	.	0	0	0	0	7	0	0	1	0	0	0	0	0

Total Landings (t) of elasmobranchs in ICES Area XIVb														
Blue skate	Norway	.	.	.	.	3	.	.	.	.	.	.		
Shagreen ray	Iceland	.	.	.	.	.	.	.	.	.	.	.		
Raja rays nei	Faroe Islands	.	.	.	.	.	.	1	.	.	.	.		
	Germany	.	.	1	.	.	.	.	.	.	.	.		
	Norway	10	2	19	8	3	6	5	.	.	.	.		
	Russian Fed.	.	.	.	.	.	.	.	.	2	.	.		
	Spain	.	.	.	.	.	.	.	15	.	.	.		
	UK	.	.	1	2	.	.	.	.	.	.	.		
	Norway	.	.	.	.	.	.	2	.	.	.	6		
Raja rays nei	Total	10	2	21	10	3	6	7	15	2	.	6		
Rabbitfish	Norway	.	.	.	.	.	.	.	1	5	.	.		
Spotted ratfish	Ireland	.	.	.	.	.	1	.	.	.	.	.		
Total	.	20	4	42	20	9	13	15	31	9	0	12	0	0
Grand Total		1722	1630	1511	1294	1258	1377	1928	1669	1210	864	710	613	0

[1] Germany and Fed. Rep. of Germany combined.

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



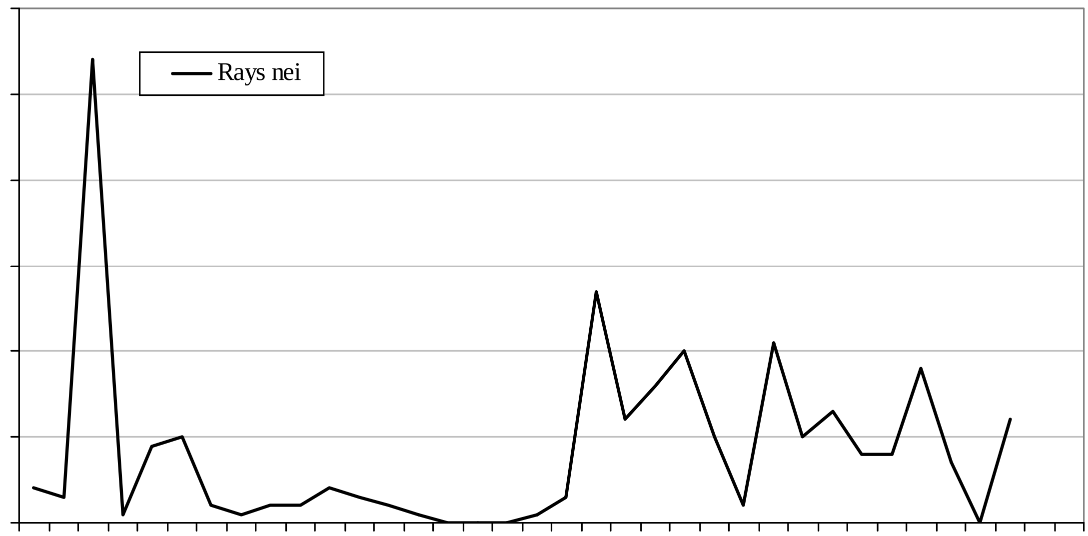


Figure 16.1. Demersal Elasmobranchs at Iceland and east Greenland. WG estimates of the most commonly reported rays and chimeras in Va (upper panel) and in XIV (lower panel), 1973–2007.

17 Demersal elasmobranchs at the Faroe Islands

17.1 Ecoregion and stock boundaries

The elasmobranch fauna off the Faroe Islands (ICES Divisions Vb1, Vb2) 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*, Arctic skate *Amblyraja hyperborea* and starry ray (thorny skate) *Amblyraja radiata.* Demersal sharks include several deep-water species (Leafscale gulper shark *Centrophorus squamosus,* black dogfish *Centroscyllium fabricii,* birdbeak dogfish *Deania calcea*, longnose velvet dogfish *Centroselachus crepidater*, smallmouth velvet dogfish *Scymnodon obscurus*, Greenland shark *Somniosus microcephalus*, mouse catshark *Galeus murinus* and blackmouth catshark *Galeus melastomus;* see Section 5) and spurdog (Section 2). Chimareas also occur in the area: rabbitfish *Chimarea monstrosa*, large-eyed rabbitfish *Hydrolagus mirabilis*, narrownose chimaera *Harriotta raleighana* and spearnose chimaera *Rhinochimaera atlantica*.

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 Islands, 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 2008

France provided catch data from 1983 to 2008 and Table 17.1 and 17.2 have been updated with this 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. 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 (1996–2008) and Russian landings (2004) of *D. batis* 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 above 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.

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 the Faroe Islands is required, including from fishery-independent sources.

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.

Electronic sources:

Faroe Island data downloaded on the 24 June 2009 from http://www.hagstova.fo/portal/page/portal/HAGSTOVAN/Statistics_%20Faroe_Islands

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 Rays in ICES Division Vb1														
Species	Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dipturus batis	Russian Fed.	.	.	.	.	.	.	.	.	35	n/a			
Raja rays nei	Faroe Islands	160	148	121	132	n/a	41	18	55	113	155	129	129	n/a
	Germany1	.	.	.	1	1	.	.	2	1	n/a	1		
	Norway	40	13	22	43	16	15	9	3	.	n/a	9	10	2
Total Vb1		200	161	143	176	17	56	27	60	149	155	139	139	2
WG Estimates of Landings (t) of Rays in ICES Division Vb2														
Raja rays nei	Faroe Islands	5	30	23	43	n/a	35	7	43	159	119	109	56	n/a
	Norway	20	1	23	2	34	6	6	2	.	n/a	1	6	1
Total Vb2		25	31	46	45	34	41	13	45	159	119	110	62	1
WG Estimates of Landings (t) of Rays in ICES Division Vb unspecified														
Dipturus batis	France	2	3	0	4	2	2	2	3	2	1	2	1	0
	Faroe Islands					125								202
Dipturus oxyrinchus	France	0	0	0	0	0	3	0	0	0	0	0	0	0
Raja clavata	France	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucoraja naevus	France	0	0	0	0	0	0	0	0	0	0	0	0	0
Raja montagui	France	0	0	0	0	0	0	0	0	0	0	0	0	0
Dasyatis pastinaca	France	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucoraja circularis	France	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucoraja fullonica	France	0	0	0	0	0	0	0	0	0	0	0	0	0
Rays and skates nei	France	1	2	0	2	0	0	1	5	8	6	20	8	6
	UK	4	11	7	6	35	27	12	8	20	n/a	2	2	0
Total Vb		7	16	7	12	163	32	15	17	31	8	23	12	209
All areas	All	232	208	196	233	214	129	55	122	339	282	272	213	212

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 Vb2														
Species	Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Rabbitfish	Norway	.	.	.	.	.	.	4	.	3	n/a	.	.	.
Total Vb2		0	0	0	0	0	0	4	0	3	0	0	0	0
WG Estimates of Landings (t) of Rabbitfish in ICES Division Vb unspecified														
Rabbitfish	France	0	0	0	3	54	94	45	53	56	57	52	78	54
Rabbitfish	UK	1	.	.	.	.	.	.	1	.	n/a	.	.	.
Total Vb		1	0	0	3	54	94	45	54	56	57	52	78	54
All areas	All	1	0	0	3	54	94	49	54	59	57	52	78	54

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	*	*	**	***	***	***	**

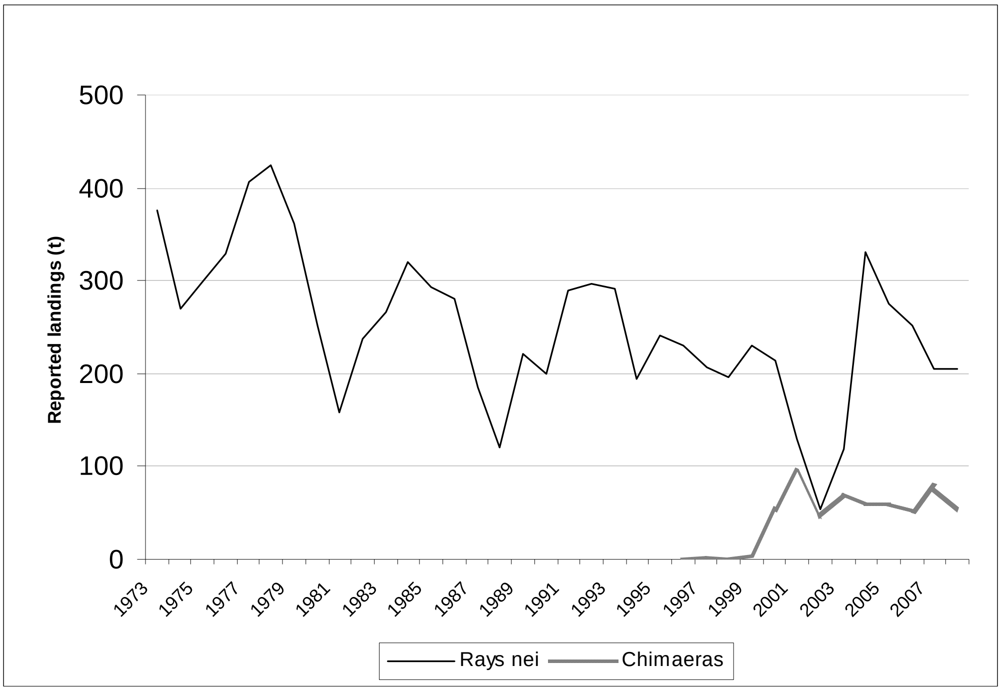


Figure 17.1. Demersal elasmobranchs at the Faroe Islands. Reported landings of skates and rays and rabbitfish from Division Vb based on ICES FISHST and new data from France.

18 Demersal elasmobranchs in the Celtic Seas (ICES Subareas VI and VII (Except Division VIId))

There are no new evaluations of the status of the stocks in this ecoregion. Therefore, this year is an update of landings and some additional survey data. For a complete report on these stocks see ICES, 2007.

18.1 Ecoregion 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 NE 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* 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 demersal 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 small-eyed 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. A recent tagging study demonstrated that common skate, *Dipturus batis*, move into shallow water in summer and autumn (Thorborn, 2008).

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, R. 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, the latter being the most abundant. *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. 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. 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, while *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, including blonde ray, in the Bristol Channel (VIIf) at some times of year.

Most coastal dogfishes (e.g. tope, smooth-hounds and catsharks) are taken as a by-catch in various trawl and gillnet fisheries (see above). As a consequence of 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.

There is also a large recreational fishery for skates, rays and dogfishes, particularly for those species close to shore, with some ports having locally important charter boat fisheries.

18.2.2 The fishery in 2008

Landings tables for the relevant species are provided in Tables 18.1–18.6.

There is no other new information specifically relating to elasmobranchs. Changes in fishing patterns in these areas are summarized by the ICES Working Group for the Celtic Seas Ecoregion (WGCSE) and ICES, 2008b.

18.2.3 ICES advice applicable

ICES provided advice for stocks in this region for the first time in 2008. The advice was divided into the following sections:

No fisheries

Species where indicators demonstrate extirpation

White skate - Has a localized and patchy distribution, and is extirpated from most parts of the Celtic Seas ecoregion. It should receive the highest possible protection. Any incidental bycatch should not be landed, but returned, to the sea, as they are likely to have a high survival rate.

Angel shark - Has a localized and patchy distribution, and is extirpated from parts of its former range. It should receive the highest possible protection. Any incidental bycatch should not be landed, but returned, to the sea, as they are likely to have a high survival rate.

No target fisheries

Species where indicators demonstrate depletion (or may be susceptible to local depletion)

Common skate - has declined in many inshore areas of England and Wales, although is still present in the inshore areas of Scotland and Ireland. Target fisheries for this species should not be permitted and measures should be taken to minimize bycatch.

Undulate ray - Has a patchy distribution, with some of these areas demonstrating signs of depletion. As a precautionary measure, target fisheries for this species should not be permitted unless exploitation rates are demonstrated to be sustainable.

Status quo catch

Species where indicators demonstrate recent stability or increase

Thornback ray, spotted ray in VIa and VIIa,f,g. and cuckoo ray in VIa.

Small-eyed ray in VIIf has a restricted distribution and is locally abundant in the Bristol Channel; this stock should be monitored to ensure that it does not decline.

Lesser spotted dogfish - The current exploitation rates appear to be sustainable. As there are no apparent detrimental impacts on the stock from current commercial fisheries, no management actions are required for this species at this time.

Greater spotted dogfish - Has a restricted distribution and is locally abundant in parts of the Celtic Seas ecoregion, and should be monitored appropriately.

Smooth hounds have a relatively higher productivity than similar elasmobranchs and can probably sustain fisheries. Management measures should prevent overexploitation. Fisheries should only expand when accompanying measures lead to improved data collection and biological studies to ensure its sustainable harvest.

No advice was provided for species where indicators were unknown, i.e. Cuckoo ray in VII, blonde ray, sandy ray and shagreen ray.

18.2.4 Management applicable

There was no TAC in this area in 2008. A TAC for skates and rays of 15 748 t for VI and VIIa–c, e–k is in place for 2009. This does not apply to undulate ray (*Raja undulata*), common skate (*Dipturus batis*), Norwegian skate (*Dipturus nidarosiensis*) and white skate (*Rostroraja alba*), each of which must be immediately released unharmed where applicable. Fishers shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species. It is forbidden to retain angel shark.

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.

The European Commission published an action plan for the conservation and management of sharks in February, 2009. This intends, among other aims, to ensure that directed fisheries for sharks are sustainable and that bycatches of sharks resulting from other fisheries are sustainable (EC, 2009). This will affect the way the fisheries in this ecoregion operate in future.

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 for several years now. The North Devon Fishery has also recently introduced a voluntary minimum landing size of 38 cm (disc width = wingtip to wingtip) for rays. Within the Bristol Channel, Belgian beam trawlers are also observing the minimum landing size on a voluntary basis (Anon, 2009).

A new management plan for targeted skate fisheries is currently being prepared for the Irish South and East Fishermen's Association. This will be a partnership between fishermen and state agencies. It is expected that the management plan will use indicators such as changes in maximum length to monitor and conserve skate stocks in the southern Irish Sea. It is intended to apply to both otter and beam trawlers. Accurate identification of species and the appropriate species-specific declarations will be encouraged as part of the implementation of the plan. This plan will be operational before winter 2009.

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.

Dipturus batis and *Squatina squatina* were removed from the Irish Specimen Fish List in 1975 and 2005 respectively, to prevent targeted fishing by recreational fishers.

In 2008 angel shark was added to the Wildlife and Countryside act in the United Kingdom, and is protected under legislation in inshore waters (within 6 nm of the coast).

18.3 Catch data

18.3.1 Landings

Landings data are incomplete for 2008 as not every country was able to provide national data by the time of the WGEF meeting. All data must be treated as provisional, even for those countries that provided data.

Landings tables for skates (Rajidae) by country are provided in Tables 18.1a–h. Landings for the entire dataseries available are shown in Figure 18.1(a–c). Landings by area within 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.

Landings appear as a series of 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. Landings have fluctuated considerably over the time-series, with a considerable decline in 2004 and 2005. In 2008, landings dropped below 10 000 t for the first time.

West of Scotland (VIa)

Reported landings in this Division are at their lowest point since 1973, with almost all countries declaring less than previous landings. Average landings of around 3000 t in the early 1990s are now down to less than 1000 t.

Rockall (VIb)

Reported landings of skates from Rockall have usually been less than 1000 t per year, but are now down to just over 100 t per year. Increased landings in the mid 1990s are as a result 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). One to three Russian longlining vessels fished in this area in 2008, mainly catching deep-water species, including sharks, but also catching 7 t of deep-water skate species.

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 of just over 1000 t per year, the lowest in the time-series. This may be as a result of effort changes because of the cod recovery programme in the area, where whitefish boats are switching to *Nephrops* fishing, which is thought to have a lower bycatch of skates. Most landings are from Ireland and the UK (England and Wales).

Bristol Channel (VIIf)

Reported landings from Division VIIf have been at low for four years now. Only three countries (UK (England and Wales), France and Belgium) land significant numbers of skates from this Division, with annual landings normally between 1100–1600 t. Landings appear to have stabilized around 1200 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. Landings in 2008 are the lowest in the time-series. The highest landings have consistently occurred in the southern parts of this region (Divisions VIIe,g,h), but landings from here have declined each year for the last seven years and are now also at the lowest level in the time-series. Most skates are landed under generic landing categories, although France, Spain (Basque Country) and Belgium provide some species-specific landings data (Tables 18.2–18.5). These data suggest that the four major commercial species in French fisheries (Table 18.3) 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* (See Section 18.3.3). The importance of *R. clavata* and *L. naevus* is also apparent in Spanish (Basque country) and Belgian landings data (Tables 18.4–18.5).

Although 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 18.6a 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. As a consequence of 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 18.6b). It is believed that the peak in UK landings in 1997 from VIIj–k (Figure 18.3) were misreported anglerfish (also called monkfish), as *S. squatina* is more of a coastal species. These figures have been removed from the landings data. French landings have declined from >20 t in 1978 to less than 1 t per year.

18.3.2 Discards

No new discard information was presented to 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. While 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 have traditionally been landed by grade (size) in mixed boxes, there was little size selection between different species. An exception was 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 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 in order to examine survival rates for other elasmobranch species.

18.3.3 Quality of catch data

Until 2009, there was no quota for “skates and rays” in this region. This meant that there was a strong incentive for fishers to log quota species as “skates and rays”, possibly leading to overestimation of catch quantities. Misreporting of quota species as elasmobranchs is known to have occurred, such as where anglerfish and hake are reported as “skates and rays” or under generic landings categories for dogfishes, although the extent of this problem is unknown. There is a quota in place for 2009. Misreporting by species and underreporting, however, is likely to have reduced substantially since the introduction of buyers and sellers legislation in the UK and Ireland in 2006.

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 have not always been required to carry a logbook, so inshore catches of skates may be underrepresented in official landing statistics. This may be important in areas where there may be locally abundant species that are otherwise rare.

Landings by each country have been analysed to determine the percentage landings of each country that are declared in species-specific categories (Table 18.2). From these figures it can be seen that there are large variations in species-specific landings, both within countries and between countries. In Area VII, France declared 90% of its landings in Area VI to species level, although the figure for Area VII was only 62%. In either case, the percent of landings declared to this level are higher than Ireland, which declared <1% of its landings to species level. The Irish data appear to indicate that only those catches that contain unusual species are declared separately, whereas all other species are declared in generic categories.

The UK (E&W) catch records indicate a species-level declaration of 42%. This is of a similar level to their species level declarations of 50% in the North Sea. It has been a legal requirement to declare to species level in the North Sea since 2008, but in other regions only since 2009, so a 40% level before this became a requirement is considered to be encouraging.

The declaration of skates to species level, which has already begun, and should increase, must also be applied to other elasmobranch species. Categories such as "Sharks" are still used by countries (E.g. UK (Scotland), 45 tonnes in 2008), and it is impossible to separate these into constituent species or species-complexes.

Although France has declared a large proportion of its catches to species level, close examination of the data indicates another problem, in that there are no declarations of blonde ray, *Raja brachyura*. This species is known to be relatively common in this area, and should appear in the catch records. Hence it is most likely that *R. brachyura* and *R. montagui* are landed together. This will probably occur in other fleets as well.

The difficulty in species identification has been well documented (ICES 2007a), 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 since the DELASS project has some recent information on species composition become 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 18.2–18.5.

No new fisheries-dependent information on species composition was provided, other than official landing statistics. 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; Fahy and O'Reilly, 1990; Gallagher *et al.*, 2005a).

18.4.2 Size composition

Only limited market sampling data are available for these species. While 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 were provided in ICES 2007a.

Figure 18.4a presents the length frequencies series from 1985 to 2009 (two first quarters of the year for 2009) by sex of *Leucoraja naevus* caught in Divisions VIIh and VIIIa by the French demersal trawl fisheries. It demonstrates a negatively skewed distribution during the most recent period (2004–2009) for both sexes. The positions of these catches, by gear, are illustrated in Figure 18.4b.

The Data Collection Framework (DCF) requires concurrent sampling to take place within defined métiers. It is expected that this will lead to an increase in market sampling of elasmobranchs.

In the framework of the DCF, the National "Observer programme at sea"; ObsMER Programme started to sample sharks and rays bycatch caught by the domestic fisheries since 2003. Length frequency distributions for lesser-spotted dogfish and for cuckoo ray *Leucoraja naevus* sampled in Divisions VIIg–h–j are presented in Figure 18.5.

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. While 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 national 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 WGEF.

18.5 Catch per unit of effort

18.5.1 Commercial cpue

There are no new commercial cpue data available. A decline in lpue by the French fleet in VIIg–j for *Leucoraja naevus* was noted by ICES, 2008a.

Preliminary analyses of skate cpue from the Irish otter trawl fishery in VIIa were examined by the WGEF in 2008. 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 (ICES, 2008a).

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 18.6) from southwest Ireland demonstrate that catches of *R. undulata*, a species that forms a discrete 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 1980s. 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 Q4 Southern and Western International Bottom Trawl Surveys (SWIBTS)

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 18.7). 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 18.8). 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. 26 species of elasmobranchs have been recorded in the Bay of Biscay and 19 species in the Celtic Sea (see Mahé and Poulard, 2005).

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 18.9–18.11), 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.

18.6.1.3 Other surveys

UK (NI): An annual Q1 and Q4 trawl survey of the Irish Sea is has been undertaken since 1992. The gear deployed is a commercial Rockhopper trawl fitted with a 20 mm liner in the codend and is towed for a set time period, (either 20 minutes or 1 hour) to allow comparison between tows and years. As the survey was originally targeted at juvenile gadoids, it does not extend into the deeper water of the North Channel or into soft muddy sediments in water deeper than 100 m between the Irish Coast and the Isle of Man. A stratified survey design with fixed station positions is employed with the survey area divided into nine strata defined by depth and substratum. The species composition of the catch at each station is determined, and biological information recorded for each abundant species. Gear, towing and sampling procedures are standardized for the complete time-series. This survey is now coordinating with the southern and western IBTS (ICES, 2007b, 2009).

UK (England and Wales): A Q1 survey with Portuguese High Headline Trawl (PHHT) was undertaken in the Celtic Sea (ICES Division VIIe–j) 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. In 2008 AFBI (NI) analysed available survey data from the VIIa (N) region and produced a series of distribution maps for the most abundant species of elasmobranch (Figure 18.12). The survey time-series highlighted seasonal variations in abundance of a number of species in the region, in particular the demersal shark species (Figure 18.13a), which demonstrated marked increases in catch rates in Q4 compared with Q1. This effect was not as pronounced for ray species (Figure 18.13b). To investigate the location of potential nursery grounds in the area an index based on the ratio of average weight (Kg)/average abundance (No./hr) was plotted (Figure 18.14) (NIEA, 2008).

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 to 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 18.15–18.17, demonstrating 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 downwards. There were peaks in catch rates in the late 1980s 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 demonstrate slightly different patterns of abundance for this species. The Spanish survey in the Porcupine Bank demonstrates a peak in abundance in 2003 (Figure 18.15a), 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. This survey demonstrates that there is a decreasing trend in mean length of this species in the Bay of Biscay, but this is not demonstrated in catches from the Celtic Seas (*ibid*).

Leucoraja circularis: Only the Spanish Porcupine Bank survey covers part of this species' main area of distribution and caught this species in any quantity (Figure 18.16a–c). This species is taken only infrequently in other surveys. Survey catches in 2007 were the highest since 2003, after three years of low, but stable catches. (Figure 18.16a). Peak catches were in 2003.

Leucoraja fullonica: Only the UK PHHT Q1 survey seemed to demonstrate this species regularly, although in small numbers. There were 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. The new UK SWIBTS in this area has only caught a few individuals of this species.

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 18.17a–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 18.17a) does not demonstrate a significant increase until 2003.

The UK survey in the Celtic Sea demonstrated 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 (ICES 2007a).

18.6.4 Size composition of demersal elasmobranchs

New length frequency information for *L. naevus*, *L. circularis* and *S. canicula* (Figure 18.15d, 18.16d, 18.18) 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 to 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

Warning in relation to gear performance in Spanish Porcupine 2008 survey: In spite of using the same gear design as in previous years, in 2008 survey there were differences in the mean vertical and door spread of the gear during the survey, that decreased from 2.96 m in 2008 to 2.50 ± 0.07 m for the vertical opening and increased from 131.7 m to 147.2 ± 4.7 m for the door spread. The differences with previous years were not solved despite two gear changes and modifications in the doors rigging. These changes occurred together with a longer mean time to make ground contact, produced a decrease in the abundance indices of several species. It has not been possible to evaluate the effects of the gear behaviour for all species, although it did not affect significantly the number of fish species caught: 103 fish species in 2008 compared with 97.4 fish species as a mean in the last five years. Data from this survey has been used to examine the status of *Leucoraja naevus* and *Leucoraja circularis* in this ecoregion.

The genus *Mustelus* is a problematic taxon, and it is likely that there is some confusion between *M. asterias* and *M. mustelus* in all surveys. Hence, analyses for these species should use aggregated data for the two species. *Mustelus* spp. Tope may also be misidentified as smooth hounds.

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 18.8.

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 2009.

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 was 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 18.19a 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 18.19b. The year effect estimated by the model demonstrates some fluctuations over the 20-year time 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 18.19c). The highest catch rates are estimated to come from statistical rectangles to the south and north of the Hebrides.

Scyliorhinus canicula: Figure 18.19d 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 18.20a shows the estimated effects from the fitted statistical models. The model estimates that there has been a significant increase in catch rate (N/hr) 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 18.20b. 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 18.20c 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 18.20d. 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)

Dipturus batis: Local populations still exist.

Leucoraja fullonica: Status unclear. Infrequent 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 brachyura: Status uncertain.

Raja clavata: Status uncertain, although catch rates seem to be stable/increasing in surveys.

Raja montagui: Survey catches are stable/increasing.

Scyliorhinus canicula: Survey catches are stable/increasing.

Scyliorhinus stellaris: No information.

Mustelus spp. No information.

Raja microocellata and *Raja undulata* are vagrants in this area.

Rockall (VIb)

There is not enough information to assess the status of any species in this area.

Irish Sea (VIIa)

Dipturus 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 deep waters outside Belfast Lough), although there is no evidence to suggest that *D. batis* has reappeared elsewhere in VIIa.

Leucoraja fullonica: Very infrequent in this division.

Leucoraja naevus: Uncertain, with the different surveys giving contrasting signals. There is a slight downward trend in survey catch rates. Better delineation of the stock structure is required to aid in the interpretation of these survey indices.

Raja brachyura: Uncertain. No trends are apparent from surveys. There has been an increase in occurrence in catches from NI GFS in the latter part of survey (1999 onwards). Most survey catches are from the eastern Irish Sea. There are misidentification issues with this species.

Raja clavata: Uncertain, although catch rates seem to be stable/increasing in surveys.

Raja microocellata: Occasional vagrants, presumably from the VIIf,g stock.

Raja montagui: Survey catches are stable/increasing. There are misidentification issues with this species in the commercial catch.

Raja undulata: Records of this species need to be confirmed.

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 NI GFS catches demonstrate increasing trend in most recent years. The problems of identification of species within this genus, makes species-specific assessments very difficult.

Bristol Channel (VIIf)

Dipturus batis: Unknown, but numbers are likely to be low.

Leucoraja fullonica: Occasional vagrants in this area only.

Leucoraja naevus: Very small numbers taken in the outer Bristol Channel. More common in VIIe,g,h.

Raja brachyura: Uncertain. No trends are apparent from surveys. There are likely to be misidentification issues with this species in commercial catches.

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. This is one of the main stock areas for this species.

Raja montagui: Survey catches seem to be stable/increasing. There are likely to be misidentification issues with this species in commercial catches.

Raja undulata: No recent verified records. The northern limit may be VIIe.

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)

Dipturus batis: Regularly encountered in further offshore areas, but survey information is limited.

Leucoraja fullonica: Uncertain. There is a poor signal from 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 brachyura: Status uncertain.

Raja clavata: Uncertain, although catch rates seem to be stable/increasing in surveys.

Raja microocellata: Patchy distribution. May be locally abundant in parts of VIIe. Larger individuals occur in the deeper waters of VIIg and VIIh.

Raja montagui: Survey catches are stable/increasing.

Raja undulata: Patchy distribution. More frequently encountered in the southern part of VIIe and in the inshore waters of VIIj.

Leucoraja circularis: Uncertain. Survey catches (in VIIc) appear stable, but only a short time-series is available.

Scyliorhinus canicula: Survey catches are stable/increasing.

Scyliorhinus stellaris: Occurs in shallow, rocky waters and are only infrequently encountered in surveys.

Mustelus spp.: Uncertain. Survey catches in the PHHT (1988–2005) 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 evaluations of stock status were carried out in 2009. Data are insufficient for a full stock assessment. Species-specific catch data are not fully 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 time periods. It is hoped that better species-specific data will become the norm as fishers continue to improve compliance with existing regulations and guidelines.

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 to 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

In 2008 there were no TACs for any of the relevant species in this region.

Technical interactions for fisheries in this ecoregion are revealed in Table 18.9.

It has been difficult for WGEF to deal with elasmobranchs in this region adequately. This is as a result 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*, smooth hounds *Mustelus* spp. and spotted ray *Raja montagui* in this ecoregion appear to be stable/increasing.

Council Regulation (EC) No 43/2009 of 16 January 2009 banned the retention on board of three species of skate and this has been a controversial issue for some countries. In this sense, the French fisheries Ministry has asked for explanations regarding the implementation of this measure, with regards *Raja undulata*, and the fishing industry asked this measure to be reconsidered and other scientific studies to be conducted in order to assess the English Channel and Bay of Biscay stock(s). *Raja undulata* is known to have a patchy distribution, and there are insufficient fishery-independent survey data to determine its status in VIIe, although it may be locally abundant in parts of the Normano-Breton Gulf. The Celtic Seas ecoregion is also near the northern limits of the biogeographical range of this species.

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 Douarnenez (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 (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, the ban on retaining this species will hopefully benefit their stock(s).

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.

18.12 References

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Table 18.1. 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

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Belgium	13	10	3	4	.	.	.	2	1	2	.	.	2	1	3	2	3	.
Denmark	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.
Faeroe Islands	107	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
France	736	907	777	918	653	839	730	583	2318	741	885	955	996	645	727	766	724	711
Germany	.	1	.	.	1	2	1	.	.	.	.	.	1	.	.	.	.	.
Ireland	281	336	458	425	342	242	268	343	474	537	806	836	574	440	367	690	630	150
Netherlands	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norway	116	105	70	77	96	226	81	253	119	146	217	99	67	44	93	144	264	71
Poland	64	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	.	.	.	.	.	.	.	.	.	19	11	8	4	12	14	8	.	.
UK - (E,W&N.I.)	264	266	264	334	338	292	209	89	93	99	104	141	47	47	54	87	67	57
UK – Scotland	1302	1142	1393	1792	1724	1660	1540	1577	1496	1617	1818	2016	2034	1802	2111	2137	2499	2007
Total	2883	2767	2965	3551	3154	3261	2829	2847	4501	3161	3841	4055	3726	2991	3370	3834	4187	2996

Table 18.1a Cont. Total landings (t) of *Rajidae* in Area VIa

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	2	.	1	2	7	1	2	2	4	2	4	2	8	9	4	4	0	0
Denmark	+	+	+	+	+	+	.	+	+	.	.	.	.	.	0			
Faeroe Islands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	na			
France	621	603	606	437	553	526	384	333	0	321	278	212	183	149	181	174	194	245
Germany	.	.	.	2	.	1	4	16	7	1	1	.	3	0	.	0		
Ireland	200	350	331	265	504	681	596	488	388	274	238	311	364	363	186	176	119	109
Netherlands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0		
Norway	38	82	56	9	74	29	20	50	29	49	20	25	2	2	10	4	5	11
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0		
Spain	43	.	.	.	.	47	58	69	34	2	.	9	27	14	14	0	0	4
UK - (E,W&N.I.)	77	72	70	101	138	101	69	157	67	108	65	114	159	66	26	18	5	1
UK – Scotland	2026	1605	1419	1429	1980	2606	1879	1460	1324	1316	1263	1136	1307	1012	623	369	444	303
Total	3007	2712	2483	2245	3256	3992	3012	2575	1853	2073	1869	1809	2053	1488	1043	744	767	673

Table 18.1b Total Landings (t) of *Rajidae* in Area VIb

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Estonia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Faeroe Islands	2	95	43	43	24	15	61	44	.	23	22	18	2	6	.	.	.	.
France	125	423	39	44	10	20	1	0	4	8	10	6	6	4	1	2	0	3
Germany	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
Ireland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norway	.	22	123	45	60	145	217	222	117	147	332	364	164	231	200	132	279	203
Portugal	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Russian Federation	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	.	.	.	.	.	.	.	.	63	.	.	12	8	48	41	36	.	.
UK - (E,W&N.I.)	11	.	.	39	62	36	56	.	4	.	8	4	18	15	12	7	4	4
UK – Scotland	562	166	307	77	160	189	152	181	152	44	9	15	58	38	59	72	70	76
Total	700	706	512	248	316	405	487	447	340	222	381	419	256	342	313	250	354	286

Table 18.1b Cont. Total Landings (t) of *Rajidae* in Area VIb

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Estonia	.	.	.	.	.	.	.	.	.	.	56	1	.	.	.			
Faeroe Islands	.	.	.	.	.	.	.	.	.	.	.	.	.	na	na			
France	13	0	4	0	0	0	0	0	0	7	5	5	2	6	15	0	17	17
Germany	.	.	6	25	17	49	26	36	67	76	8	1	6	22.3	22	6	0	
Ireland	.	.	24	23	60	68	23	15	28	20	10	1	18	7.28	9	24	14	15
Norway	248	234	170	272	176	95	101	98	59	120	80	44	61	45.95	39	82	81	66
Portugal	.	.	.	.	56	.	25	26	24	29	17	31	18	na	0	0		
Russian Federation	.	.	.	.	.	.	.	.	.	5	8	.	.	na	na			7
Spain	14	.	.	.	.	328	410	483	322	347	158	36	46	0.5	0	0	0	0
UK - (E,W&N.I.)	11	12	21	28	73	175	105	134	147	156	120	92	47	47.8	20	20	9	0
UK – Scotland	67	57	70	98	97	83	91	101	123	204	97	79	146	164	59	51	46	32
Total	353	303	295	446	479	798	781	893	770	964	559	290	344	294	164	183	167	137

Table 18.1c **Total landings (t) of *Rajidae* in area VIIa**

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Belgium	296	365	278	195	236	212	177	151	206	230	233	246	372	425	545	390	271	298
France	1516	426	337	491	827	967	560	593	1985	617	440	788	1194	1578	1318	1009	641	712
Ireland	822	916	838	936	858	796	813	725	851	803	781	1067	1946	1416	1644	1911	1808	1811
Netherlands	1	1	3	1	1	.	1	+	+	+	+	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
UK - (E,W&N.I.)	1564	1533	1430	1163	1130	906	1045	1202	1113	1307	1133	1126	1103	976	1503	1435	1373	1378
UK (Scotland)	62	69	53	39	47	52	58	132	82	89	87	192	219	224	321	210	171	227
Total	4265	3310	2939	2825	3099	2933	2654	2803	4237	3046	2674	3419	4834	4619	5331	4955	4264	4426

Table 18.1c Cont. **Total landings (t) of *Rajidae* in area VIIa**

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	209	230	107	224	218	265	298	398	542	504	724	997	830	860	860	593	680	274
France	890	642	550	330	293	282	151	285	n.s.	163	343	349	322	183	192	114	51	14
Ireland	1400	1301	679	514	438	438	593	692	827	759	807	1032	1086	825	786	645	721	515
Netherlands	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	4	4	6	+	+	+	+	.	0		
Norway	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	0	0
Spain																		4
UK - (E,W&N.I.)	1226	1150	1003	748	606	789	824	1009	936	671	983	863	1184	533	1252	271	260	243
UK (Scotland)	163	107	96	86	42	55	80	52	33	86	80	68	67	38	30	65	28	1
Total	3888	3430	2435	1902	1597	1829	1946	2440	2342	2189	2937	3309	3489	2256	3120	1689	1740	1050

Table 18.1d **Total landings (t) of Rajidae in area VIIf**

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Belgium	182	273	280	184	106	75	127	189	167	130	139	98	177	209	129	172	268	135
Denmark	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
France	.	242	426	569	720	680	873	896	856	837	648	377	306	330	247	464	366	326
Germany	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ireland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Netherlands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norway	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain (b)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
UK - (E,W&N.I.)	504	401	468	437	452	436	444	494	508	529	480	558	648	697	784	761	710	666
UK (Scotland)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	686	916	1174	1190	1278	1191	1444	1579	1531	1496	1267	1033	1131	1236	1160	1397	1344	1127

Table 18.1d Cont. **Total landings (t) of Rajidae in area VIIf**

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	155	128	96	117	108	89	116	121	103	90	91	117	134	210	208	138	206	168
Denmark	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.			
France	607	663	565	468	394	432	485	464	453	538	642	526	536	478	429	305	424	399
Germany	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0		
Ireland	.	.	.	.	.	.	.	1	.	.	.	1	1	15	8	6	2	4
Netherlands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0		
Norway	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	0
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Spain (b)	.	.	.	.	.	8	10	12	1	.	3	.	.	.	.	0	0	0
UK - (E,W&N.I.)	627	705	638	630	589	676	664	624	560	613	691	920	766	609	631	653	620	639
UK (Scotland)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		0	0
Total	1389	1497	1299	1215	1091	1205	1275	1222	1117	1241	1427	1564	1437	1312	1276	1101	1252	1209

Table 18.1e **Total landings (t) of Rajidae in area VIIegh**

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Belgium	259	238	209	529	308	208	206	254	318	271	182	215	211	311	224	227	355	242
Denmark	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	1
France	5729	4095	6901	6602	6189	6095	6519	6796	7647	6765	7323	6561	6890	7771	7693	7986	7566	7734
Germany	18	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ireland	147	158	148	241	158	143	218	399	380	291	236	303	286	251	296	315	57	100
Netherlands	.	.	1	7	13	6	.	.	.	.	2	na	na	na	na	na	na	na
Norway	.	.	.	.	.	.	.	.	.	.	12	.	.	25	.	.	12	5
Poland	24	28	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain (b)	.	.	.	.	.	45	0	0	77	30	29	24	2	62	75	49	.	.
UK - (E,W&N.I.)	432	466	572	556	566	615	564	528	606	637	700	832	936	939	1061	1307	865	1211
UK (Scotland)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	6609	4985	7831	7935	7234	7112	7507	7977	9028	7994	8484	7935	8325	9359	9349	9885	8857	9293

Table 18.1e Cont. **Total landings (t) of Rajidae in area VIIegh**

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	97	183	209	172	203	177	293	260	240	223	248	347	576	407	432	582	569	632
Denmark	.	1	+	0	+	.	.	.	.	.	.	.	.	.	.			
France	7077	6477	5873	5836	6029	6425	7093	6114	6098	5710	5603	5273	5588	4261	4517	3740	3741	3302
Germany	.	.	.	.	.	.	.	.	.	.	.	+	.	3	.			
Ireland	68	.	120	106	162	349	479	446	408	203	481	729	838	844	334	315	285	214
Netherlands	na	na	na	na	na	na	na	9	na	7	7	11	.	.	.	1		
Norway	.	.	.	.	.	.	.	.	.	.	11	.	.	.	.	0	0	0
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Spain (b)	21	.	.	.	.	312	932	1178	2647	1706	1142	653	31	15	9	1	1	3
UK - (E,W&N.I.)	638	751	735	869	997	953	1098	1167	796	932	880	775	804	811	1024	727	730	667
UK (Scotland)	.	.	1	.	.	.	2	.	2	.	2	.	.	149	3	1	13	1
Total	7901	7412	6938	6983	7391	8216	9897	9173	10191	8781	8374	7788	7837	6490	6318	5366	5339	4820

Table 18.1f **Total landings (t) of *Rajidae* in area VIIbcjk**

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Belgium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	907	725	292	480	239	219	188	340	1120	203	169	198	344	346	456	462	427	781
Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	266	321	314	320	265	268	239	269	336	271	325	296	220	226	419	332	633	350
Spain (b)	0	0	0	0	0	3	0	0	47	33	24	31	1	53	64	41	0	0
UK - (E,W&N.I.)	1	+	+	0	+	0	0	+	0	+	0	4	1	3	27	28	25	5
UK (Scotland)	0	0	0	0	0	1		1	0	0	0	1	+	1	+	1	13	14
Total	1174	1046	606	800	504	491	427	610	1503	507	518	530	566	629	966	864	1098	1150

Table 18.1f Cont **Total landings (t) of *Rajidae* in area VIIbcjk**

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	0	0	0	0	0	0	0	0	24	5	0	5	1	na	0	0	0	0
France	541	546	298	224	297	375	599	500	ns	568	362	272	192	101	257	255	391	421
Germany	0	0	7	18	3	4	9	17	10	21	7	+	3	15	17	0		
Ireland	400	619	602	625	735	757	811	741	740	653	383	354	435	511	465	473	417	384
Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	4	0
Spain (b)	124	0	0	0	0	1341	1676	1978	2419	2573	1205	2939	1281	7	16	19	11	1
UK - (E,W&N.I.)	53	71	88	201	361	469	468	376	352	597	545	373	350	364	269	176	172	83
UK (Scotland)	15	10	34	43	73	58	36	67	121	189	162	124	226	70	58	77	45	66
Total	1133	1246	1029	1111	1469	3004	3599	3679	3642	4601	2664	4062	2487	968	1081	1016	1040	954

Table 18.1g **Total landings (t) of *Rajidae* in area VII (unspecified)**

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Spain																		643
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	643

Table 18.1h **Total landings (t) of *Rajidae* the Celtic Seas**

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Belgium	750	886	770	912	650	495	510	596	692	633	554	559	762	946	901	791	897	675
Denmark	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2	1
Estonia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Faeroe Islands	109	95	43	43	24	15	61	44	.	23	22	18	3	6	.	.	.	.
France	9013	6818	8772	9104	8638	8820	8871	9208	13930	9171	9475	8885	9736	10674	10442	10689	9724	10267
Germany	18	1	.	.	1	2	1	.	.	.	.	.	1	.	.	1	1	0
Ireland	1516	1731	1758	1922	1623	1449	1538	1736	2041	1902	2148	2502	3026	2333	2726	3248	3128	2411
Netherlands	1	1	4	9	14	6	1	+	+	+	2	na	na	na	na	na	na	na
Norway	120	127	193	122	156	371	298	475	236	293	561	463	231	300	293	276	555	279
Poland	88	28	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Portugal	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Russian Federation	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	.	.	.	.	.	48	0	0	187	82	64	75	15	175	194	134	0	0
UK - (E,W&N.I.)	2776	2666	2734	2529	2548	2285	2318	2313	2324	2572	2425	2665	2753	2677	3441	3625	3044	3321
UK – Scotland	1926	1377	1753	1908	1931	1902	1750	1891	1730	1750	1914	2224	2311	2065	2491	2420	2753	2324
Total	16317	13730	16027	16549	15585	15393	15348	16263	21140	16426	17165	17391	18838	19176	20489	21185	20104	19278

Table 18.1h Cont **Total landings (t) of *Rajidae* in the Celtic Seas**

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	463	541	413	515	536	532	709	781	913	824	1067	1467	1549	1485	1503	1316	1455	1074
Denmark	.	2	+	.	+	.	.	.	.	.	.	.	.	.	0	0	0	0
Estonia	.	.	.	.	.	.	.	.	.	.	56	1	.	.	.	0	0	0
Faeroe Islands	.	.	.	.	.	.	.	.	.	.	.	.	.	.	na	0	0	0
France	9749	8931	7896	7295	7566	8040	8712	7696	6551	7307	7233	6637	6823	5178	5591	4587	4818	4398
Germany	0	0	13	45	20	54	39	69	84	98	16	2	12	40	39	7	0	0
Ireland	2068	2270	1756	1533	1898	2294	2502	2382	2390	1909	1919	2428	2742	2565	1787	1640	1558	1240
Netherlands	na	na	na	na	na	na	na	13	4	13	7	11	na	na	0	1	0	0
Norway	286	316	226	281	250	124	121	148	88	169	111	69	63	48	49	101	90	77
Poland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	0
Portugal	.	.	.	.	56	.	25	26	24	29	17	31	18	na	0	0	0	0
Russian Federation	.	.	.	.	.	.	.	.	.	5	8	.	.	na	na	0	0	7
Spain	202	0	0	0	0	2036	3086	3720	5423	4628	2508	3637	1385	37	39	20	12	655
UK - (E,W&N.I.)	2632	2761	2555	2577	2764	3163	3228	3467	2858	3077	3283	3137	3310	2431	3222	1865	1796	1633
UK – Scotland	2271	1779	1620	1656	2192	2802	2088	1680	1603	1795	1604	1407	1746	1433	773	562	576	403
Total	17671	16600	14479	13902	15282	19044	20510	19981	19938	19854	17830	18828	17648	13217	13004	10099	10305	9487

Table 18.2 Demersal elasmobranchs in the Celtic Seas. Species-specific landings.

Generic categories are in italics.

Area VI	Species Categories	Weights (tonnes)	% of national catch	% excluding generic categories
France				
	Blue skate	26.7	10.2%	11%
	Longnosed skate	80.6	30.8%	34%
	Thornback ray	72.6	27.8%	31%
	Cuckoo ray	46.2	17.7%	20%
	Spotted ray	0.4	0.1%	0%
	Common Stingray	0.2	0.1%	0%
	Sandy ray	2.1	0.8%	1%
	Shagreen ray	7.0	2.7%	3%
	Rays and skates	25.7	9.8%	
	Total:	261.6	100%	
Percent of catch as species specific landings:		90.2%		
Ireland				
	Rays nei	111.6		
	Rays, Stingrays, Mantas nei	12.1		
	Skates and Rays nei	0.1		
	Total:	123.7		
Percent of catch as species specific landings:		0%		
UK (E,W & NI)				
	Skate (indet.)	1.5		
UK (Scotland)				
	Skate (Norwegian)	1.3		
	Skates & Rays	301.7	99.6%	
	Total:	303.0		
Percent of catch as species specific landings:		0.4%		

Area VII (excluding VIId)	Species Categories	Weights (tonnes)	% of national catch	% excluding generic categories
Belgium				
	Blonde ray	176.6	16%	27%
	Common skate	0.1	0%	0%
	Cuckoo ray	73.3	7%	11%
	Spotted ray	78.9	7%	12%
	Starry ray	1.3	0%	0%
	Thornback ray	333.3	31%	50%
	Raja species	410.2	38%	
	Total:	1073.8	100.0%	
Percent of catch as species specific landings:		62%		
France				
	Angelshark	0.227	0.0%	0%
	Marbled electric ray	0.025	0.0%	0%
	Blue skate	241.78	5.8%	9%
	Longnosed skate	23.903	0.6%	1%
	Thornback ray	249.07	6.0%	10%
	Cuckoo ray	1248.8	30.2%	49%
	Spotted ray	612.3	14.8%	24%
	Common Stingray	1.849	0.0%	0%
	White skate	0.241	0.0%	0%
	Sandy ray	171.146	4.1%	7%
	Shagreen ray	16.575	0.4%	1%
	Small-eyed ray	7.5	0.2%	0%
	Raja rays	37.799	0.9%	
	Rays and skates	1524.66	36.9%	
	Sharks, rays, skates, etc.	0.144	0.0%	
	Total:	4136.019	100.0%	
Percent of catch as species specific landings:		62%		
Ireland				
	Rays nei	598.91	53.6%	
	Rays, Stingrays, Mantas nei	508.12	45.5%	
	Skate Blue	0.11	0.0%	1%
	Skate Longnosed	0.68	0.1%	7%
	Skate norwegian	8.27	0.7%	88%
	Skates and Rays nei	0.33	0.0%	4%
	Total:	1116.42	100.0%	
Percent of catch as species specific landings:		0.8%		
UK (E,W & NI)				
	Electric ray	0.05	0.0%	0%
	Marbled electric ray	0.001	0.0%	0%
	Skate (Amblyraja radiata)	1.125	0.1%	0%
	Skate (Dipturus batis)	21.277	1.3%	3%
	Skate (Dipturus nidarosiensis)	22.383	1.4%	3%
	Skate (Dipturus oxyrinchus)	10.457	0.6%	2%
	Skate (indet.)	946.533	58.0%	
	Skate (Leucoraja circularis)	13.6	0.8%	2%
	Skate (Leucoraja fullonica)	12.502	0.8%	2%
	Skate (Leucoraja naevus)	162.237	9.9%	24%
	Skate (Raja brachyura)	132.442	8.1%	19%
	Skate (Raja clavata)	211.064	12.9%	31%
	Skate (Raja microocellata)	87.362	5.3%	13%
	Skate (Raja montagui)	10.452	0.6%	2%
	Skate (Raja undulata)	0.827	0.1%	0%
	Skate (Rostroraja alba)	0.95	0.1%	0%
	Total:	1633.262	100.0%	
Percent of catch as species specific landings:		42%		
UK (Scotland)				
	Skates & Rays	0.789	100%	

Total Landings of skates and rays:	7576 t
Total landings in species specific categories:	3506 t
Percent of catch in species specific categories:	46%

Table 18.3a. 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	10 430	11 544	8035	8989	8956	7504

*** WGEF consider that records *of R. montagui* also include landings of *R. brachyura*.**

Table 18.3b. 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 consider that records of *R. montagui* also include landings of *R. brachyuran*.**

 # Including *D. batis, R. alba, D. oxyrinchus, D. nidarosiensis*.

Table 18.4. 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 18.5. 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 18.6a. 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 18.6b. 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	1984
Belgium	0	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	9
France (ICES)	0	0	0	0	0	24	19	0	0	18	13	9
UK (E,W &N.I.)	0	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	18

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	0	0	0	0	0	0	0	0	0	0	0	0
France (Bulletin)	11.5	0	8	13	9	5	4	2	2	2	2	2
France (ICES)	13	14	12	2	2	2	1	1	1	1	2	1
UK (E,W &N.I.)	0	0	0	0	2	1	1	0	0	0	0	0
Total	24.5	14	20	15	13	8	6	3	3	3	4	3

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	0	0	0	0	0	0	0	+	+	.	na	
France (Bulletin)	2	0	0	0	0	0	0	0	0	0.125	na	
France (ICES)	0	0	1	+	+	+	0	+	+	.	0.501	0.227
UK (E,W &N.I.)	(47)	0	0	0	0	0	0	0	0	0.042	0.0009	0
Total	2	0	1	0	0	0	0	0	0	0.167	0.5019	0.227

Table 18.7. Demersal elasmobranchs in the Celtic Seas. Summary details of SWIBTS and other surveys in Celtic Seas ecoregion.

COUNTRY	UK (SCOT)	FRANCE	SPAIN (PORCUPINE)	IRELAND	UK (E & W)	UK (NI)	UK (E&W)
Coordinated	IBTSWG	IBTSWG	IBTSWG	IBTSWG	IBTSWG	IBTSWG	WGBEAM
Institute	MLA	IFREMER	IEO	MI	Cefas	AFBNI	Cefas
Survey Area	VI, VIIa	VIIf-j, VIII	Porcupine	VIa, VII	VIIa, e-h	VIIa	VIIa,f,g(in part)
Depth range (m)	20–200	30–400	180–800	15–200	15–200		10–135
Initiated (as per quarter)	1992	1997	2001	2003	2003	1992	1991
Quarter	4	4	3 & 4	4	4	1, 4	3
Research vessel	Scotia	Thalassa	Vizconde de Eza	Celtic Explorer	Endeavour	Lough Foyle (1992-2003) Corystes (2004 -)	Corystes
Gear Type	GOV 36/47	GOV 36/47	Porcupine BACA 40/52	GOV 36/47	GOV 36/47 (fine ground)	Rockhopper trawl	4 m beam trawl
					GOV 35/45 (Rock-hopper)		
Exocet Kite	Yes	No	No	No	No	No	n/a
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”)		n/a

Table 18.8. 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 18.9. 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 1903–2008 (Source: ICES).

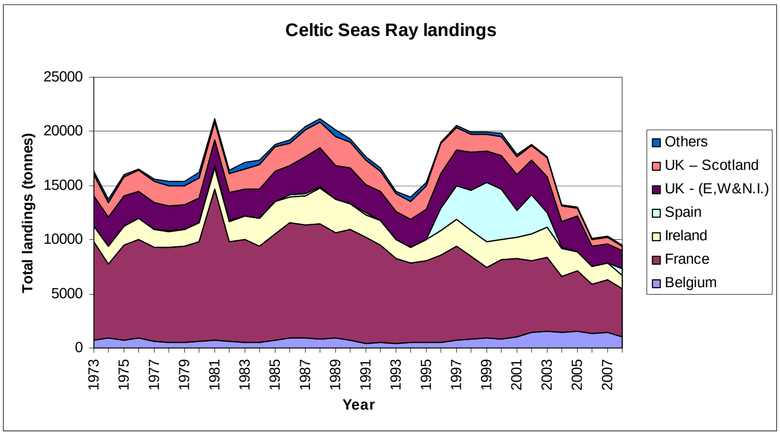


Figure 18.1b. Demersal elasmobranchs in the Celtic Seas. Total landings (tonnes) of *Rajidae* by nation in the Celtic Seas from 1973–2008 (Source: ICES).

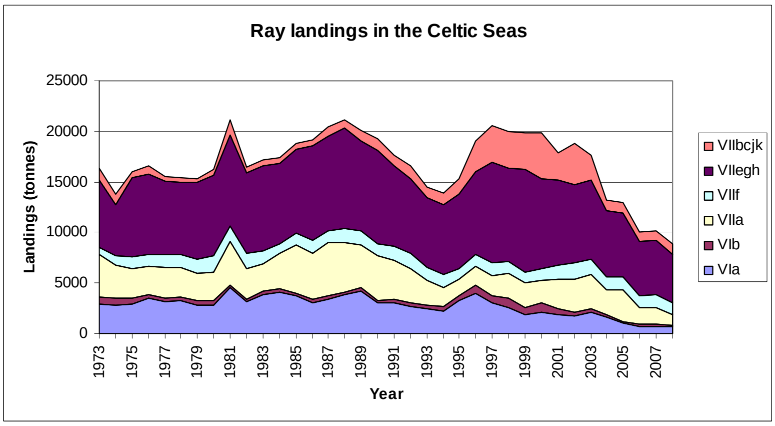


Figure 18.1c. Demersal elasmobranchs in the Celtic Seas. Total landings (tonnes) of *Rajidae* by ICES Division in the Celtic Seas from 1973–2008 (Source: ICES).

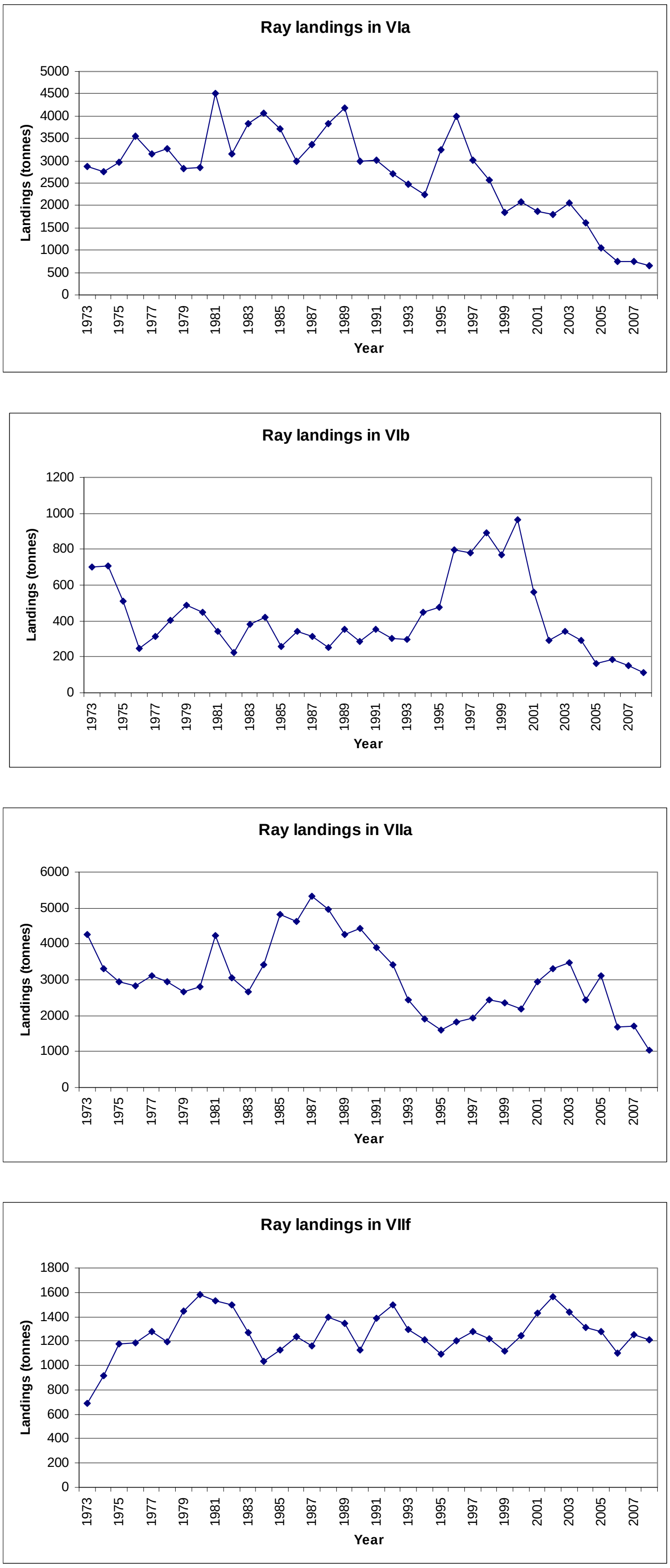
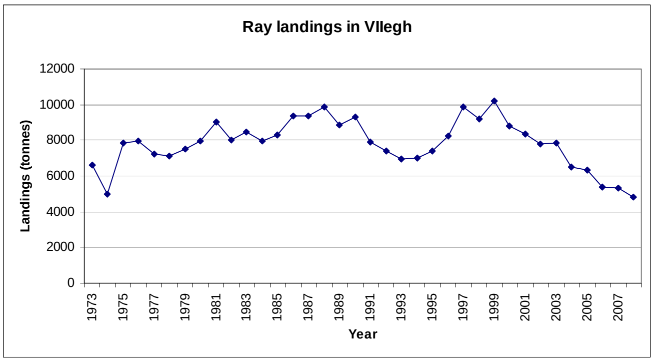


Figure 18.2 a–d. Demersal elasmobranchs in the Celtic Seas. Landings (tonnes) of *Rajidae* by ICES Division in the Celtic Seas from 1973–2008 (Source: ICES).



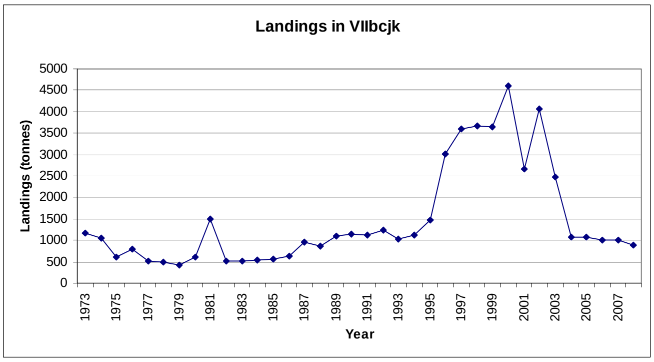
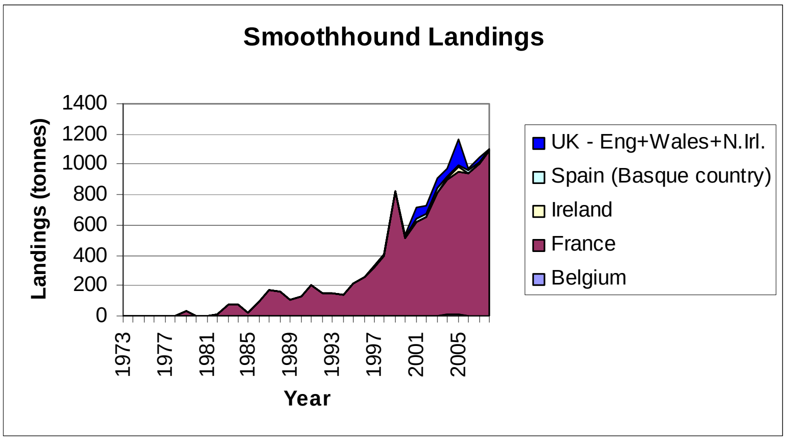


Figure 18.2 e–f. Demersal elasmobranchs in the Celtic Seas. Landings (tonnes) of *Rajidae* by ICES Division in the Celtic Seas from 1973–2008 (Source: ICES).



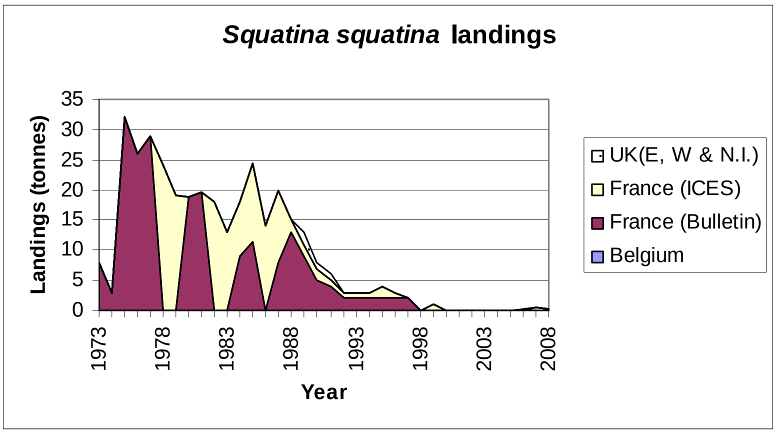
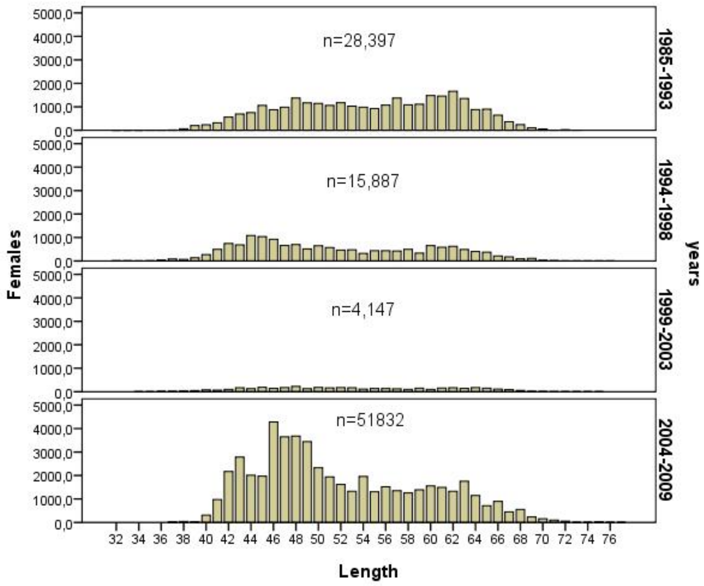


Figure 18.3. Demersal elasmobranchs in the Celtic Seas. Total landings of *Mustelus* spp. and *Squatina squatina* (Source: ICES and Bulletin de Statistiques des Peches Maritimes).



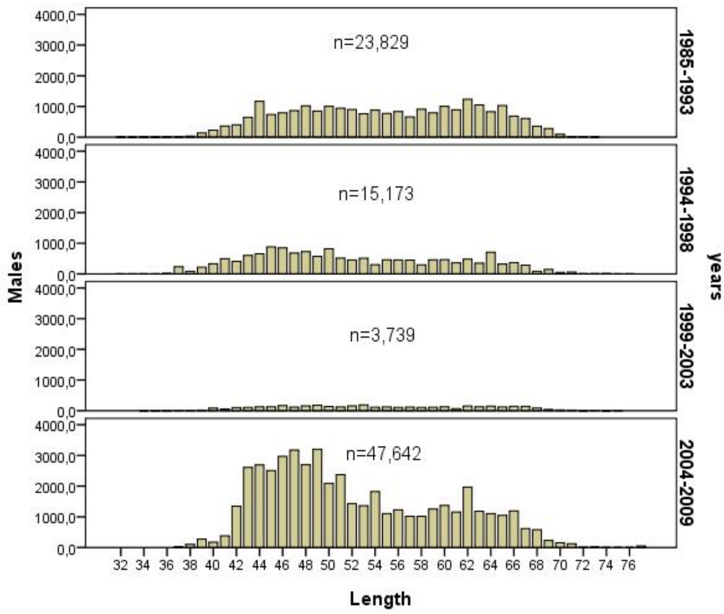


Figure 18.4a. Demersal elasmobranchs in the Celtic Seas. Length frequency distributions of cuckoo ray *Leucoraja naevus* caught in divisions VIIh and VIIIa by the French demersal trawl fisheries between 1985 and 2009 (two first quarters of the year).

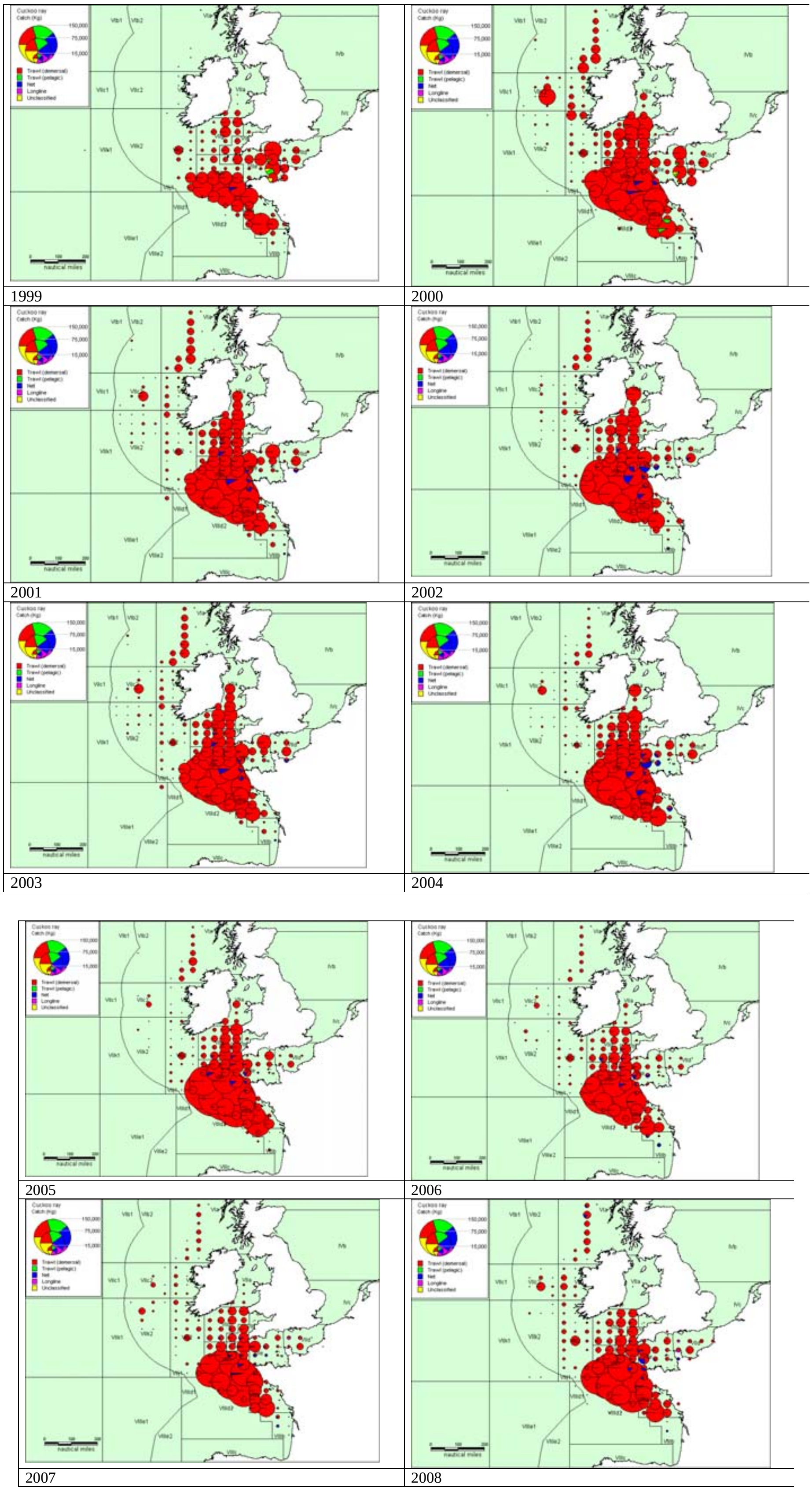


Figure18.4b. Demersal Elasmobranchs in the Celtic Seas. *Leucoraja naevus* catches per year and per gear for the French fisheries from 1999 to 2008. Source: IFREMER.

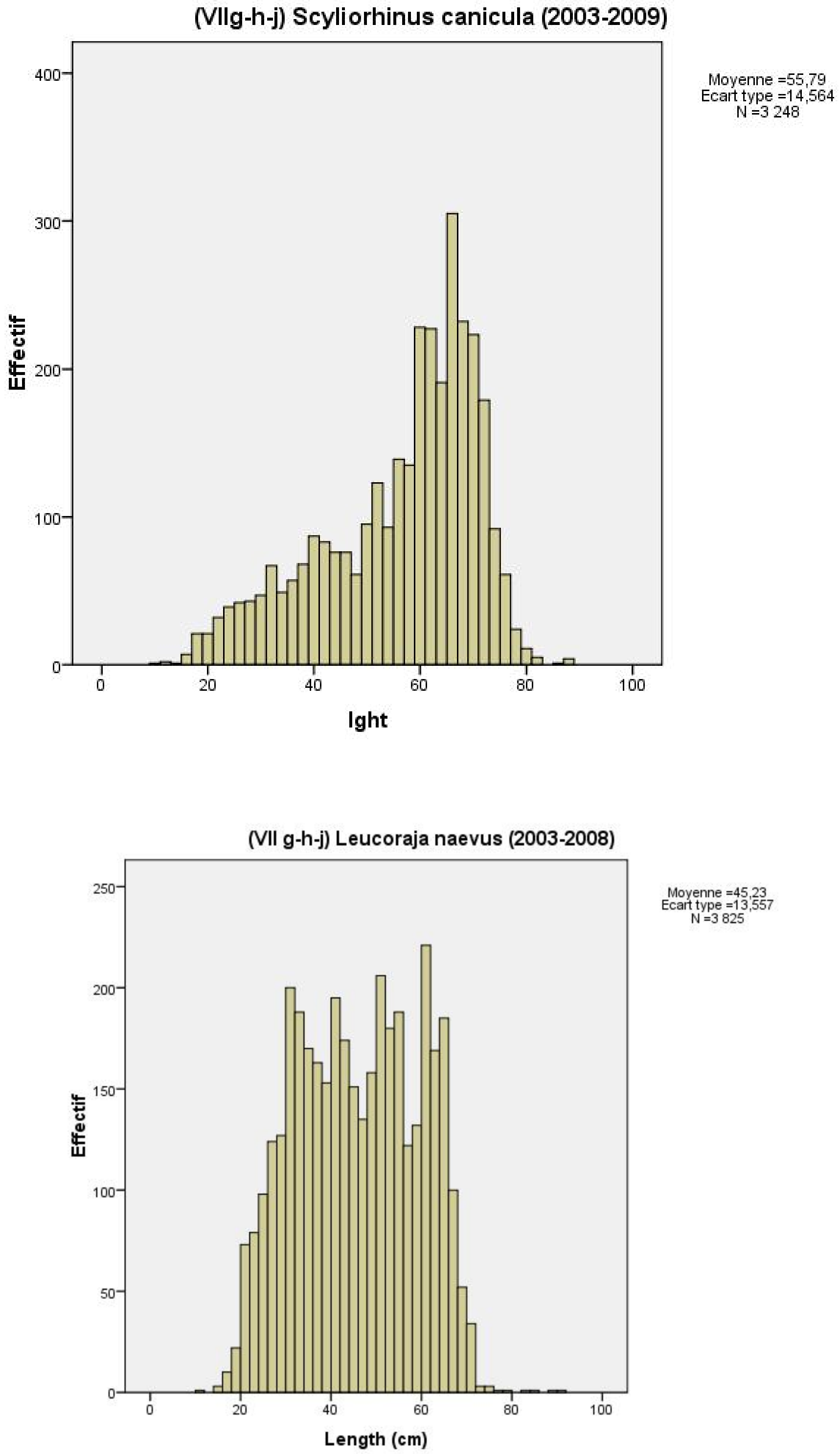


Figure 18.5. Demersal elasmobranchs in the Celtic Seas. Length frequency of *Scyliorhinus canicula (*above) and *Leucoraja naevus* (below) sampled by the French observer at sea programme, demersal trawl fishery, 2003–2009, in area VIIg,h,j. (Source: IFREMER).

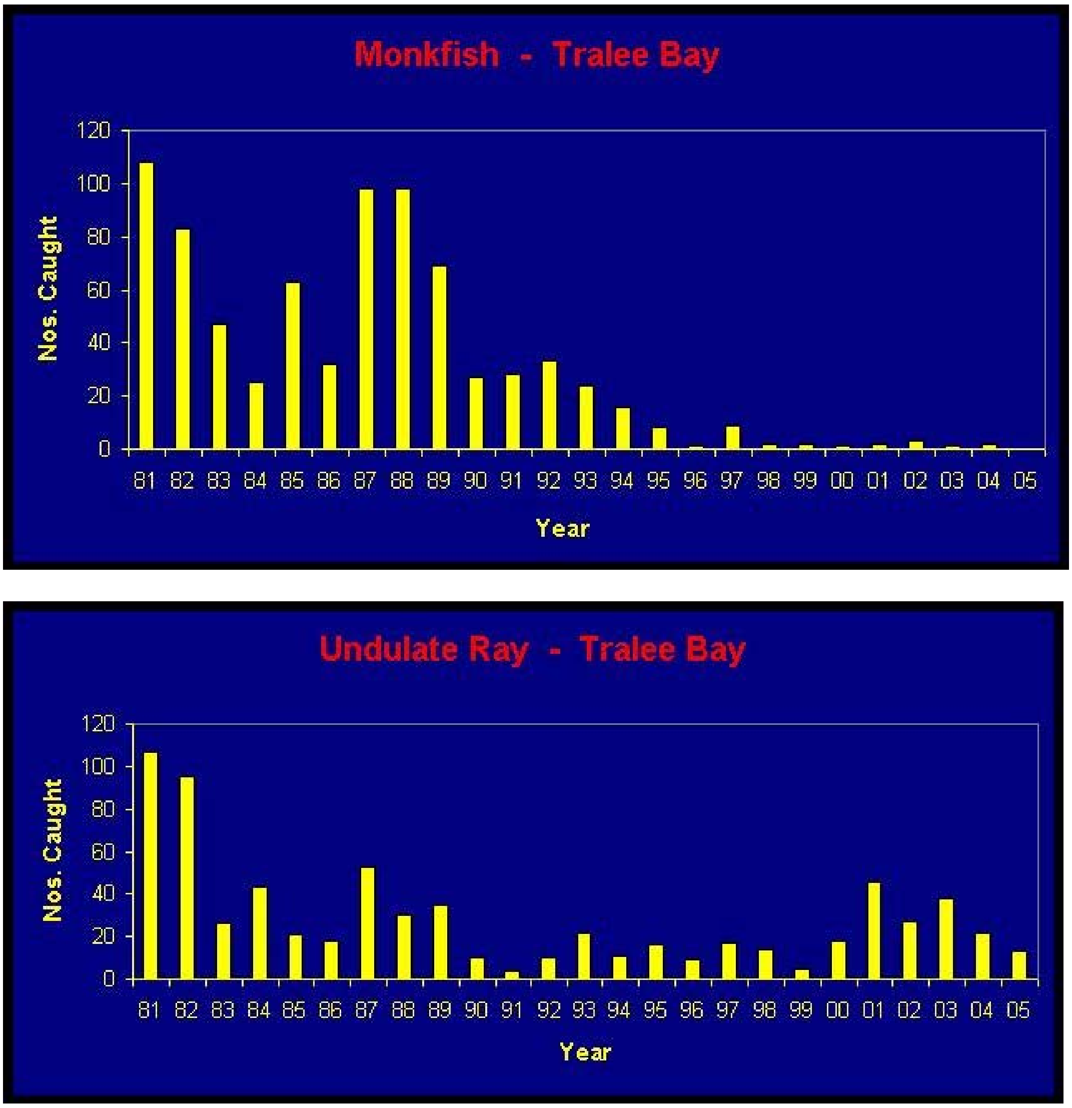


Figure 18.6. Demersal Elasmobranchs in the Celtic Seas. Angling effort of two charter boats in Tralee Bay 1981–2005 of monkfish (angel shark *Squatina squatina)* and undulate ray *R. undulata*. Source: Irish Central Fisheries Board.

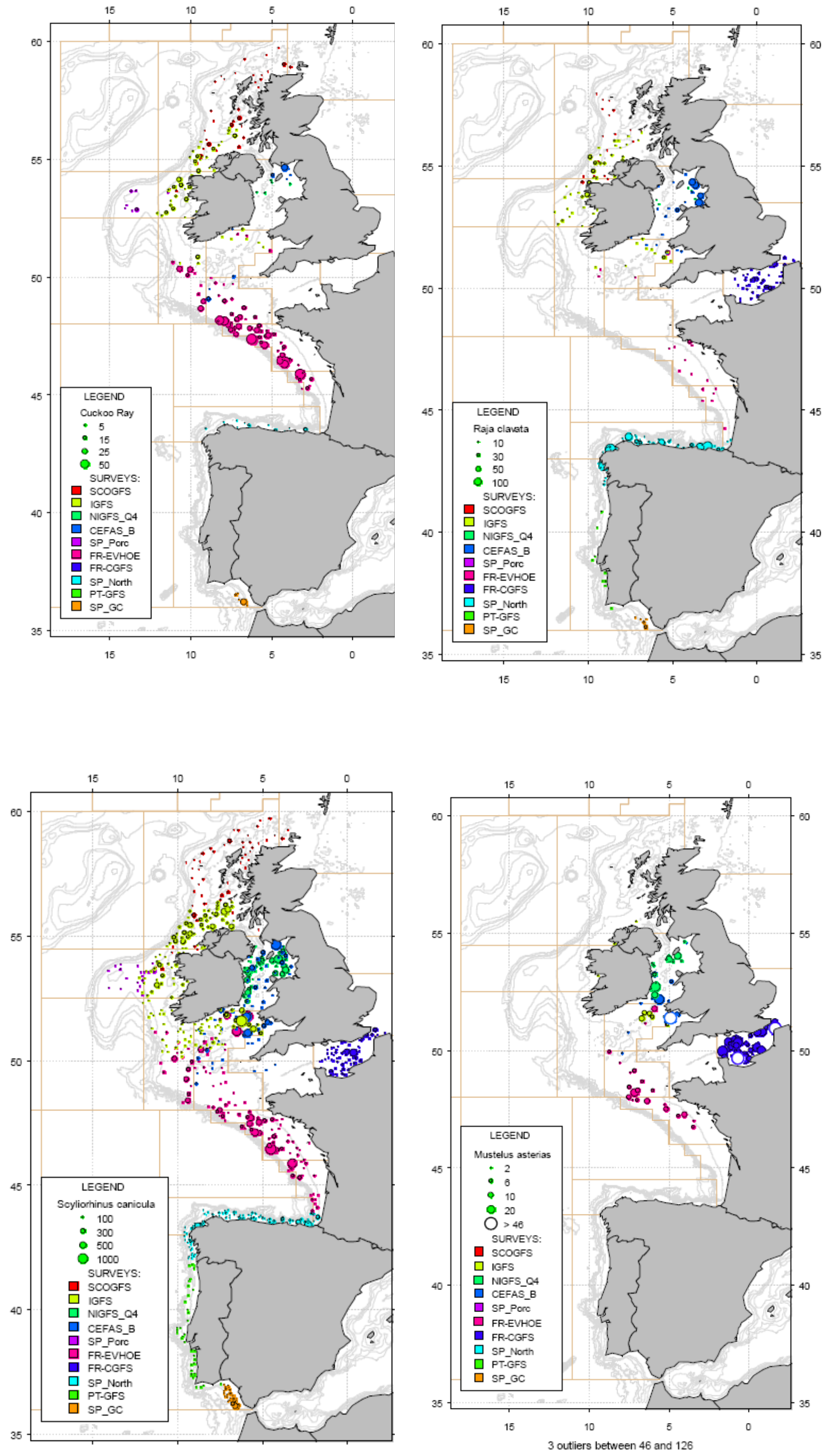


Figure 18.7. Demersal elasmobranchs in the Celtic Seas. Catches, in numbers per hour, of cuckoo ray *Leucoraja naevus*, thornback ray *Raja clavata*, lesser-spotted dogfish *Scyliorhinus canicula* and starry smooth hound *Mustelus asterias* in Q4 IBTS surveys in the Southern and Western Areas in 2008. 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, 2009).

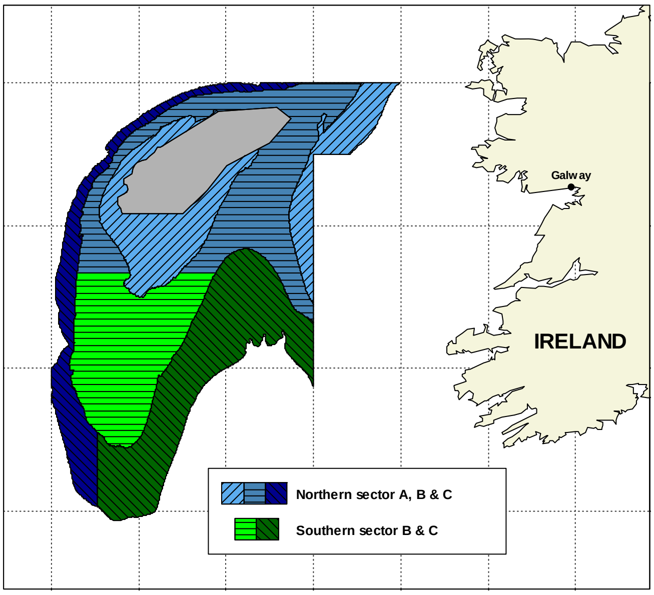


Figure 18.8. Demersal Elasmobranchs in the Celtic Seas. Area covered and sampling design of Spanish Groundfish Survey in Porcupine bank. Depth strata are 190–300 m, 301–450 m and 450–800 m. The grey area in the middle of the bank corresponds to a non-trawlable rocky mound not sampled in the survey.

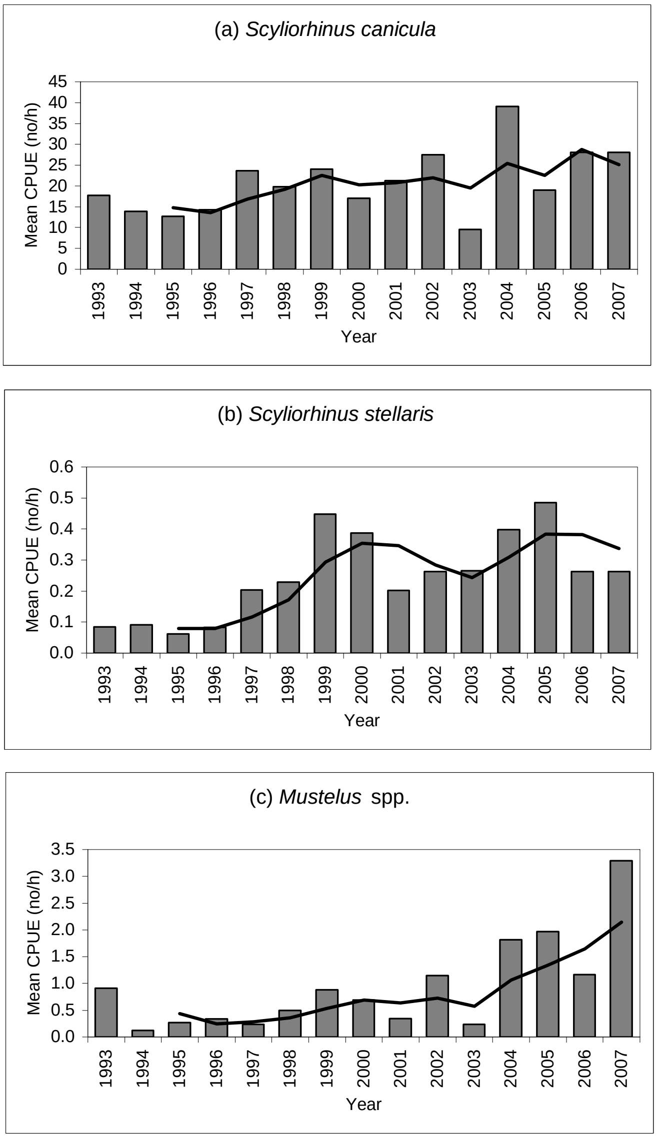


Figure 18.9. Demersal elasmobranchs in the Celtic Seas. Mean catch rates of (a) lesser-spotted dogfish, (b) greater-spotted dogfish and (c) smoothhounds from the UK 4 m-beam trawl survey in the Irish Sea and Bristol Channel (1993–2007). Smoothed line is three-year moving average.

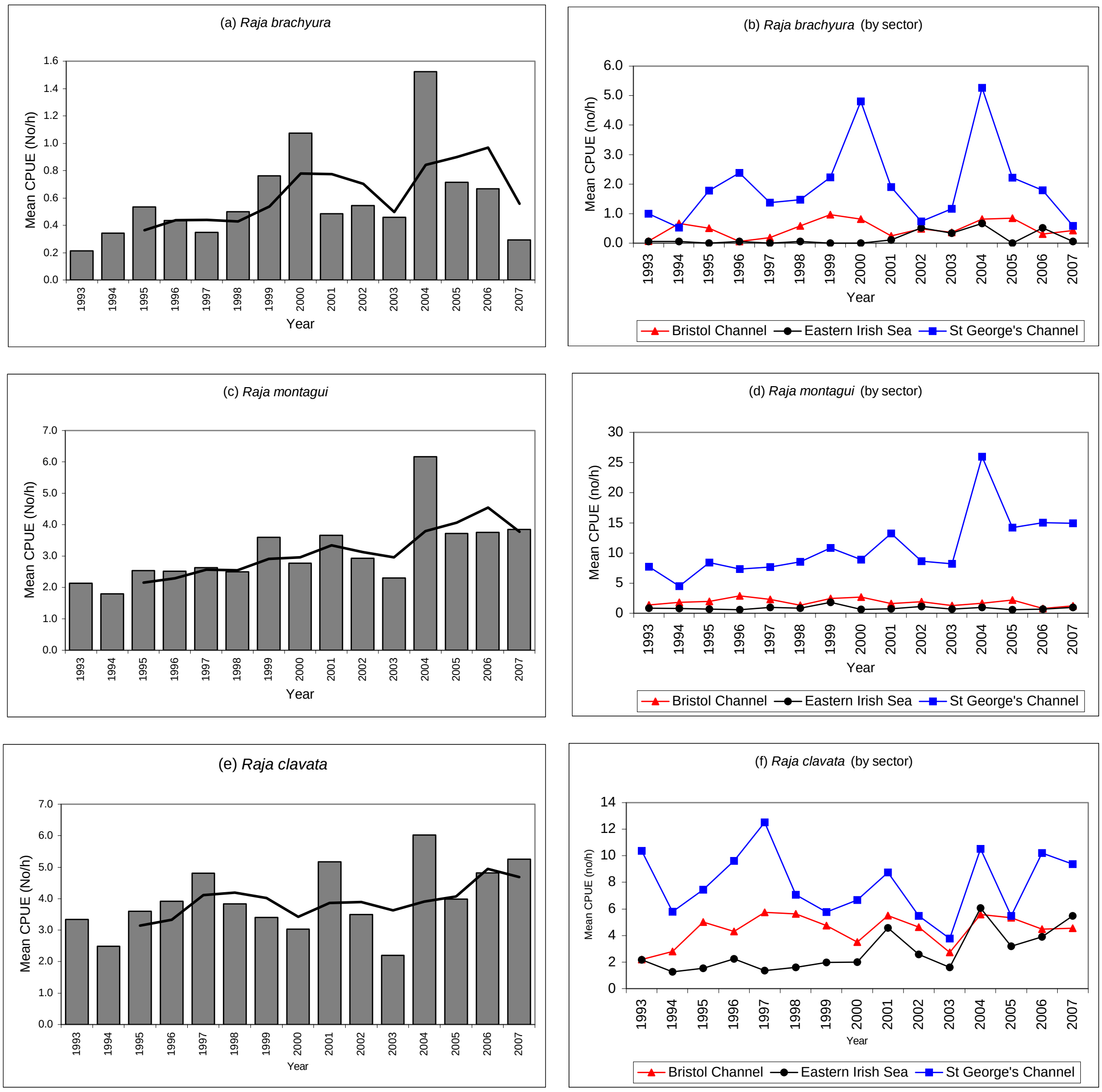


Figure 18.10. Demersal elasmobranchs in the Celtic Seas. Mean catch rates of (a-b) blonde ray, (c–d) spotted ray and (e–f) thornback ray from the UK 4 m-beam trawl survey in the Irish Sea and Bristol Channel (1993–2007). Smoothed line is three-year moving average. Right hand panel shows mean catch rates by sector.

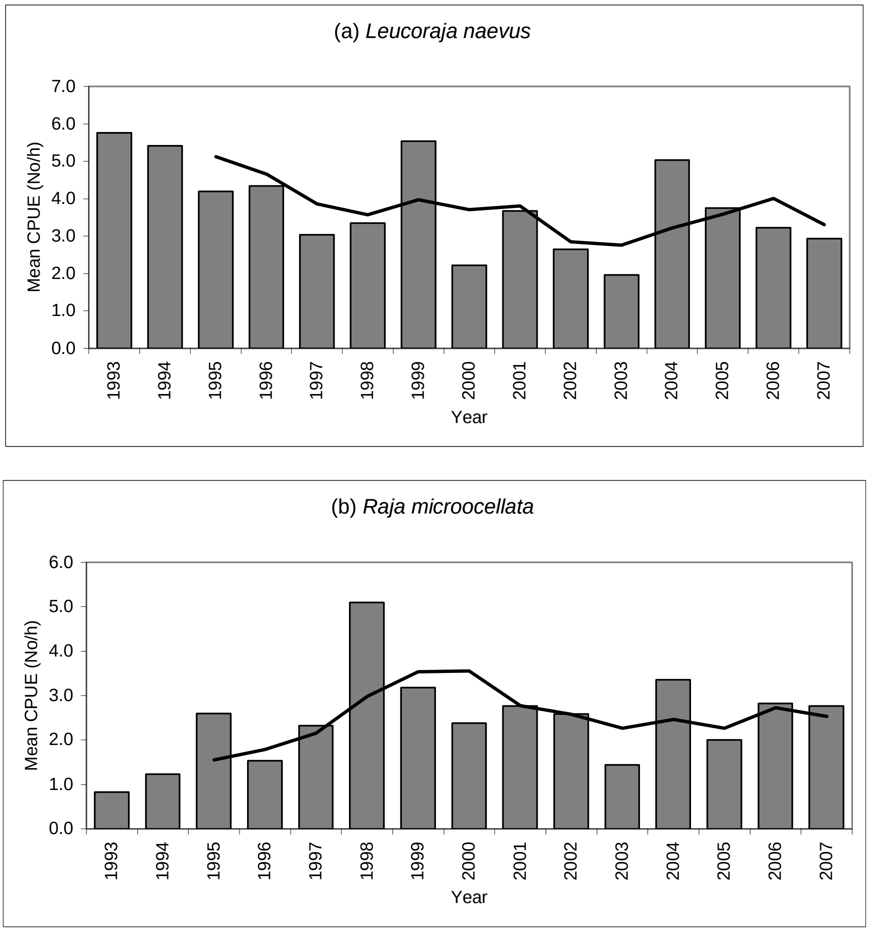


Figure 18.11. Demersal elasmobranchs in the Celtic Seas. Mean catch rates of (a) cuckoo ray (Central Irish Sea and St George's Channel) and (b) small-eyed ray (Bristol Channel) from the UK 4 m beam trawl survey in the Irish Sea and Bristol Channel (1993–2007). Smoothed line is three-year moving average.

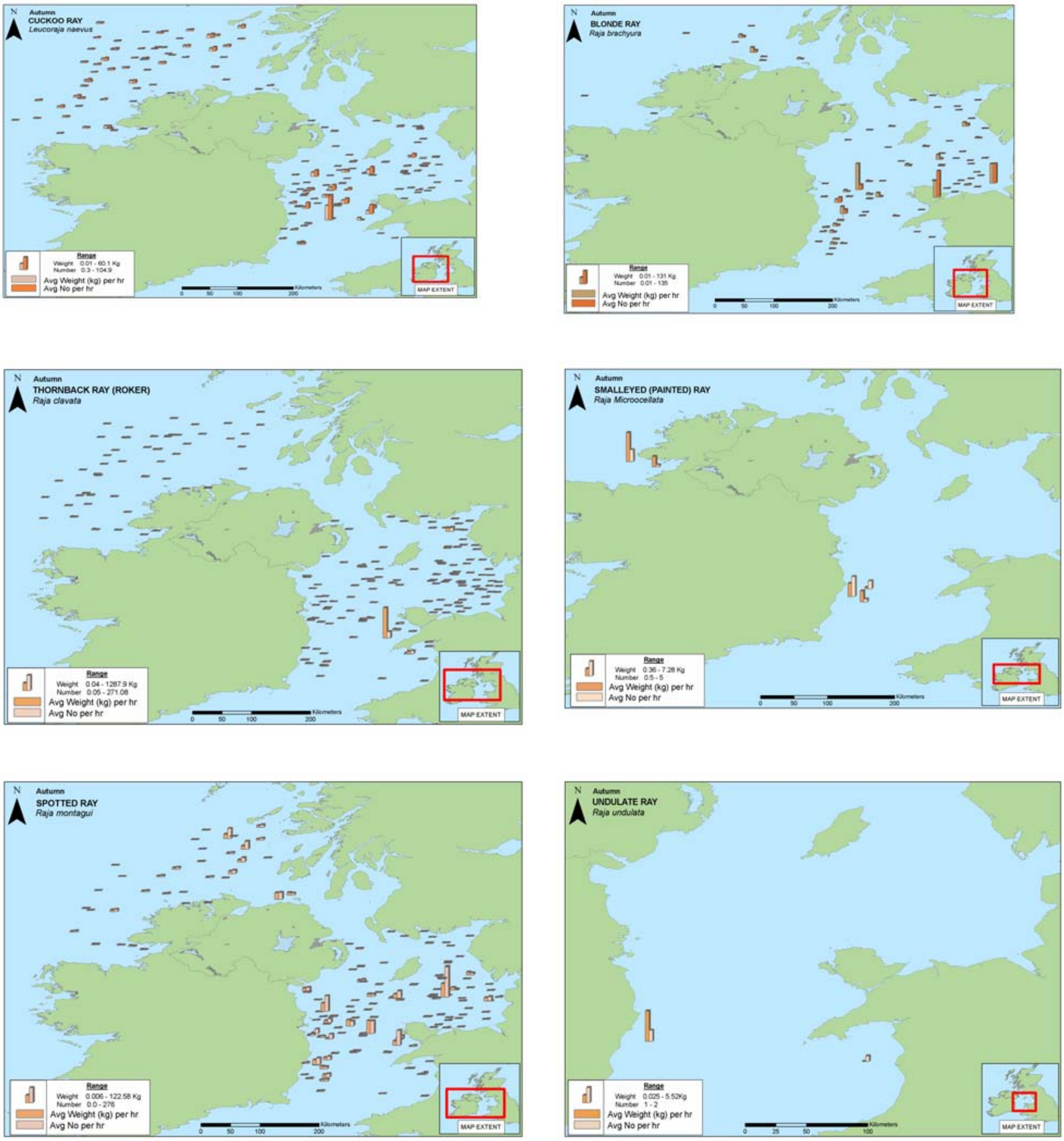
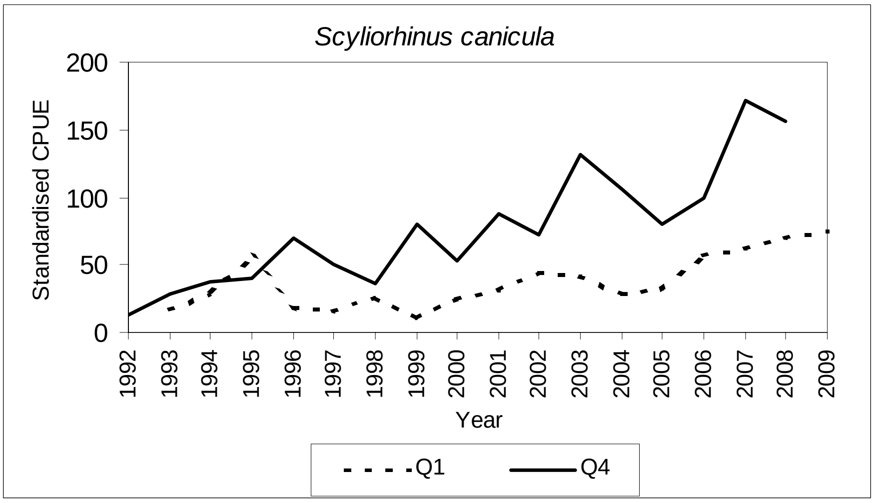
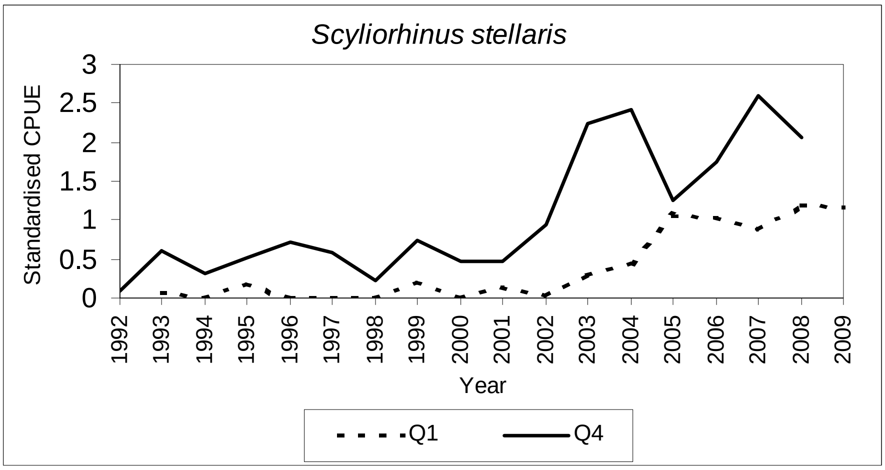


Figure 18.12. Demersal elasmobranchs in the Celtic Seas. Catches of cuckoo ray *Leucoraja naevus*, blonde ray *Raja brachyura*, thornback ray *Raja clavata*, small-eyed ray *Raja microcellata*, spotted ray *Raja montagui* and undulate ray *Raja undulata*, mean weight per hour, from combined autumn surveys in the Celtic seas. Source: NIEA 2008.





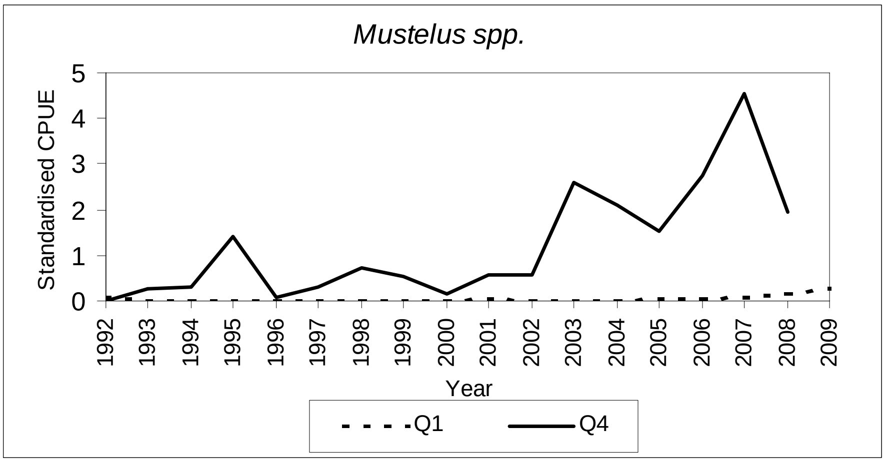


Figure 18.13a. Demersal elasmobranchs in the Celtic Seas. Mean catch rates of *Scyliorhinus canicula, Scyliorhinus stellaris* and *Mustelus spp*. from the Q1 (1992–2009) and Q4 (1992–2008) UK (NI) survey in Area VIIa (N).

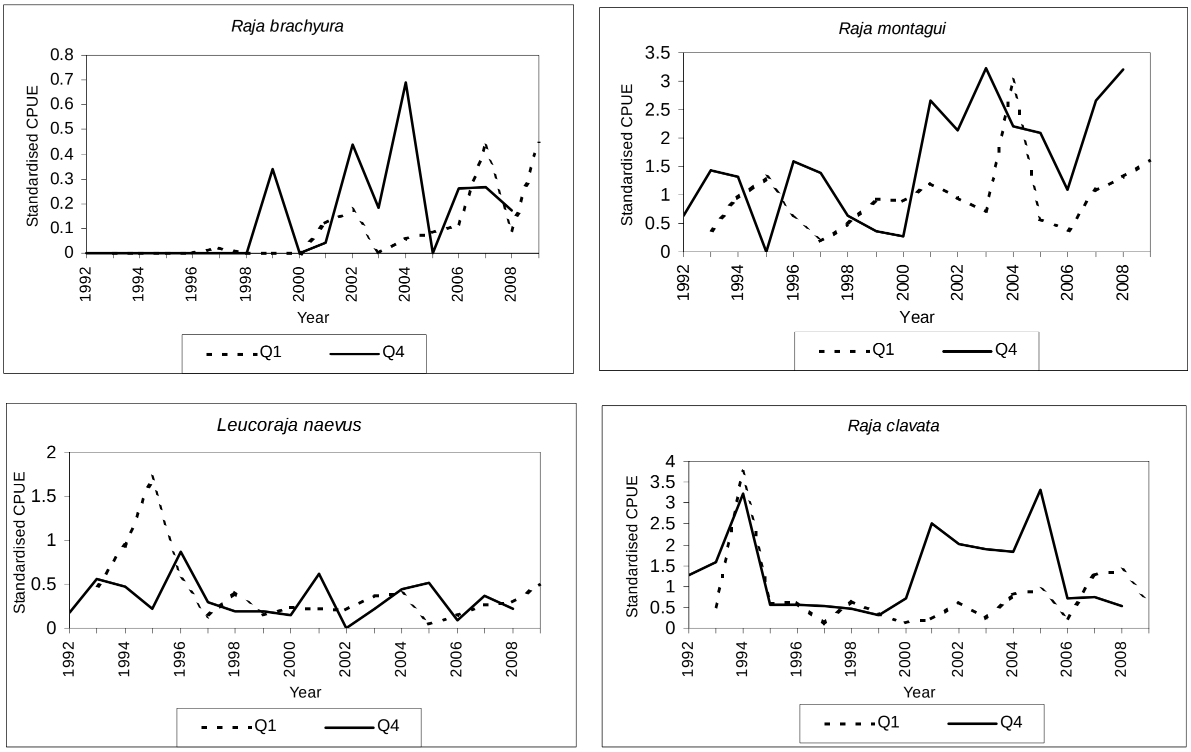


Figure 18.13b. Demersal elasmobranchs in the Celtic Seas. Mean catch rates of *Raja brachyura* and *Raja montagui*, *Leucoraja naevus* and *Raja clavata* from the Q1 (1992–2009) and Q4 (1992–2008) UK (NI) survey in the Irish Sea (1992–2009). Smoothed line is three-year moving average.

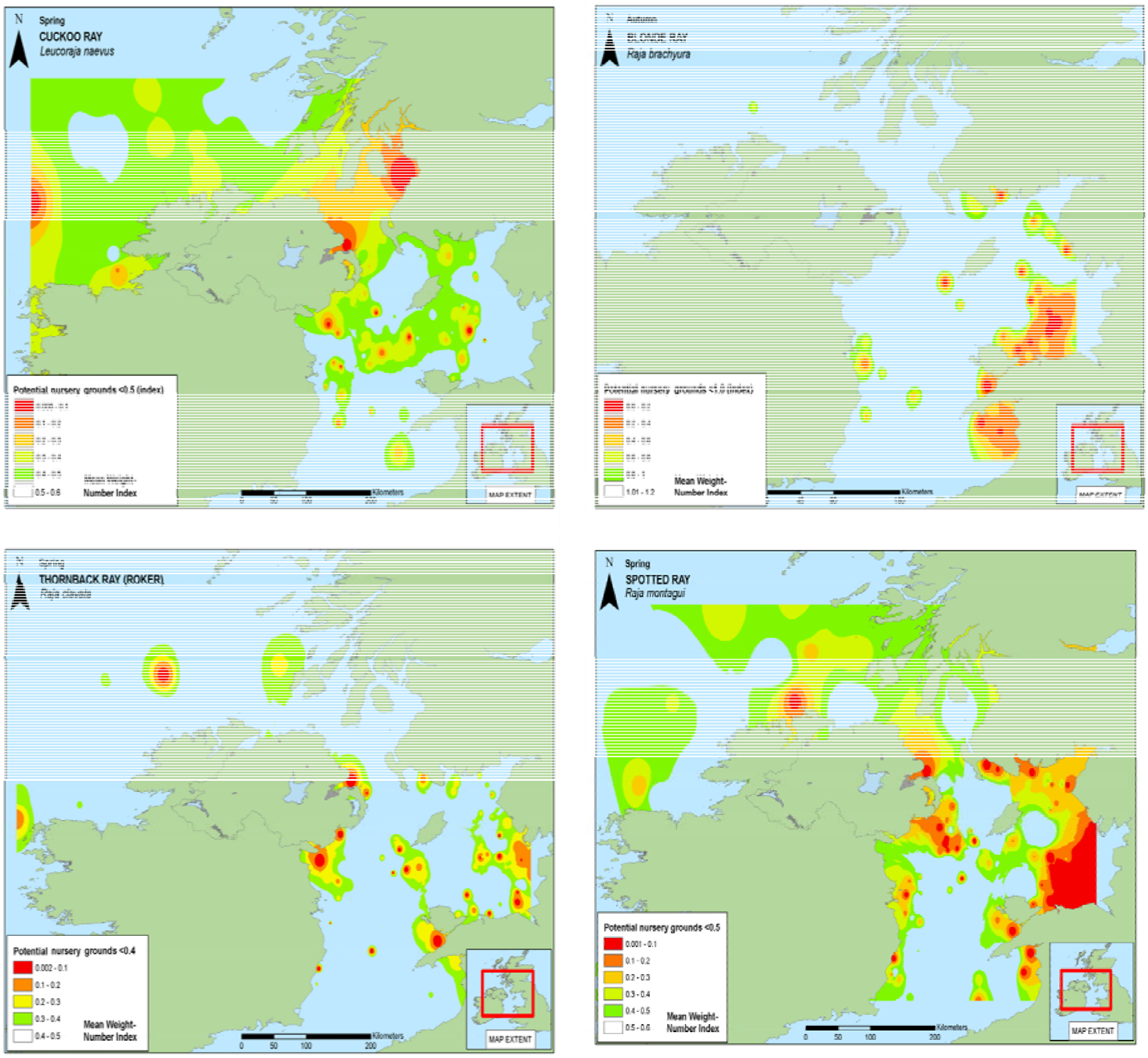


Figure 18.14. Demersal elasmobranchs in the Celtic Seas. Potential nursery areas for cuckoo ray *Leucoraja naevus*, blonde ray, *Raya brachyura,* thornback ray, *Raja clavata* and spotted ray, *Raja montagui,* in study area as estimated from research survey data (average weight (Kg)/average abundance (No./hr). The lower the index value the larger proportion of smaller individuals in sample catch. (NIEA, 2008).

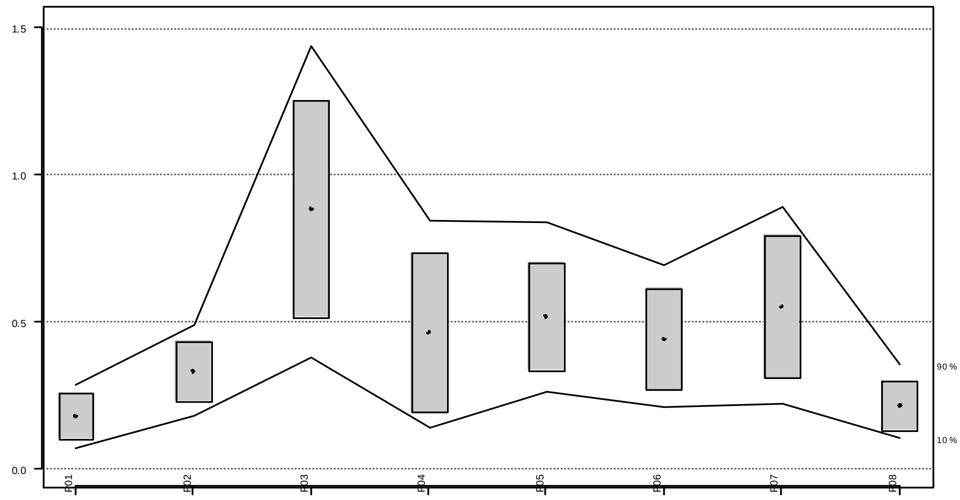


Figure 18.15a. Demersal elasmobranchs in the Celtic Seas. Changes in cuckoo ray (*Leucoraja naevus)* biomass index during Porcupine Survey time-series (2001–2008). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000) (F. Velasco, pers. com.).

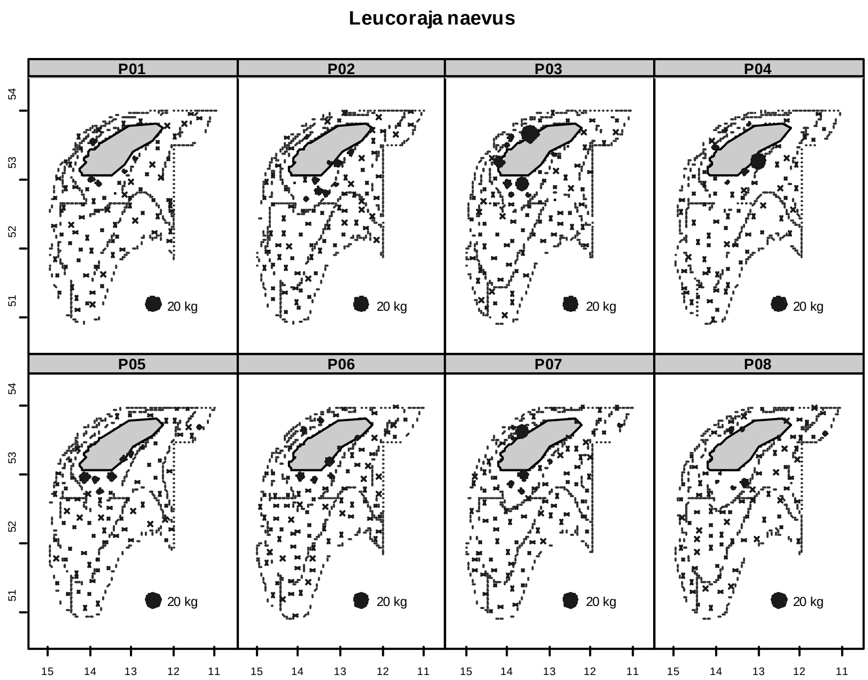


Figure18.15b. Demersal elasmobranchs in the Celtic Seas. Geographic distribution of cuckoo ray (*L. naevus*) catches (kg/30 min haul) in Porcupine surveys (2001–2008). (F. Velasco, pers. com.).

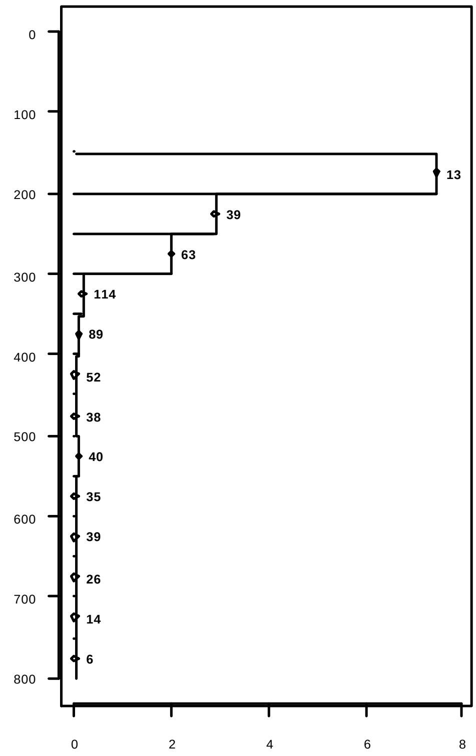


Figure 18.15c. Demersal elasmobranchs in the Celtic Seas. Bathymetric distribution of cuckoo ray (*L. naevus*) catches (ind./30 min haul) by size range in Porcupine surveys as a whole. Numbers to the right of each bar correspond to the number of hauls per depth stratum.

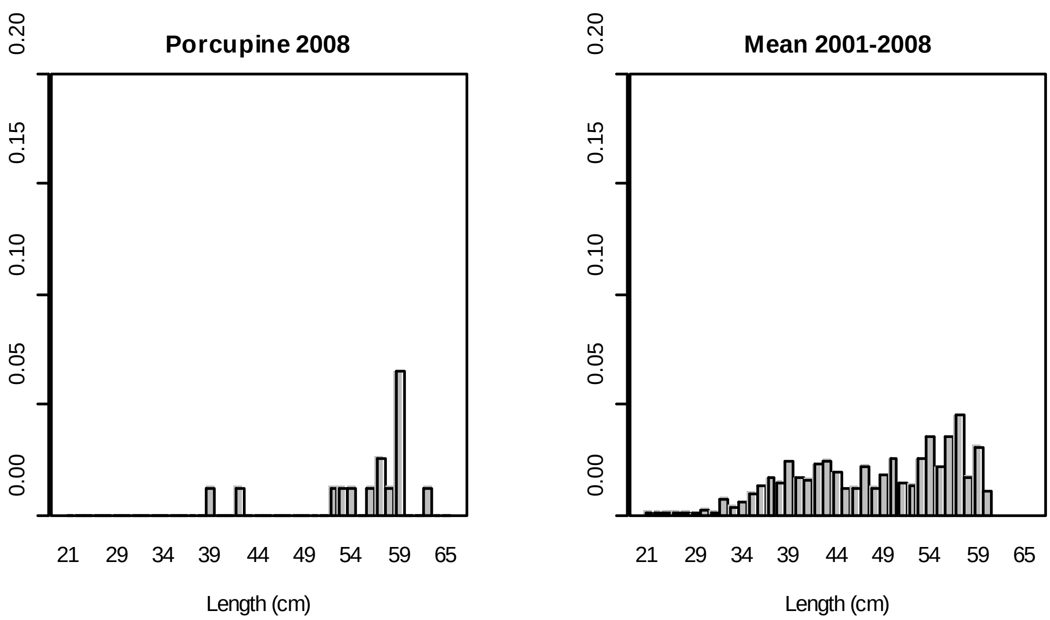


Figure 18.15d. Demersal elasmobranchs in the Celtic Seas. Stratified length distributions of cuckoo ray (*L. naevus*) in 2008 in Porcupine survey, and Mean values during Porcupine Survey time-series (2001–2008) (F. Velasco, pers. com.).

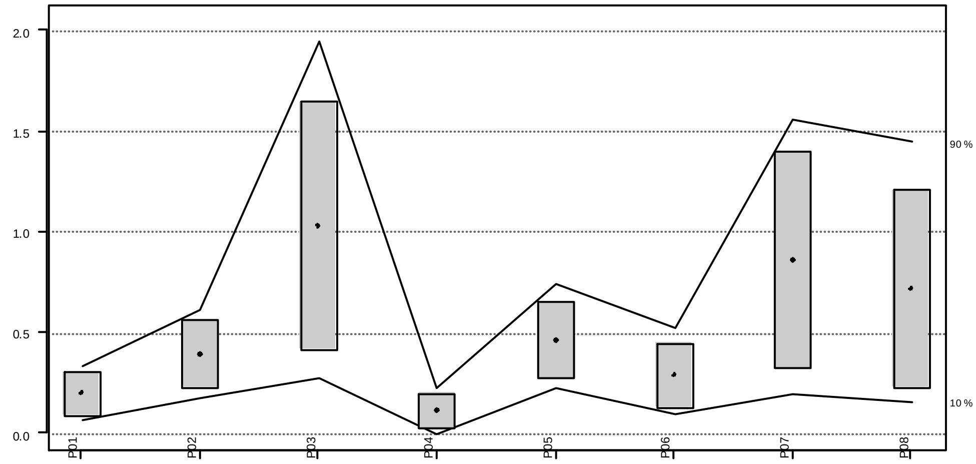


Figure18.16a. Demersal elasmobranchs in the Celtic Seas. Changes in sandy ray (*Leucoraja circularis*) biomass index during Porcupine Survey time-series (2001–2008). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000) (F. Velasco, pers. com.).

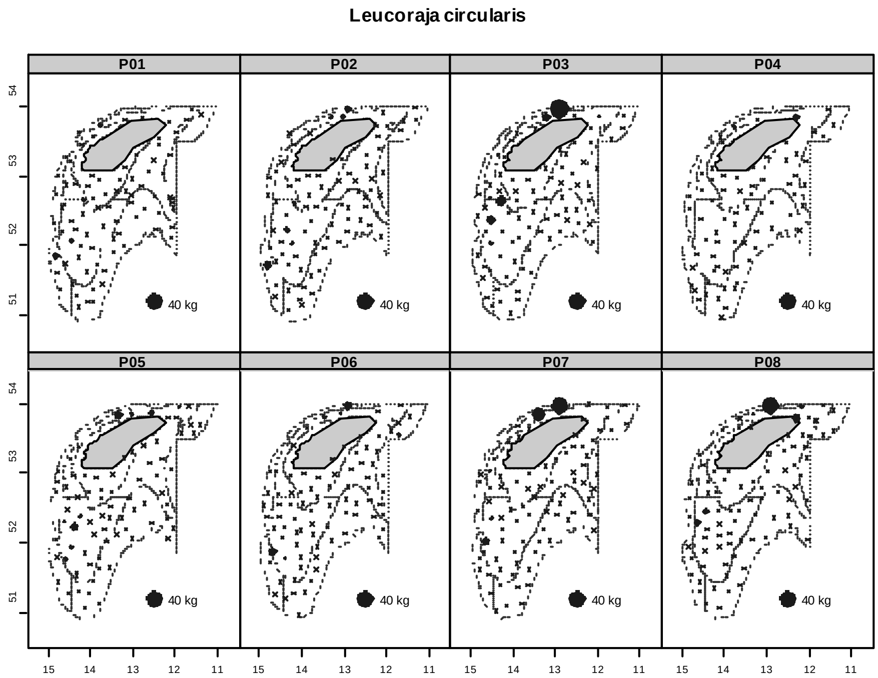


Figure 18.16b. Demersal elasmobranchs in the Celtic Seas. Geographic distribution of sandy ray (*L. circularis*) catches (kg/30 min haul) in Porcupine surveys (2001–2007) (F. Velasco, pers. com.).

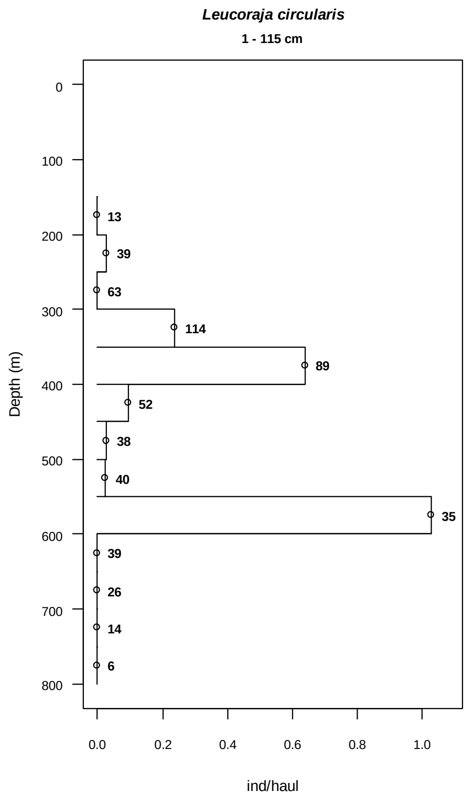


Figure 18.16c. Demersal elasmobranchs in the Celtic Seas. Bathymetric distribution of sandy ray (*L. circularis*) catches (ind./30 min haul) by size range in Porcupine surveys as a whole. Numbers to the right of each bar correspond to the number of hauls per depth stratum.

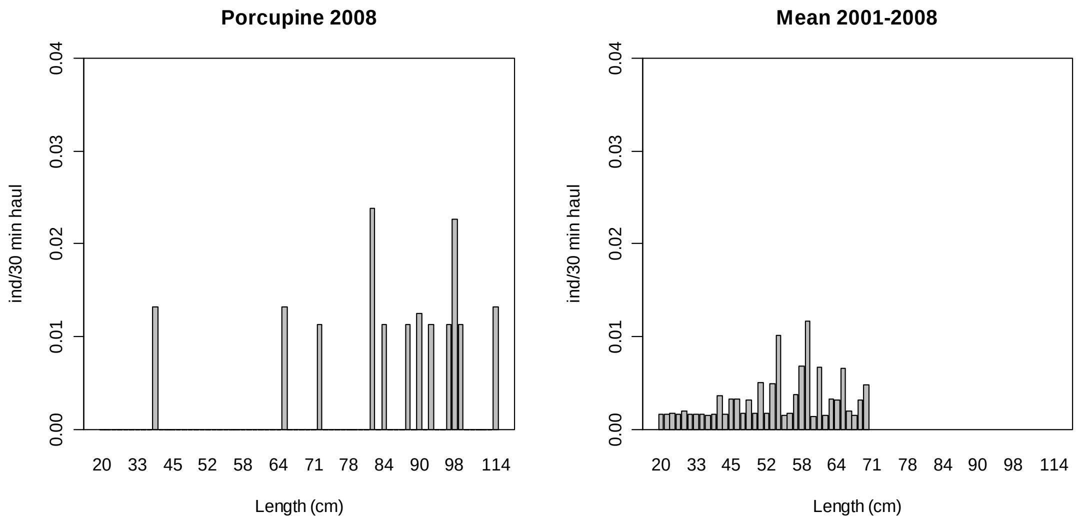


Figure 18.16d. Demersal elasmobranchs in the Celtic Seas. Stratified length distributions of sandy ray (*L. circularis*) in 2008 in Porcupine survey, and Mean values during Porcupine Survey time-series (2001–2008) (F. Velasco, pers. com.).

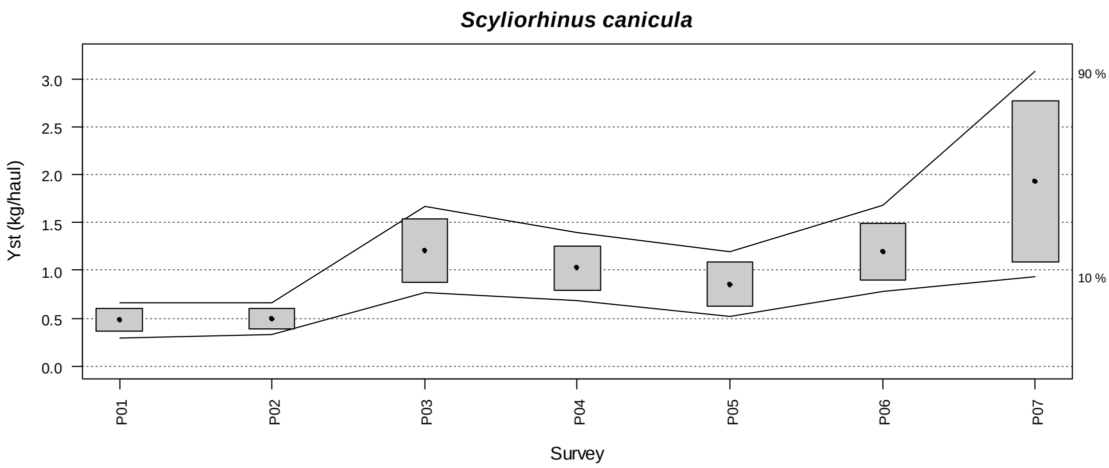


Figure 18.17a. Demersal elasmobranchs in the Celtic Seas. Changes in lesser-spotted dogfish (Scyliorhinus canicula) biomass index during Porcupine Survey time-series (2001–2007). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

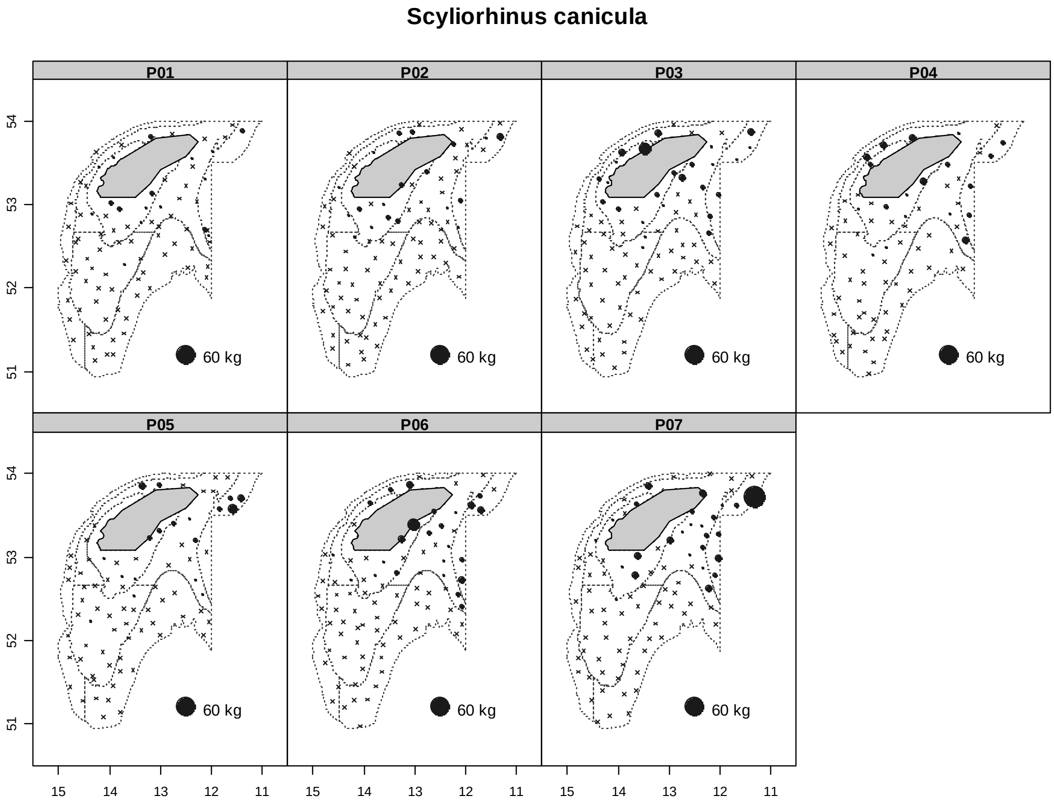


Figure 18.17b. Demersal elasmobranchs in the Celtic Seas. Geographic distribution of lesser spotted dogfish (*S. canicula*) catches (kg/30 min haul) in Porcupine surveys (2001–2007).

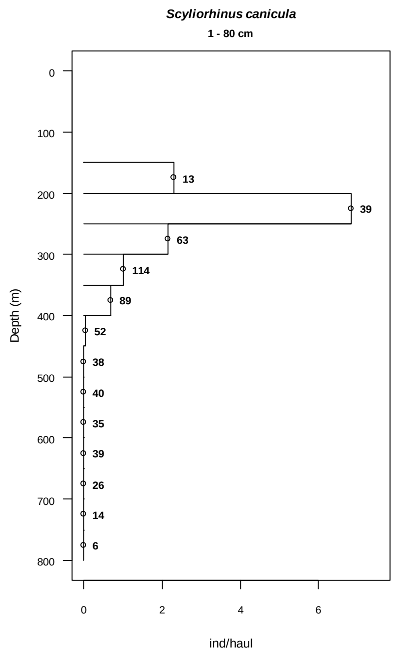


Figure 18.17c. Demersal elasmobranchs in the Celtic Seas. Bathymetric distribution of lesser spotted dogfish (*S. canicula*) catches (ind./30 min haul) by size range in Porcupine surveys as a whole. Numbers to the right of each bar correspond to the number of hauls per depth stratum.

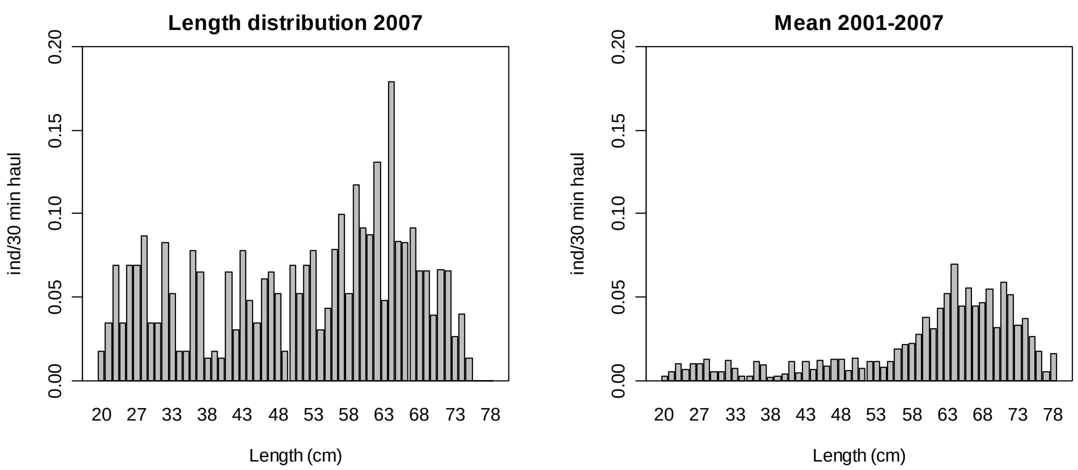


Figure 18.18. Demersal elasmobranchs in the Celtic Seas. Stratified length distributions of lesser spotted dogfish (*S. canicula*) in 2007 in Porcupine survey, and Mean values during Porcupine Survey time-series (2001–2007).

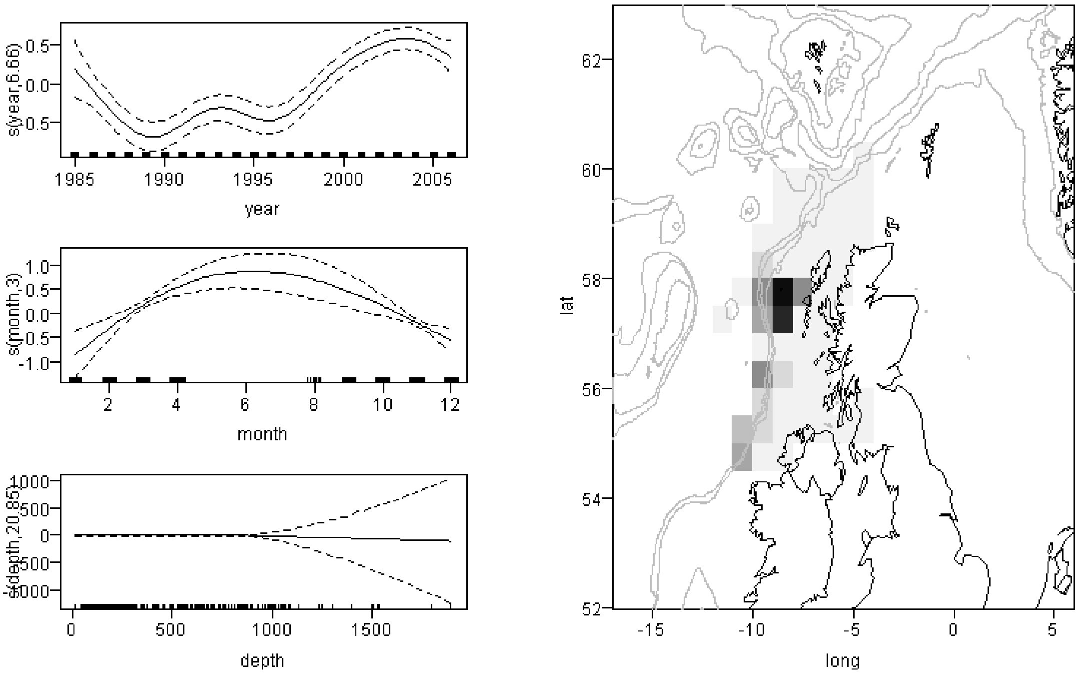


Figure 18.19a. Demersal Elasmobranchs in the Celtic Seas. Thornback ray in Division VIa. Estimated effects (year, month, depth and statistical rectangle) from the GAM analysis of Scottish survey catch rate data (log scale). Models are for N/hr.

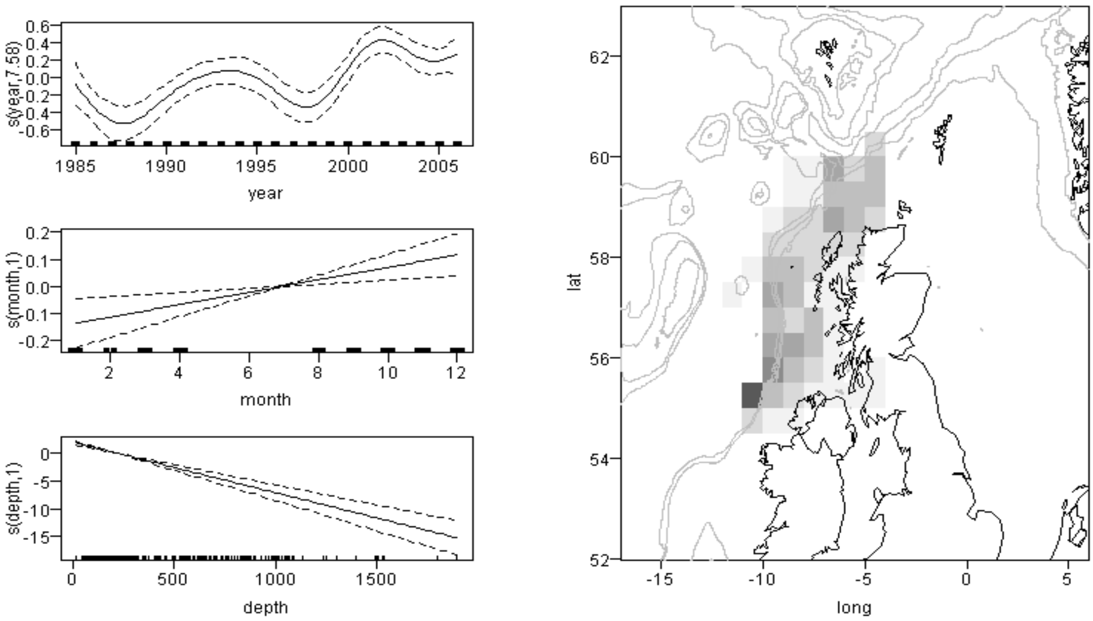


Figure 18.19b. Demersal Elasmobranchs in the Celtic Seas. Cuckoo ray in Division VIa. Estimated effects (year, month, depth and statistical rectangle) from the GAM analysis of Scottish survey data (log scale). Models are of N/hr.

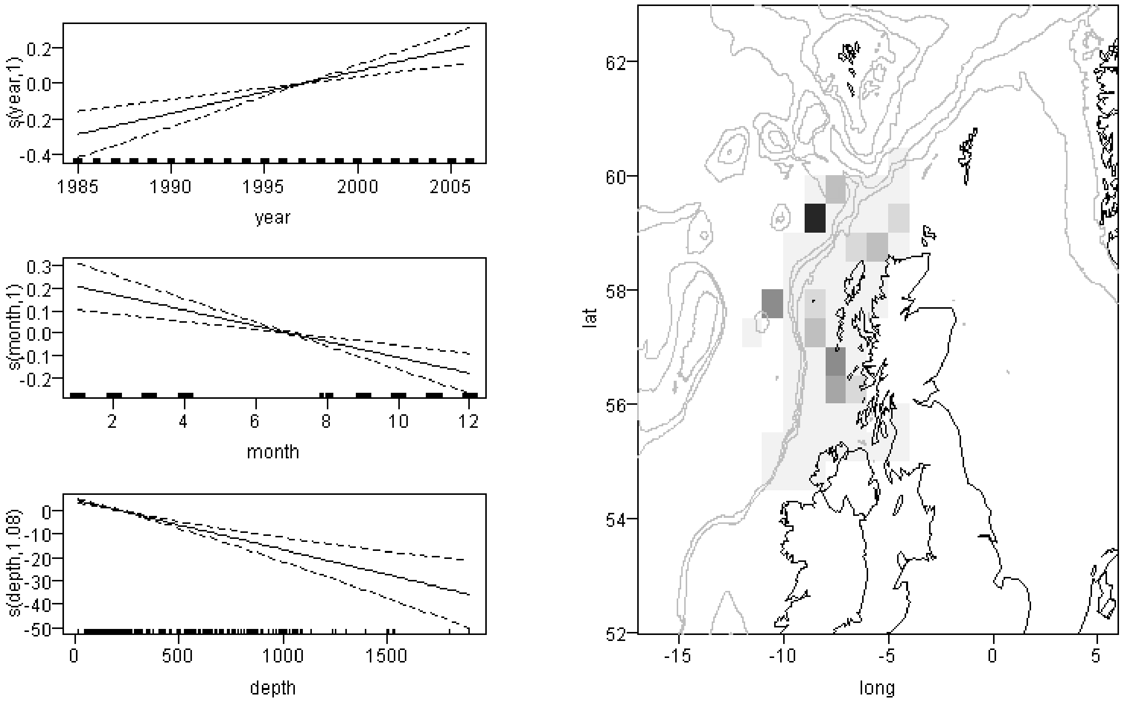


Figure 18.19c. Demersal Elasmobranchs in the Celtic Seas. Spotted ray in Division VIa. Estimated effects (year, month, depth and statistical rectangle) from the GAM analysis of Scottish survey data (log scale). Models are for N/hr.

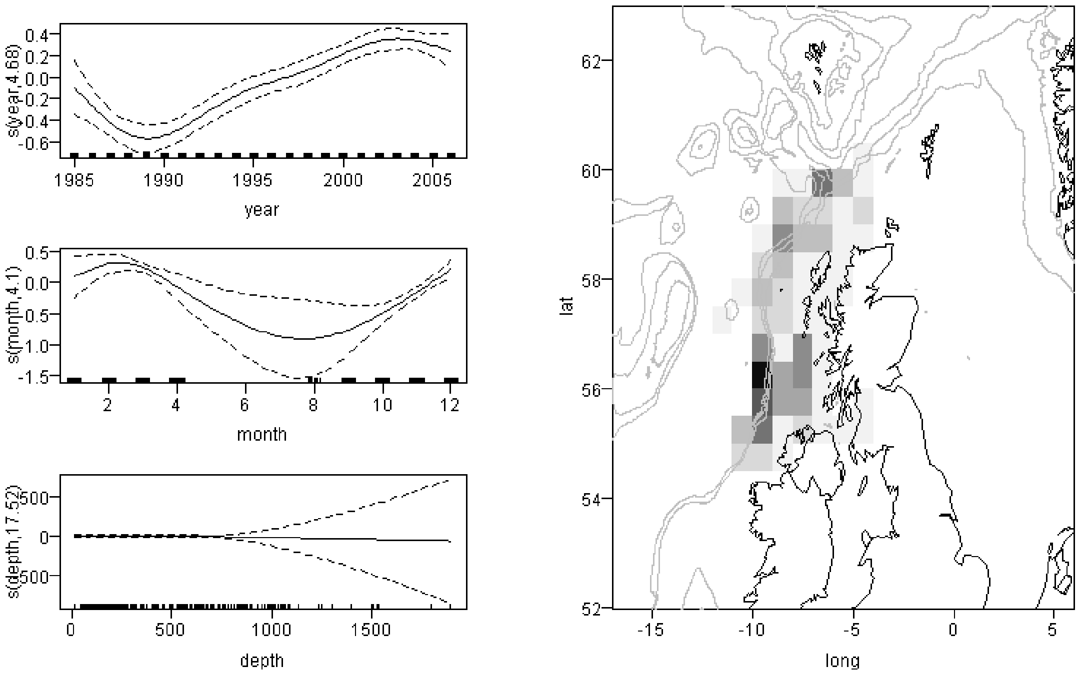


Figure 18.19d. Demersal Elasmobranchs in the Celtic Seas. Lesser spotted dogfish in Division VIa. Estimated effects (year, month, depth and statistical rectangle) from the GAM analysis of Scottish survey data. (N/hr).

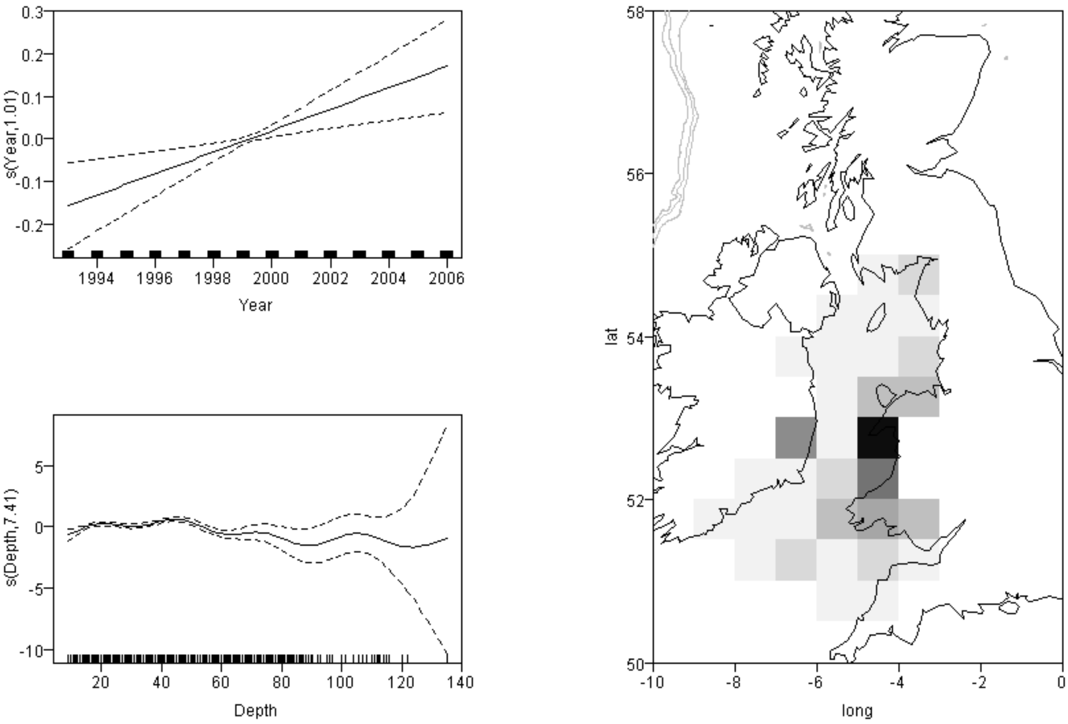


Figure 18.20a. Demersal Elasmobranchs in the Celtic Seas. Thornback ray in Divisions VIIa and VIIf. Estimated effects (year, depth and statistical rectangle) from the GAM analysis of UK (E & W) beam trawl survey data (log scale). Model of N/hr.

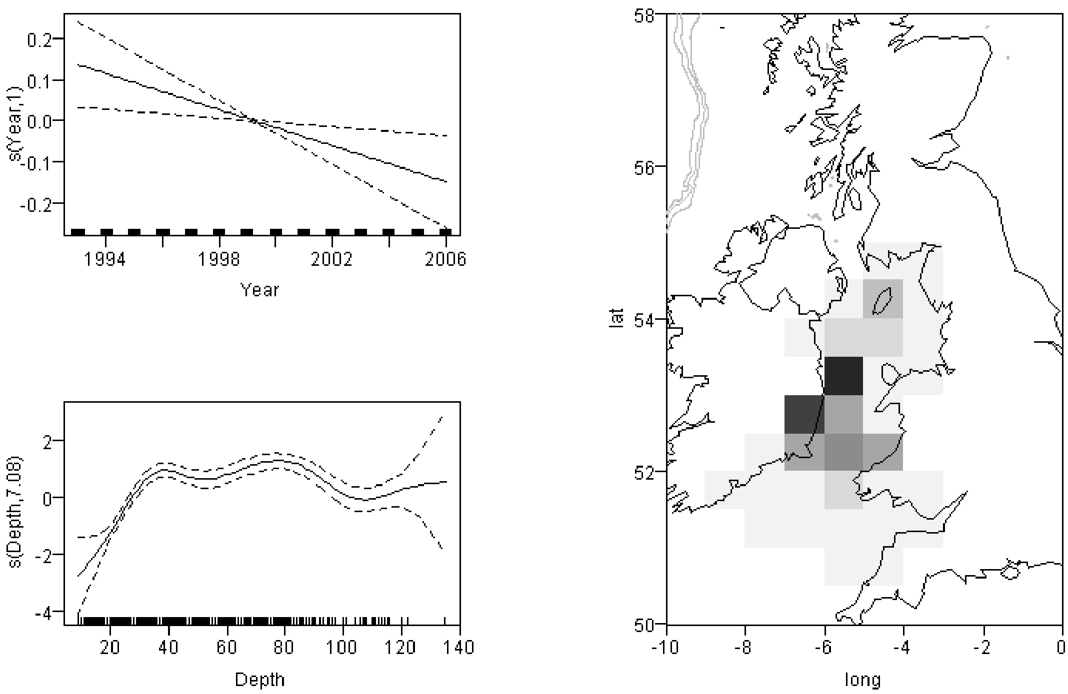


Figure 18.20b. Demersal Elasmobranchs in the Celtic Seas. Cuckoo ray in Division VIIa and VIIf. Estimated effects (year, depth and statistical rectangle) from the GAM analysis of UK (E & W) beam trawl survey data (log scale). Model of N/hr.

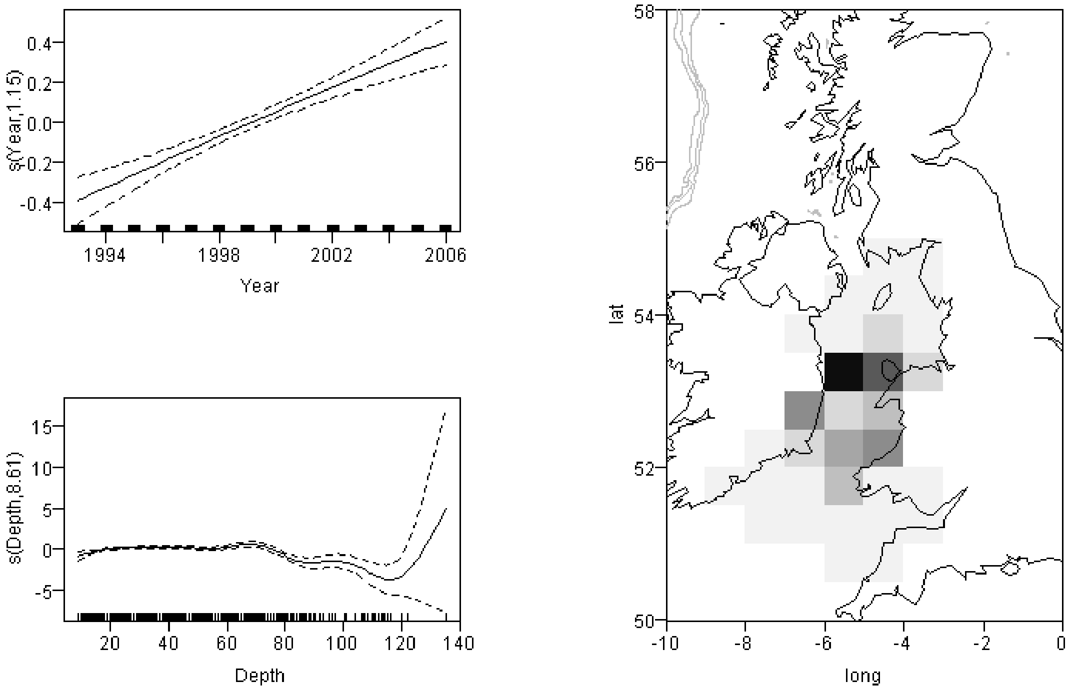


Figure 18.20c. Demersal Elasmobranchs in the Celtic Seas. Spotted ray in Division VIIa and VIIf. Estimated effects (year, depth and statistical rectangle) from the GAM analysis of UK (E & W) beam trawl survey data (log scale). Model of N/hr.

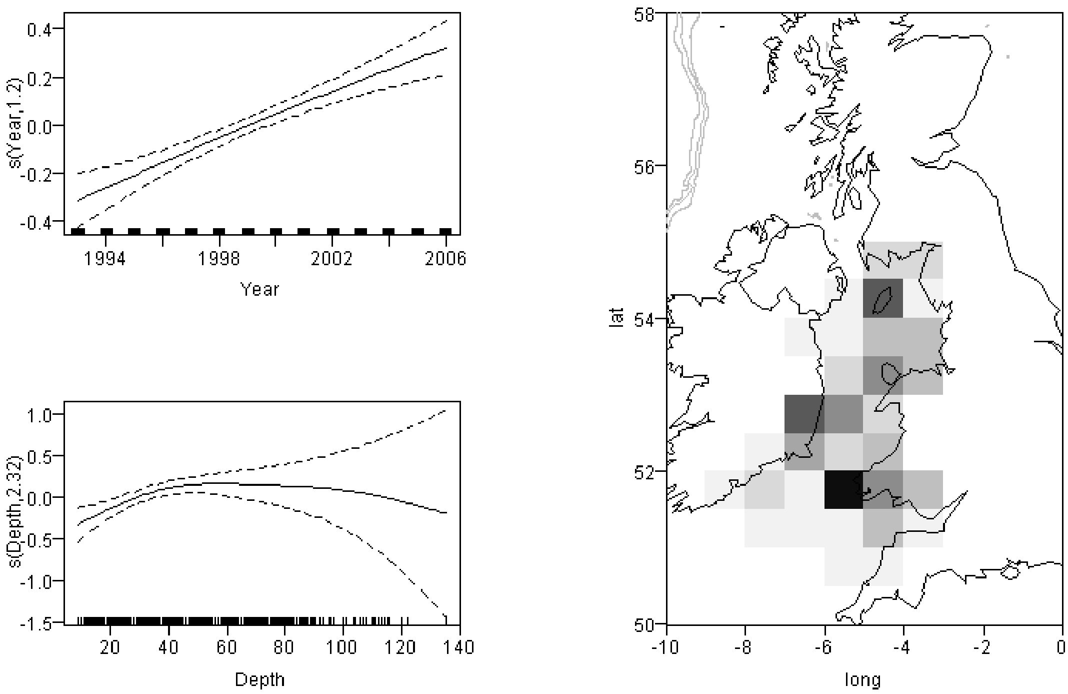


Figure 18.20d. Demersal Elasmobranchs in the Celtic Seas. Lesser spotted dogfish in Division VIIa and VIIf. Estimated effects (year, depth and statistical rectangle) from the GAM analysis of UK (E & W) beam trawl survey data (log scale). Model of N/hr.

19 Demersal elasmobranchs in the Bay of Biscay and Iberian Waters (ICES Subarea VIII and Division IXa)

19.1 Ecoregion 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:

Skates and rays

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.* Some of these species have patchy distributions.

Dogfishes

The populations of lesser-spotted dogfish (*Scyliorhinus canicula*) 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.

In terms of demersal sharks, spurdog (Section 2) and tope (section 10), blackmouth catshark *Galeus melastomus,* smooth hounds (*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 uses different types of fishing gear, such as longline and gillnets, and account for the highest landing records (75% of the annual skate and ray landings). The mixed nature of the fisheries catching skates poses 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. *R. 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 5832 t in 1986 to 2094 t in 2008, and that of *R. clavata* from about 3153 t in 1986 to 460 t in 2008.

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 2008

No new information.

19.2.3 ICES advice applicable

ICES first provided advice for the demersal elasmobranchs in the Bay of Biscay and Iberian Waters (ICES Subarea VIII and Division IXa) in 2008, primarily regarding lesser-spotted dogfish, *Raja clavata* and *Leucoraja naevus.*

According the advice the reported landings of skates (the groups as a whole) in the Subareas VIII and IX seem stable or slightly declining in recent years.

Estimates from groundfish surveys indicate an increase in the biomass of this *S. canicula* in Division VIIIc since 2002, however in Subarea IX in which this species is essentially a bycatch from other fisheries the landings decreased since 2004.

The state of other elasmobranch species (e.g. smooth hounds *Mustelus* spp.) is unknown as a consequence of a lack of species differentiation in landings and the short and discontinuous nature of relative abundance indices.

ICES recommends for these two groups of species the landings in 2009 not to exceed recent average for the period 2002–2006 (3900 t for skates and rays and 1800 t for S. canicula).

19.2.4 Management applicable

The Council Regulation (EC) No 43/2009 of 16 January 2009 (2) indicates that: Catches of cuckoo ray (*Leucoraja naevus*) (RJN/8910-C), thornback ray (*Raja clavata*) (RJC/8910-C) shall be reported separately. Does not apply to undulate ray (*Raja undulata*), common skate (*Dipturus batis*) and white skate (*Rostroraja alba*). Catches of these species may not be retained on board and shall be promptly released unharmed to the extent practicable. Fishers shall be encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of the species.

This is until now the only measures adopted for the Council of the EU to promote the management of skates in this ecoregion.

Council Regulation (EC) No 43/2009 also states that "*Angel shark in all EC waters may not be retained on board*" and that catches "*shall be promptly released unharmed to the extent practicable*".

19.2.5 Landings

Skates and rays

Landings for the period 1996–2008 are given in Table 19.1a–e. Historically the main countries reporting international landings since 1973 in Subarea VIII are France, Spain and Portugal.

French and Spanish and Basque Country (Spain) skate landings come mainly from Divisions VIIIa, b and c. 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 and in 2007 coincides with a misreporting period of Spanish landings but from 1996–2006 the annual landings seem to have stabilized at 3500–5000 t (Figure 19.1).

The annual landings of skates by Portugal in Division IXa remain very stable since 1996; at around 1500 t. Spanish landings in this Division are between 250 and 350 $t.y^{-1}$ since 1998.

New species-specific landings of skates for Subarea VIII and Division IXa have been provided in 2008. 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*.

Lesser-spotted dogfish

Landings 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 2008 reached 149 t (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 and only 120 t were reported by this country in 2008. The total historical landings of lesser-spotted dogfish in Biscay and Iberian waters have been quite stable since 1996, (on average 1800 $t.y^{-1}$) but an important peak can be observed in 1998 (Table 19.2; Figure 19.2).

The information about the historical landing-series of other elasmobranch species such as smooth hounds and angel shark are poor. Of these species, only smooth hounds are landed in significant quantities in Subarea VIII, mainly by the French and Spanish. 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) and especially in 2008. The increase in 2008 is also important in the Spanish (Basque) fleets landed 82 t in that year.

In Division IXa after a continuous decrease of landings of smooth hounds by the Portuguese fleet since 2004 a peak of 42 t is observed in 2008.

Other demersal sharks

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 Subarea (Table 19.4). In Division IXa, 66 t of this species were reported in 2002 by the Spanish fleet but not more data have been reported since that date.

19.2.6 Discards

Updated information of demersal elasmobranch discards of the Basque trawler fleet since 2003 were presented in this section. The discards were estimated by observers on board "baka" trawlers and Very High Vertical Open Pair Trawler (VHVOP) and Baka Otter trawl operating in Subarea 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

Skates and rays: Smaller skates (mainly juveniles of *L. naevus* and *R. clavata*) are usually discarded, and the trend of discards of these species demonstrates a decrease since 2004 (Table 19.6).

Lesser-spotted dogfish: Even though this species is the most important elasmobranch species landed by this fleet the estimated discards have been since the first year of series higher than the landings (Table 19.6). Maximum discard estimates (654 t) were reached in 2004, in 2005 and 2006 the discards of this species decreased strongly but it increases again in 2007 and 2008. Blackmouth catshark is landed and discarded in insignificant amounts except in 2004 in which 226 t were estimated as discards. This important discard recorded in 2004 might be due probably to an overestimation of the estimates in the subsamples because Blackmouth catshark is a scarce species in this fishery.

VHVOP fleet

The elasmobranch catches and landings of VHVOP operating in Division VIIIc are historically scarce. Lesser-spotted dogfish in Division VIIIa, b, d is not an appreciated species, as a consequence of its low price and like in "baka" trawler fleet, only larger specimens are retained (Table 19.6).

19.2.7 Quality of the catch data

In 2008 all the countries involved in the elasmobranch fisheries in Bay of Biscay and Iberian waters reported landings, however the non-reported data in 2007 are still not resolved for some countries.

19.3 Commercial catch compositions

19.3.1 Species and size composition

Length frequencies of *L. naevus* in the period from 1985 to 2009 are provided from the French demersal trawl fleet. The data belongs to the catches in divisions VIIh and VIIIa. During the last period, a negatively skewed distribution can be observed (Figure 19.3a). In the framework of the French DCR program, the National "Observer program at sea"; ObsMER started to sample shark and skate bycatches caught by the domestic fisheries since 2003. Length frequency distributions for dogfish *S. canicula* and for cuckoo ray *L. naevus* sampled in divisions VIIIa-b are presented in Figure 19.3b.

19.3.2 Quality of the catch data

Although in some years of the historical series a significative proportion of annual skate landings is still reported as *Rajidae* spp, most of the countries involved in the fisheries in Divisions IXa and Subarea VIII have provided in last year's relevant information on specific composition of landings. However, at least for the less common species, the estimates of specific composition of landings skates in Portugal and Spain (Basque Country) are still based in the extrapolation of proportions of species obtained as result of special samplings in ports carried out several years ago (see foot note in Table 19.5). In order to register possible changes that might occur in the specific composition of landings of these species, this methodology should be improved with a more intensive and effective sampling in ports. It is also important to mention the difficulties for the identification of some species not common in the landings as *R. brachyura* that does not appear in the annual landings reported by France throughout the time when species-specific landings data have been provided (Table 19.5).

19.4 Commercial catch-effort data

A nominal lpue and effort series of data since 1994 of the Basque Country's baka trawlers and Very High Vertical Open Pair Trawler (VHVOP) operating in Subarea VIII has been updated this year (Table 19.7).

The lpue data are referred to the main elasmobranch species landed by the fleets: lesser-spotted dogfish, rajidae (*L. naevus* and *R. clavata* combined), spurdog and smooth hounds.

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 Basque ports. Effective fishing effort for each fleet was calculated using the following formula:

Effort = fishing days = trips * (mean days/trip)

In "baka" trawlers, since 1994 landings of lesser-spotted dogfish have been on average 289 $t.y^{-1}$, the highest lpue for this species (135 kg/day) was recorded in 2008. The other hand for rajidae the best lpue (201 kg/day) was reached in 1998 but since then a continuous decrease has been observed. Landings of spurdog in VIII have been historically very scarce, that is why the lpue of this species are very low. In 2008 only 0.4 kg/day were reached being the lowest value of the series. The highest lpue of smooth hound was recorded in 2008 (24 kg/day).

Elasmobranch landings and lpue in VHVOP have been historically much lower than in baka trawlers. The largest lpue values for lesser-spotted dogfish and rajidae in the series have been 6 kg/day. Lpue of spurdog and smooth hounds in VIII have been even lower than obtained by baka trawler and barely reached 2.2 kg/day in 1998 and 18 kg/day in 2000 respectively.

19.5 Fishery-independent surveys

The size compositions of *S. canicula*, *R. clavata* and *L. naevus* updated from the Spanish IEO Q4-IBTS survey in the Cantabrian Sea and Galician waters is presented in this Section (see Figures 19.3c, 19.3d, and 19.3e). See Section 19.5.1 for a description of the survey-series.

19.5.1 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

The abundance levels in Division VIIIc remained stable in the time-series, but increased strongly in 2006 in Division IXa although in 2007 and 2008 and important decrease is observed (Figure 19.5).

Skates and rays

R. clavata in Division VIIIc demonstrates an increasing trend since 1995, with peaks in 2000 and 2001 and levels from 2006 to 2008 remain among the highest in the series. For this species no clear trends can be observed in Division VIIIc (Figure 19.6). Although the abundance of *L. naevus* demonstrates periodical saw tooths in the Division VIIIc an increasing trend is observed from 1997 to 2001 and from 2003 to 2005 and a also an important peak in 2007 (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.

19.5.2 French Surveys in the Bay of Biscay

Data were collected during the French EVHOE surveys covering the Bay of Biscay and the Celtic Sea from respectively 1987 and 1997 to 2008. 26 species of elasmobranch were recorded in the Bay of Biscay and 19 species in the Celtic Sea. Between 1987 and 2004, increasing trends in abundance were identified over the whole area for *S. canicula*, and for *G. melastomus*, *M. asterias* and *L. naevus* in the Bay of Biscay. *S. acanthias* demonstrated a negative trend in abundance in the Bay of Biscay area. Mean length demonstrated a decreasing trend over the whole area for *S. canicula* and for *L. naevus* and *R. clavata* in the Bay of Biscay (Mahé and Poulard, 2005). Complementary results covering the whole period should be published soon.

19.6 Life-history information

No new information is available for the WGEF 2009.

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.

19.7 Exploratory assessment models

19.7.1 Previous assessments

No new information is available for the WGEF 2008.

19.7.2 Exploratory analyses

No new assessments were conducted during this WG, although analyses of survey data (see above) and catch rates were undertaken.

Lesser-spotted dogfish

Updated information of trawler fleet confirmed that the lpue for *S. canicula* in Subarea VIII have been increasing from 1994 to 2008. 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. The information from Division IXa indicates a important decrease of *S. canicula* landings since 1999, Although in this Division, lesser-spotted dogfish is essentially a bycatch from other fisheries, so the decrease on landings registered during the last years could be related to changes in the effort distribution targeting different species, and to better discrimination of the species at Portuguese landing ports.

Skates and rays

In Subarea VIII the commercial lpue of skates decreased strongly from 1998 to 2003 although a slight recovery can be observed since 2004. In VIIIc, although landings reported do not demonstrate clear trends, results obtained from surveys carried out in this Subarea indicate an increase of *R. clavata* biomass since 1996. Less clear is the situation of *L. naevus*, demonstrating a series of occasional 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. On the other hand, the trend of skate landings in Division IXa is quite stable, and has been always above 1500 t y^{-1}, except in 2007, when data are lacking for Spain.

Other demersal elasmobranchs

The state of other elasmobranchs stocks (smooth hounds and angel shark) is still unclear for the same reasons of the past WG, (short length, gaps in the historical series, and difficulties in separating the two species of smooth hounds). Taking all these aspects into consideration, the available landing data of smooth hounds (*Mustelus* spp.) demonstrated that landings in Subarea VIII have been increased five times since 1996. In Subdivision IXa, *Mustelus* spp landings have been decreasing until 2007 since the maximum recorded in 1999.

However, in order to clarify these aspects, better information on species composition of landings (especially for smooth hounds) in the area considered is necessary.

19.8 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.

19.9 Reference points

No reference points have been proposed for the stocks in this ecoregion.

19.10 Management considerations

According to the historical series on landings and lpue and the information available from the surveys, the Lesser-spotted dogfish stock in Subarea VIII is increasing in abundance. Skates in this Subarea according to the landings time-series and lpue seem to be decreasing in abundance since 1998, although a slight recovery that can be observed since 2005. In Division IXa the historical landings of skates are stable since 20 years ago, whereas the decrease on landings of lesser-spotted dogfish is probably related to changes in the effort distribution targeting different species.

The situation and structure of the stocks of other elasmobranch species less frequent in the landings (e.g. *Squatina squatina*) and smooth hounds remains less clear.

The Council Regulation (EC) No 43/2009 of 16 January 2009 which bans the retention on board of three species of skate (see 19.2.4 Management applicable) has been a controversial issue in the affected countries. In this sense, the French fisheries Ministry has asked for explanations regarding the implementation of this measure, with regards undulate ray. Despite an official answer from the EU commission confirming this position, the fishing industry asked this measure to be reconsidered and other scientific studies to be conducted in order to assess the English Channel and Bay of Biscay stock(s).

Also, Spanish artisanal fishers operating in coastal waters of IXa and VIIIc expressed initial surprise at this measure, as there is not enough information or evidence of declines in the populations of *R. undulata*. In this sense, as a consequence of the coastal and shallow distribution of this species, there is not enough information of catches and landings obtained from the surveys or from the Spanish trawler fleets, which historically land most of skates in Cantabrian Sea and Bay of Biscay waters, but do not fish *R. undulata*, because trawling is banned in waters shallower than 100 m. Most of the catches of this species come from small artisanal vessels (gillnetters) operating in bays or shallow waters. The “modus operandi” of these fleets make it very difficult to get reliable information about the landings of these species and therefore to obtain any scientifically valid information on the status of these populations. On the contrary, a recent work carried out in the coastal waters of Galicia (IXa) confirmed the importance of undulate ray for the artisanal fleets in the area and did not find evidence to establish any decreasing trend in its abundance in the study area (Bañon *et al.*, 2008).

ICES provided advice for undulate ray in the Celtic Seas ecoregion, where there was concern over this species in certain areas. The Celtic Seas is the northern limit of the biogeographical distribution of this species. ICES did not comment on the status of this species in the Biscay-Iberian ecoregion, which is the main part of its biogeographical range.

19.11 References

Mahé J.C., Poulard J.C. 2005. Spatial distribution and abundance trends of main elasmobranchs species in the Bay of Biscay and Celtic Sea from bottom trawl surveys. ICES CM 2005/N:04.

Bañón Diaz, R.; Quinteiro Frenádez, R.; García Tasende, M.; Juncal Cladas, L.M.; Campelos Álvarez, J.M.; Lamas Rodriguez, F.; Morales de la Fuente, C.; and Ribó Landín, J. 2008. Composición, distribución y abundancia de rayas (Elasmobranchii: Rajidae) en aguas costeras de Galicia. Foro Ac. Rec. Mar. Rías Gal. 10: 325–331.

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 divisions VIIIab												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	12	6	11	11	6	11	14	11	8	12	14		
France	1535	1733	1503	1479	1206	1091	1106	1037	1170	1797	1296	1505	1395
Netherlands						1						0	0
Spain	872	906	724	677	146	76	323	27	20	9	12		17
Spain (Basque Country)	*	*	*	*	296,9	336,84	*	252	242	278	218	199	283
UK (E&W)	22	76	13	7	2	3	4	4		8	40	0	179
UK (Scotland)										1		3	0
Total of submitted data	2442	2721	2251	2174	1657	1518	1447	1331	1440	2106	1581	1707	1874

*** Included in Spanish Landings.**

Table 19.1b	Total landings (t) of Rajidae in division VIIID												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium													
France	46	50	60	52	43	66	64	73	63	97	61	58	89
Spain	89	92	74	2	1	1	9	5	40	**	**		0
Spain (Basque Country)	*	*	*	*	0	2	*	0	1	0	1	2	0
UK (E&W)											3	0	0
UK (Scotland)												1	0
Total of submitted data	135	143	134	54	44	69	73	78	104	97	64	61	89

*** Included in Spanish Landings.**

**** Included in Area VIIIab.**

Table 19.1c	Total landings (t) of Rajidae in division VIIIc												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium													
France	0	0	1	1	1	0	0	0	0	0	0	1	0
Netherlands												0	0
Portugal	11	7	10	4	4	5			264	0		0	0
Spain	0	321	345	226	424	978	352	1004	511	546	430		486
Spain (Basque Country)	*	*	*	*	5	16	*	21	21	20	14	9	23
UK (E&W)												0	0
UK (Scotland)												0	0
Total of submitted data	11	328	356	231	434	999	352	1025	796	567	444	10	509

*** Included in Spanish Landings.**

Table 19.1d	Total landings (t) of Rajidae in division IXa												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
France	n.a.	n.a.	n.a.	n.a.	0	0	0	0	0	0	0	0	0
Portugal	1534	1512	1485	1420	1528	1591	1521	1598	1614	1303	1544	1555	1580
Spain	58	143	197	276	285	416	339	342	325	300	364		345
Total of submitted data	1592	1655	1682	1696	1813	2007	1860	1940	1939	1602	1908	1555	1926

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	2008
Belgium	12	6	11	11	6	11	14	11	8	12	14	0	0
France	1581	1784	1564	1532	1250	1157	1170	1110	1233	1894	1357	1564	1484
Netherlands	0	0	0	0	0	1	0	0	0	0	0	0	0
Portugal	1545	1519	1495	1424	1532	1596	1521	1598	1878	1303	1602	1555	1580
Spain	1019	1462	1340	1181	855	1471	1022	1378	895	855	806	na	849
Spain (Basque Country)	*	*	*	*	302	354	*	273	264	298	233	210	306
UK (E&W)	22	76	13	7	2	3	4	4	0	8	43	0	179
UK (Scotland)										1		4	0
Total of submitted data	4179	4846	4423	4155	3947	4593	3732	4374	4279	4372	4055	3333	4398

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 divisions VIIIab												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	.	.	.	.	.	.	.	.	9	10	13	.	.
France	568	645	762	405	426	426	360	503	708	798	879	821	932
Spain	0	0	63	0	7	7	28	1	0	0	2	N.A.	1
Spain (Basque Country)	223	270	336	254	247	277	353	318	254	335	318	247	218
UK (E&W)								2		3	0		0
Total	791	915	1161	660	681	711	741	824	971	1147	1211	1068	1151

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	2008
France	5	4	5	2	4	5	3	7	7	10	5	4	10
Spain	0	0	97	0	78	0	0	0	0	*	*	N.A.	0
Spain (Basque Country)	0	0	0	0	0	0	1	0	1	0	2	2	0
Total	5	4	103	2	83	5	4	7	7	10	7	6	10

*** Included in area VIIIab.**

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	2008
France	0	0	1	1	1	4	3	4	5	1	0	1	1
Spain	417	458	375,6	448	167	187,6	65	114	88	143	168	N.A.	149
Spain (Basque Country)	11	8	8	9	5	10	52	65	63	66	73	59	47
Total	428	466	385	458	173	201	120	183	157	211	241	60	198

TABLE 19.2D	LESSER-SPOTTED DOGFISH (SCYLIORHINUS CANICULA) LANDINGS (T) IN DIVISION IXA												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Spain	3	6	19	34	30	39	39	69	86	88	92	N.A.	76
Portugal	667	691	689	882	757	734	673	658	677	385	185	157	120
Total	670	697	708	916	787	773	712	727	763	472	276	157	196

TABLE 19.2E	COMBINED LANDINGS (T) OF LESSER-SPOTTED DOGFISH (SCYLIORHINUS CANICULA) IN BISCAY AND IBERIAN WATER												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	.	.	.	.	.	.	.	.	9	10	13	.	.
France	573	648	768	408	431	435	366	513	720	809	884	826	944
Spain	420	464	555	482	283	234	132	184	174	231	262	N.A.	226
Spain (Basque Country)	234	278	344	263	253	287	405	384	318	401	392	308	265
UK (E&W)	.	.	.	.	.	.	.	2	.	3			0
Portugal	667	691	689	882	757	734	673	658	677	385	185	157	120
Total	1894	2081	2356	2036	1723	1690	1576	1741	1898	1839	1735	1291	1555

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 SUBAREA VIII												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	.	.	.	.	.	.	.	.	+	0,1	0,1	.	.
France	97	115	158	48	142	149	188	321	407	394	437	354	665
Portugal	.	.	.	.	+	.	.	.	1	0	0	0	0
Spain (Basque Country)	53	56	57	46	61	58	85	58	56	54	62	45	82
Total	150	170	214	94	202	207	273	379	464	448	500	399	748

TABLE 19.3B	SMOOTH HOUND (MUSTELUS MUSTELUS)-ICES DIVISION IXA									
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Portugal	72	39	41	43	50	35	24	11	57	42
Total	72	39	41	43	50	34	24	11	57	42

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 19.4a	Angel shark (*Squatina squatina*) - ICES Subarea VIII												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
France	0	0	0	0	0	0	0	0	0	0	0	0	0
UK (E&W)	.	.	.	.	.	.	.	.	.	.	0	0	0
Total	0	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 Subarea 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							841
France	2008	VIII		5	3	56	5	775	82		41	0	2	0						502
Belgium	2002	VIIIa,b						15	6		0									
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		7	202	46	0	6	0			0					
Spain (Basque Country)*	2005	VIII		3	0		8	229	52	0	7	0			0					
Spain (Basque Country)*	2006	VIII		3	0		6	179	41		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.
Spain (Basque Country)*	2007	VIII		2	0		5	161	37		5	0			0					
Spain (Basque Country)*	2008	VIII		4	0		8	236	52		7	0			0					
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	
Portugal**	2008	IXa				33		19	418		155	52				340				557

*** landings based on the average species proportion from 2000 to 2003.**

**** Landings based in the species proportion of 2004.**

Table 19.6. Elasmobranch discard estimates of Baka Trawler and VHVOP fleets in Subarea VIII.

Baka Otter trawl						
	Scyliorhinus canicula		*Galeus melastomus*		*Rajidae spp.*	
	landings (t)	estimated discard (t)	landings (t)	estimated discard (t)	landings (t)	estimated discard (t)
2003	368	348	1	0	239	76
2004	299	654	1	227	191	64
2005	396	275	4	5	248	13
2006	383	173	4	1	205	10
2007	309	417	6	N.A.	199	N.A.
2008	400	641	4	23	255	24

Pair trawl with nets of very high vertical opening (VHVO)		
	Scyliorhinus canicula	
	landings (t)	estimated discard (t)
2003	9	3
2004	14	2
2005	4	7
2006	7	0
2007	15	5
2008	8	3

Table 19.7. Effective effort (fishing days = trips*(days/trip)), landings (t), and lpue (landings in kg/day) of main elasmobranchs caught by the Basque Country Baka trawler and Pair trawl with nets of very high vertical opening (VHVO) in Subarea VIII.

Baka Otter trawl									
		Scyliorhinus canicula		*Rajidae spp*		*Squalus acanthias*		*smooth hounds*	
	effort (days)	Landings (t)	lpue (kg/days)	Landings (t)	lpue (kg/days)	Landings (t)	lpue (kg/days)	Landings (t)	lpue (kg/days)
1994	5619	115	20	180	32	32	6	34	6
1995	4474	203	45	505	113	23	5	25	6
1996	4378	212	49	477	109	45	10	35	8
1997	4286	247	58	554	129	34	8	38	9
1998	3002	308	103	604	201	25	8	28	9
1999	2337	237	101	367	157	12	5	27	11
2000	2227	228	102	273	123	38	17	28	13
2001	2707	239	88	301	111	10	4	33	12
2002	3617	389	107	281	78	27	7	50	14
2003	3363	368	109	239	71	8	3	40	12
2004	4232	299	71	191	45	5	1	35	8
2005	3697	396	107	248	67	4	1	41	11
2006	2979	383	128	205	69	6	2	47	16
2007	2780	309	111	199	71	6	2	32	11
2008	2967	400	135	255	86	1	0	71	24

Pair trawl with nets of very high vertical opening (VHVO)									
		Scyliorhinus canicula		*Rajidae spp*		*Squalus acanthias*		*smooth hounds*	
	effort	Landings	lpue	Landings	lpue	Landings	lpue	Landings	lpue
	(days)	(t)	(kg/day)	(t)	(kg/day)	(t)	(kg/day)	(t)	(kg/day)
1994	362	1	3	0	0		0	0	1
1995	959	0	0	1	1	0	0	2	2
1996	1332	1	1	5	4	0	0	8	6
1997	1290	2	2	5	4	0	0	9	7
1998	1482	3	2	9	6	3	2	18	12
1999	1787	6	3	8	4	3	2	12	7
2000	1214	3	2	8	6	1	1	22	18
2001	3402	7	2	14	4	1	0	13	4
2002	4045	5	1	16	4	6	2	20	5
2003	3845	9	2	15	4	6	2	13	3
2004	3944	14	4	12	3	2	0	10	3
2005	3421	4	1	5	1	3	1	11	3
2006	3228	7	2	9	3	3	1	14	4
2007	2724	15	6	4	2	5	2	10	4
2008	2342	8	3	5	2	1	0	9	4

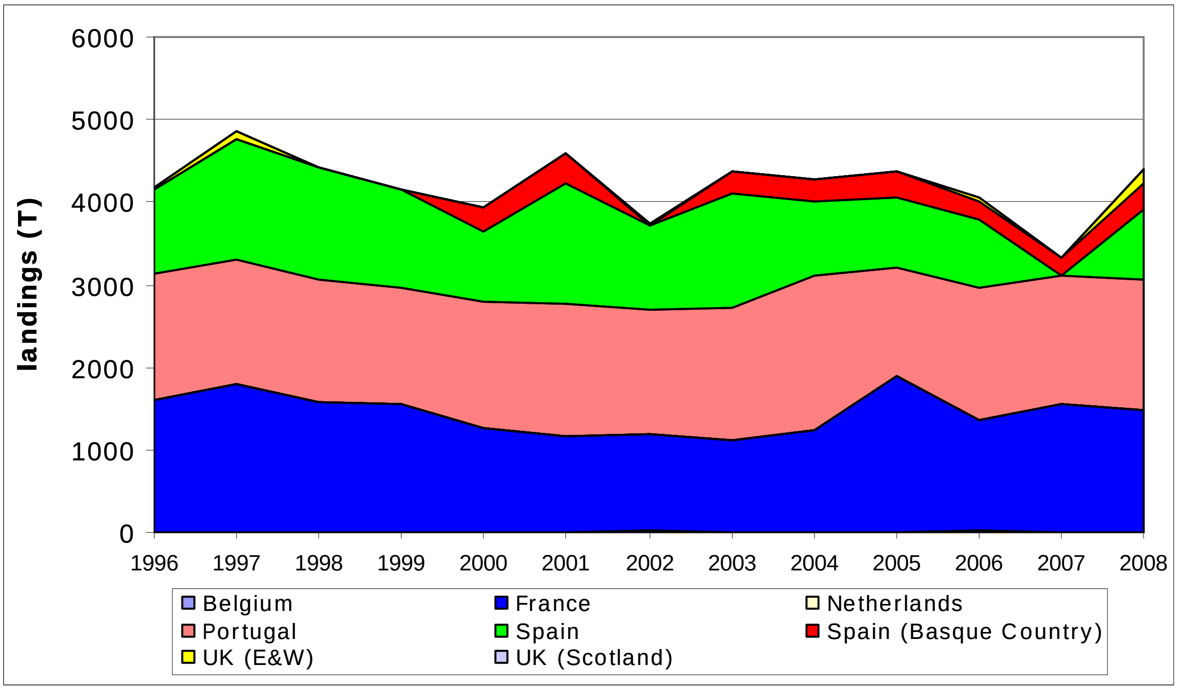


Figure 19.1. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Historical trend landings of Rajidae spp in Subarea VIII and Division IXa. (Spanish landings data not available for 2007).

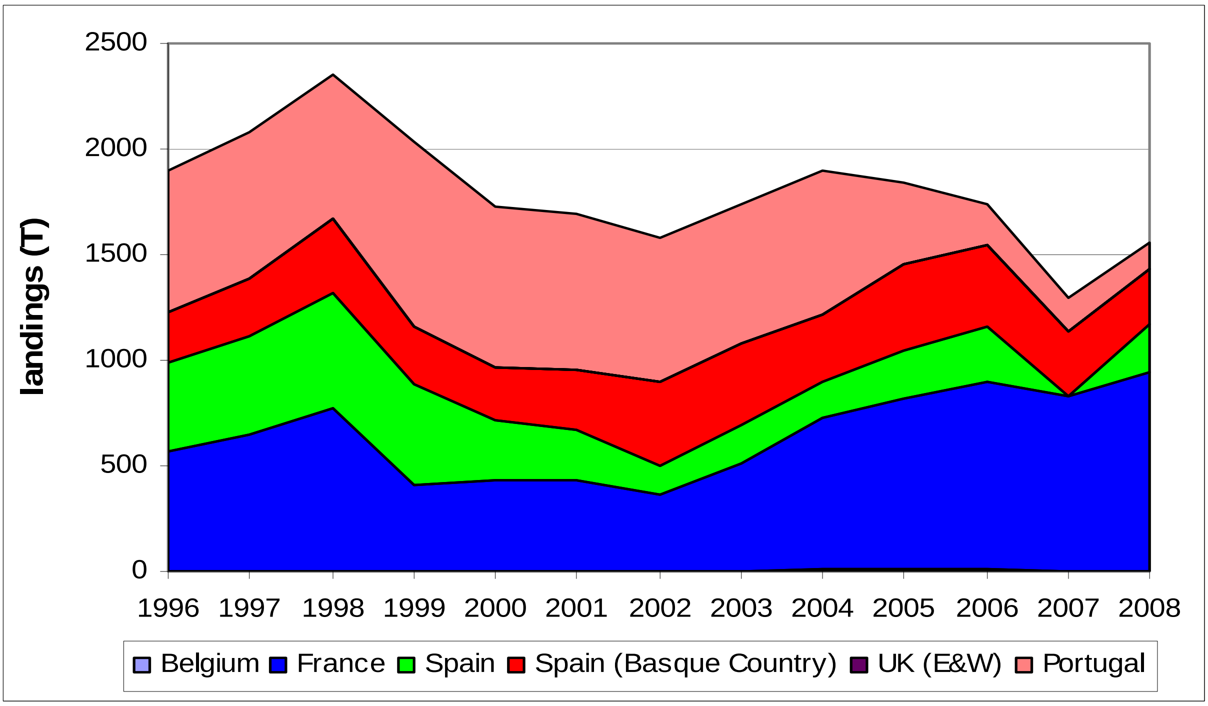


Figure 19.2. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Historical trend landings of Lesser-spotted dogfish in Subarea VIII and Division IXa. (Spanish landings data not available for 2007).

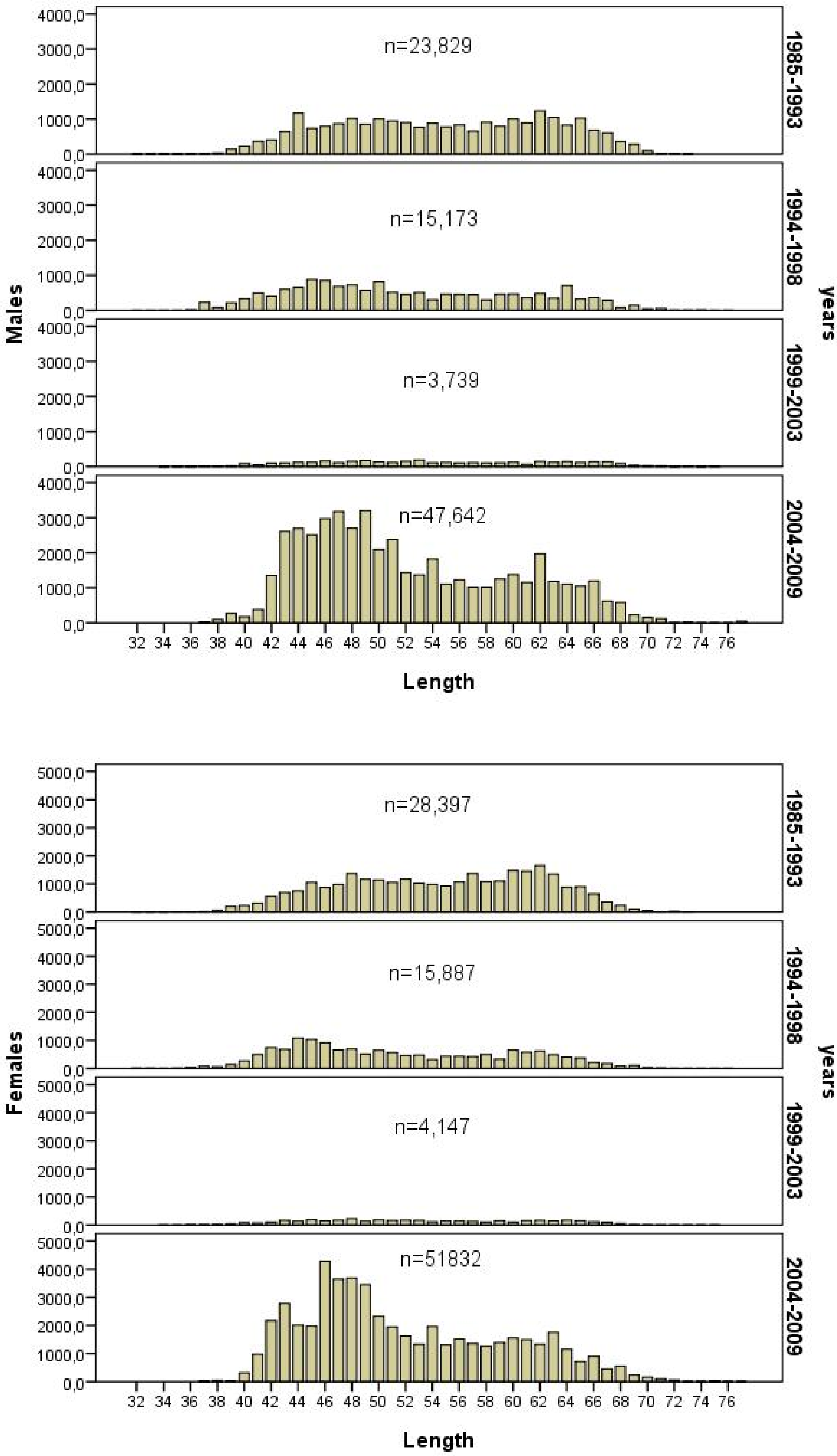
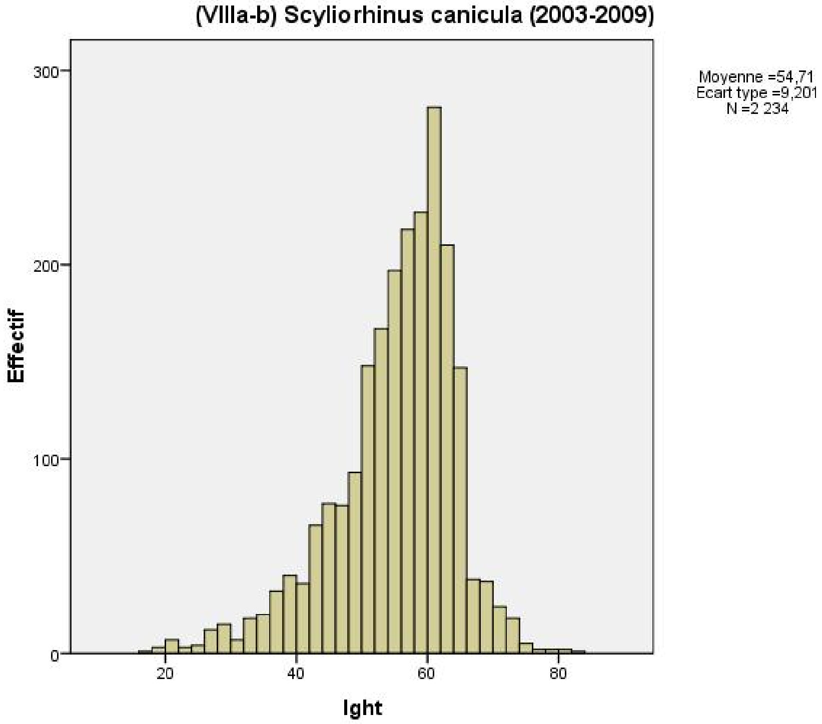


Figure 19.3a. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Length frequencies series from 1985 to 2009 (two first quarters of the year for 2009) by sex of the Cuckoo ray *L. naevus* caught in divisions VIIh and VIIIa.



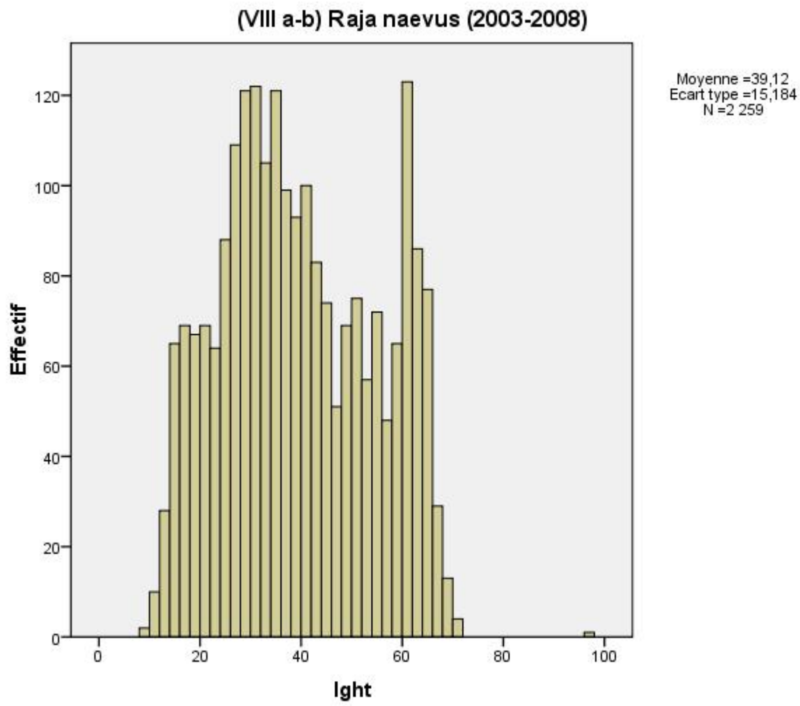


Figure 19.3b. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Length frequency distributions for *S. canicula* and *L. naevus* sampled in Divisions VIIIa–b in the period 2003–2009.

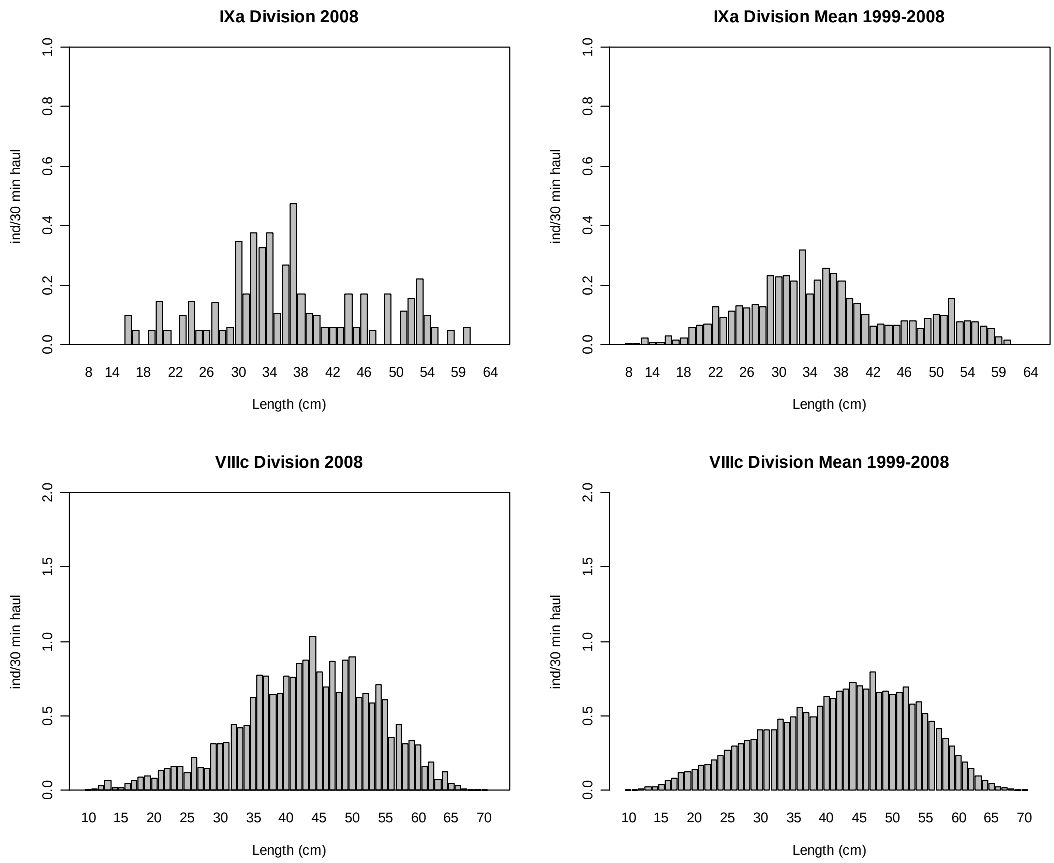


Figure 19.3c. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Stratified length distribution of lesser spotted dogfish (*S. canicula*), in the groundfish survey carried out in ICES Divisions IXa and VIIIc, during 2008 and mean values during the last decade (1999–2008).

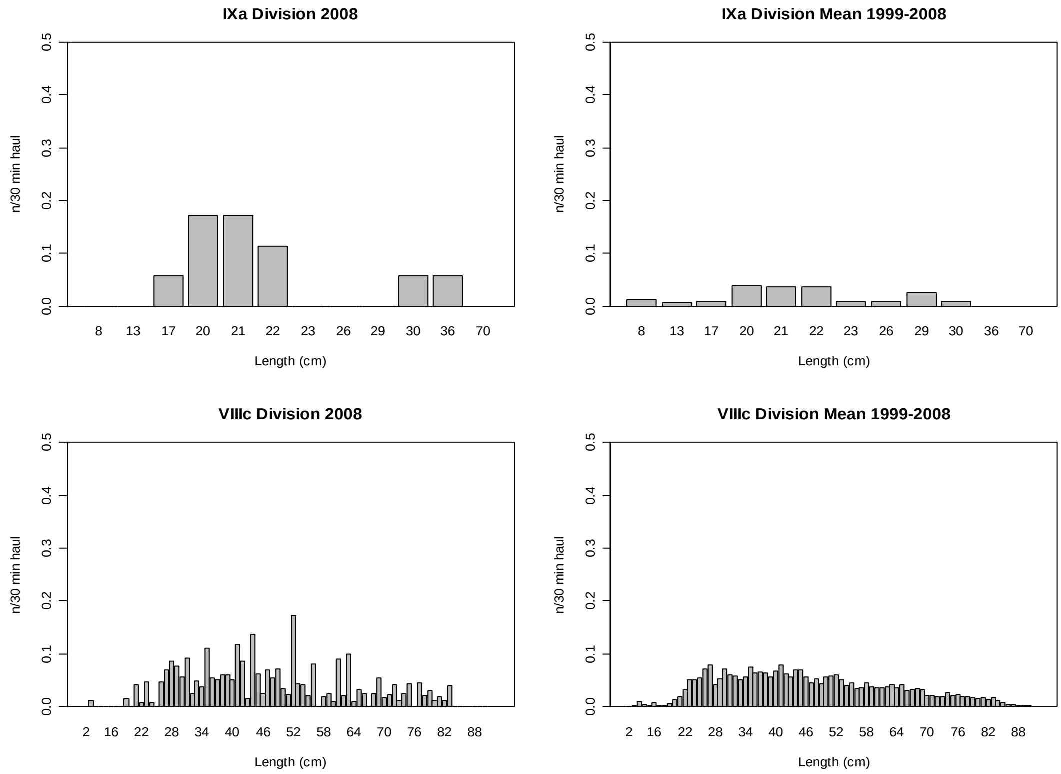


Figure 19.3d. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Stratified length distribution of thorny ray (*R. clavata*), in groundfish survey carried out in ICES Divisions IXa and VIIIc, during 2008 and mean values during the last decade (1999–2008).

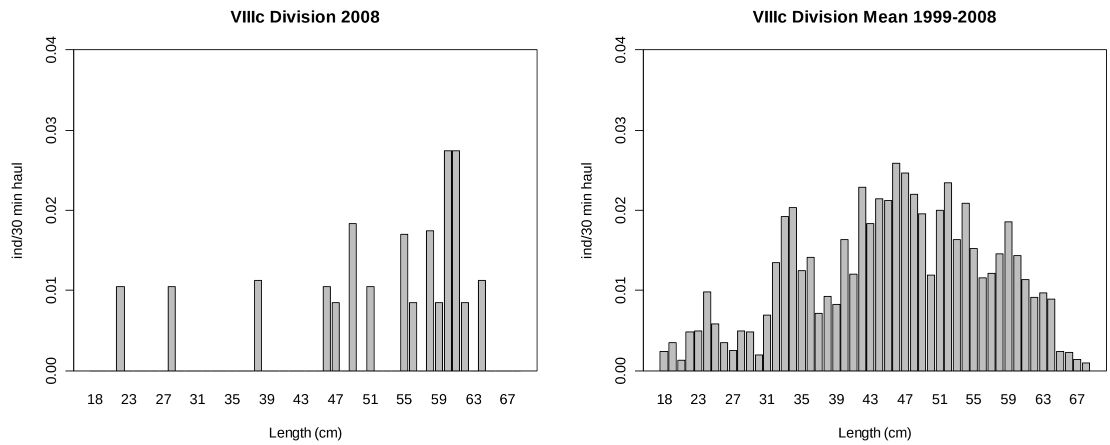


Figure 19.3e. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Stratified length distribution of cuckoo ray (*L. naevus*) in groundfish survey carried out in ICES Division VIIIc, during 2008 and mean values during the last decade (1999–2008).

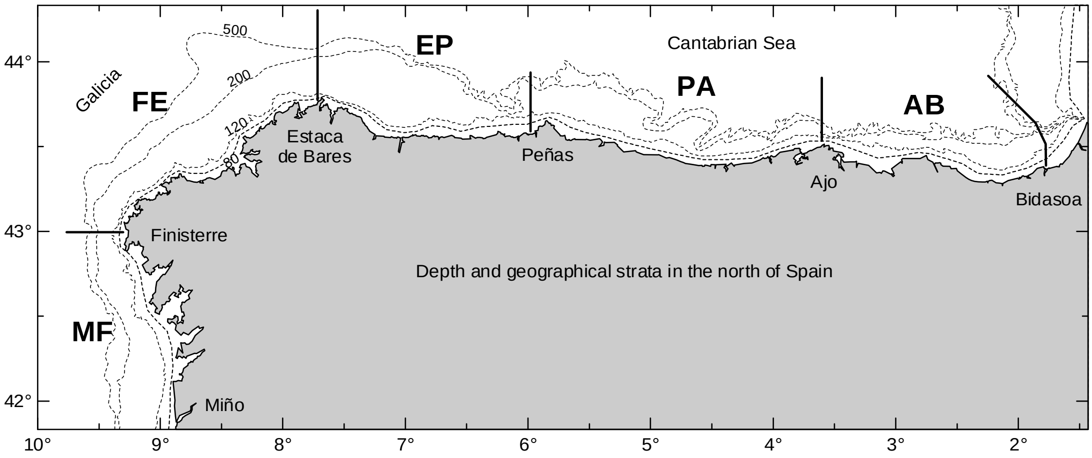


Figure 19.4. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Design of the IBTS North of Spanish Shelf groundfish survey showing geographical sectors and depth stratification.

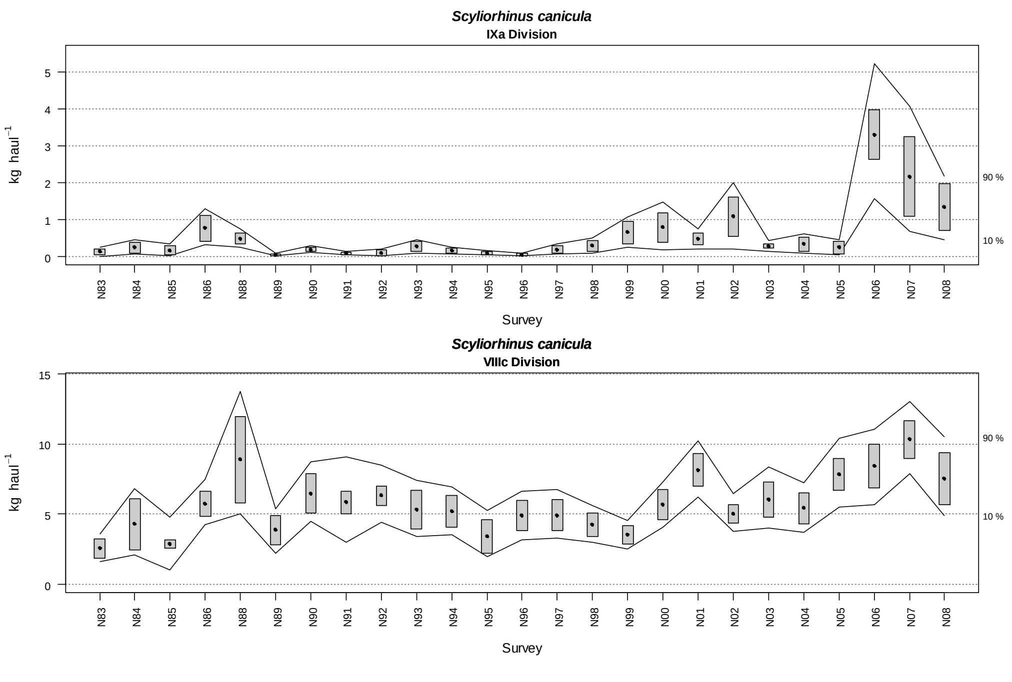


Figure 19.5. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Changes in lesser-spotted dogfish (*S. canicula*) biomass indices, in ICES Division IXa and VIIIc, during North Spanish Shelf Survey time-series (1983–2008). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (⚜ = 0.80, bootstrap iterations = 1000).

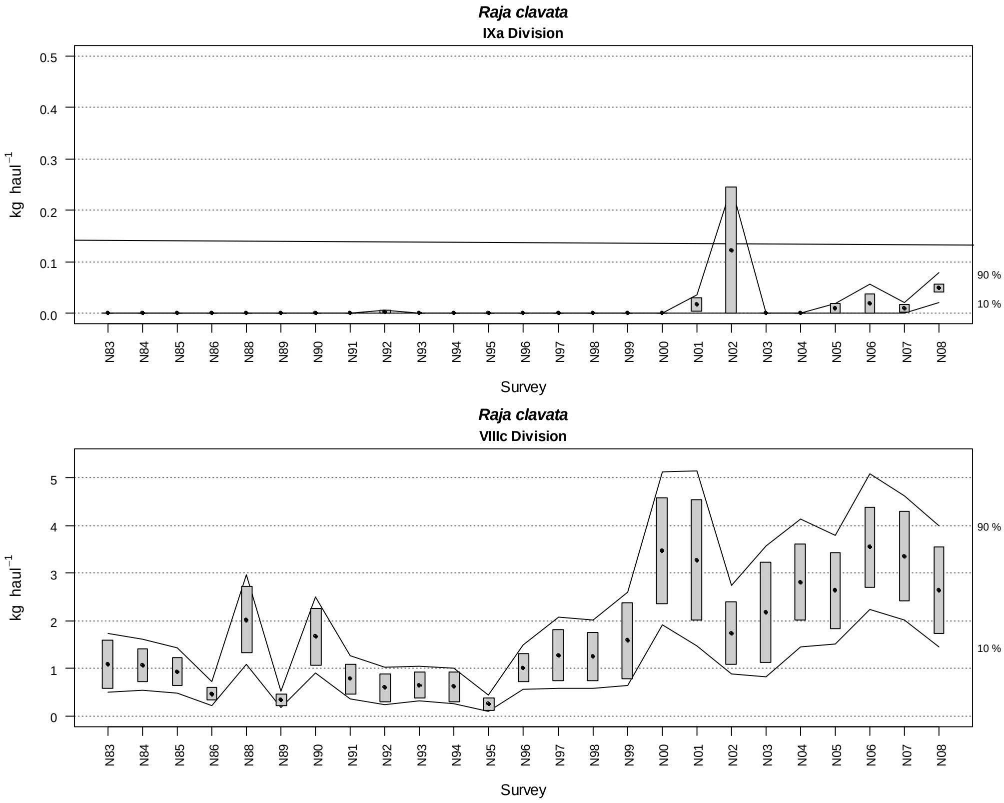


Figure 19.6. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Changes in thorny ray (*R. clavata*) biomass indices, in ICES Division IXa and VIIIc, during North Spanish Shelf time-series (1983–2008). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (⚜ = 0.80, bootstrap iterations = 1000).

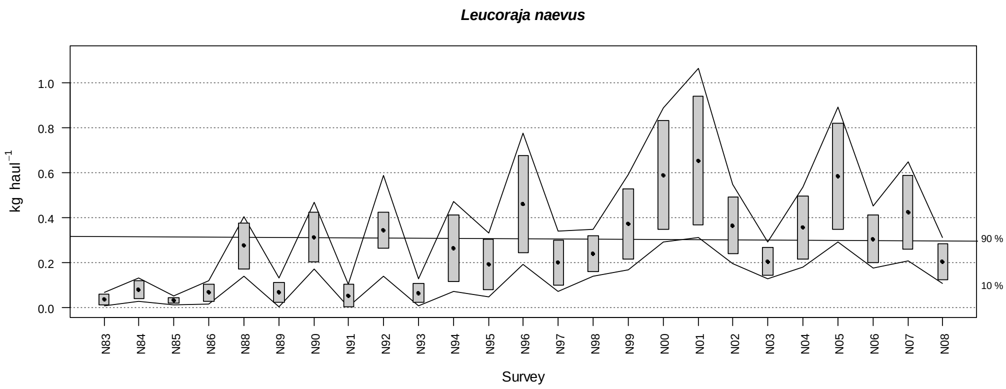
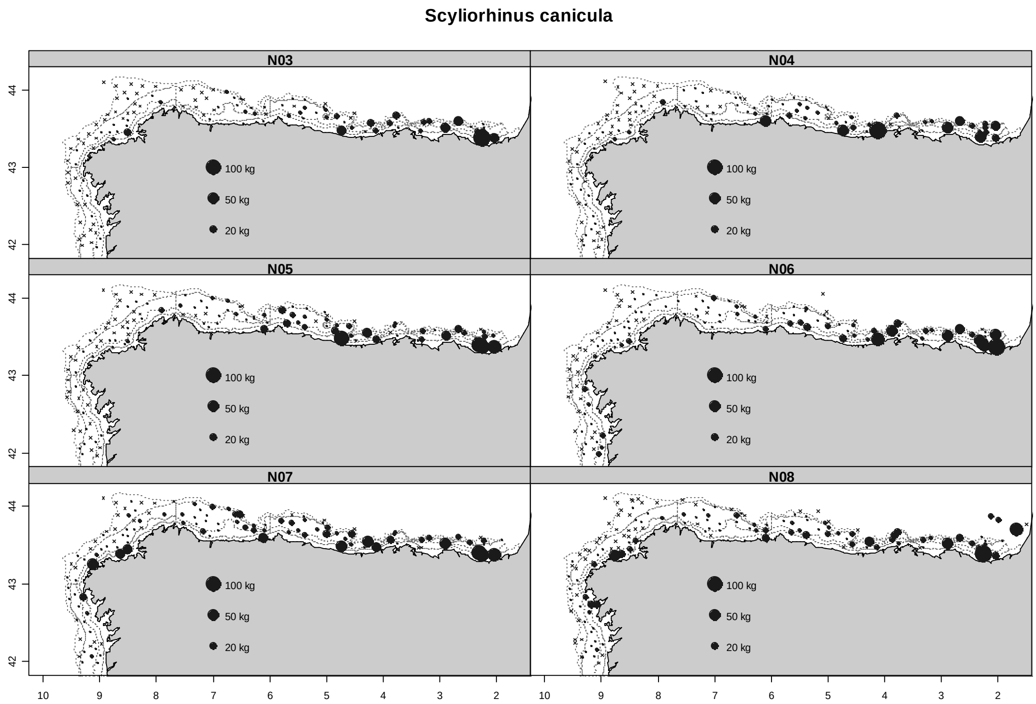
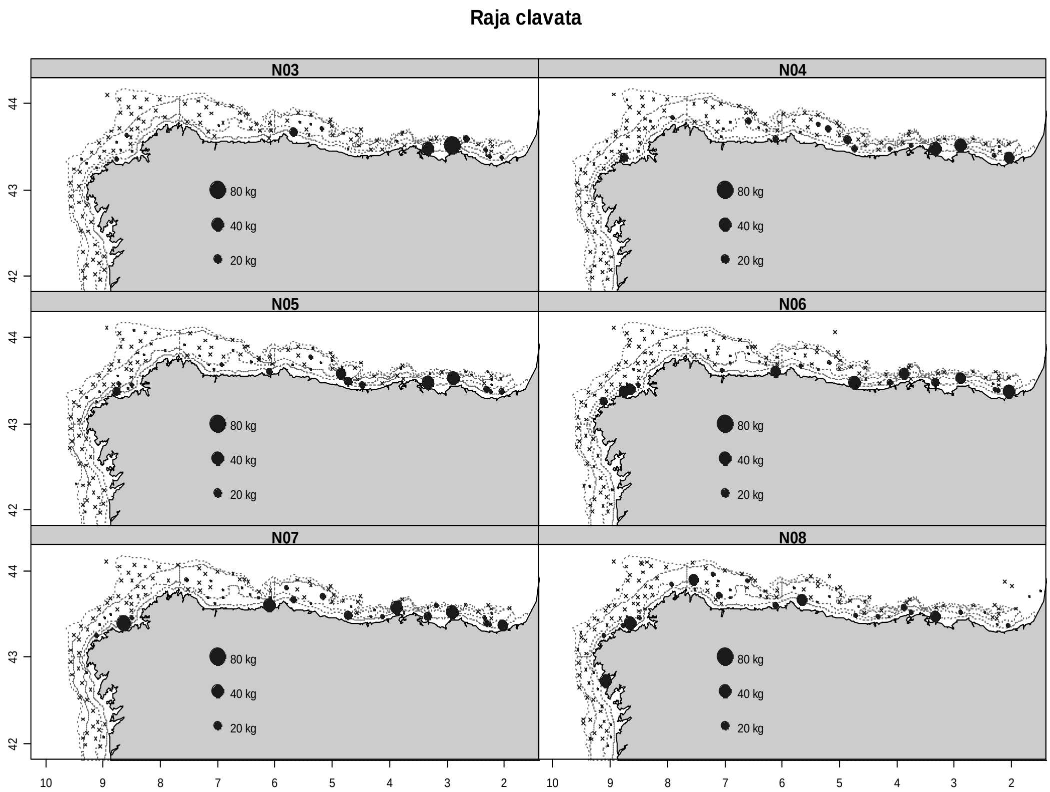


Figure 19.7. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Changes in cuckoo ray (*L. naevus*) biomass indices in VIIIc ICES Division during North Spanish Shelf time-series (1983–2008). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (⚜ = 0.80, bootstrap iterations = 1000).

a)


Scyliorhinus canicula
N03
N04
N05
N06
N07
N08
100 kg
50 kg
20 kg
44
43
42
10
9
8
7
6
5
4
3
2

b)


Raja clavata
N03
N04
N05
N06
N07
N08
80 kg
40 kg
20 kg
44
43
42
10
9
8
7
6
5
4
3
2

c)

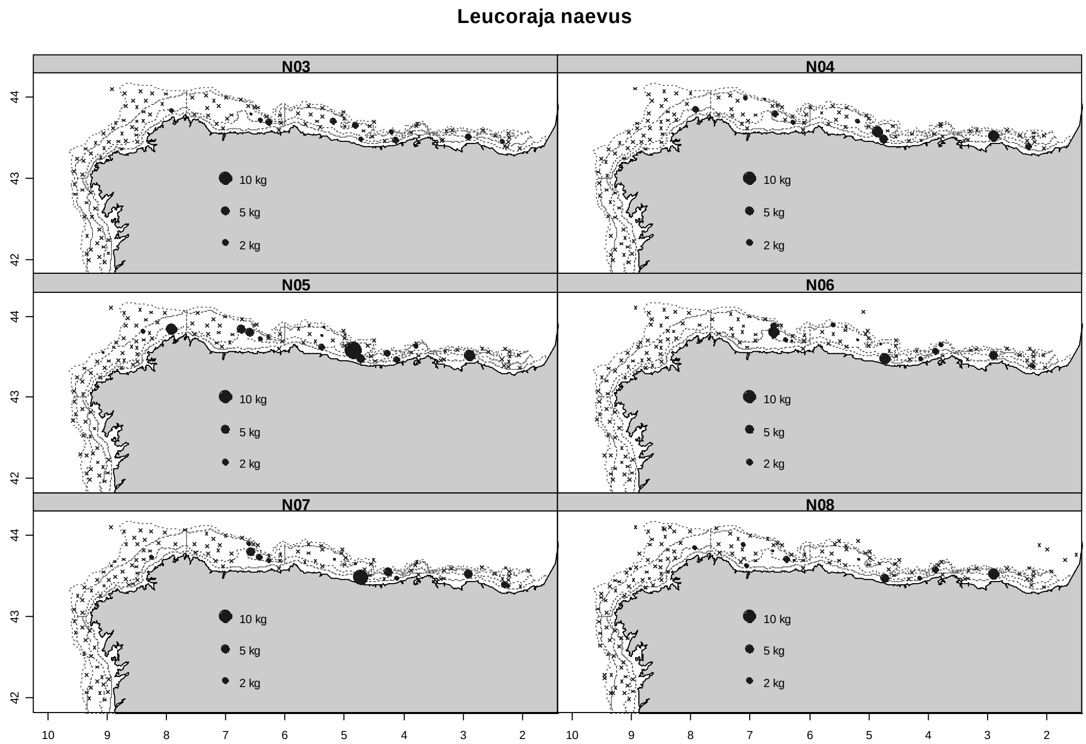


Figure 19.8a, b and c. Demersal elasmobranchs in the Bay of Biscay and Iberian Waters. Geographic distribution of lesser-spotted dogfish (*S. canicula*), thornback ray (*R. clavata*) and cuckoo ray (*L. naevus*) catches (kg/30 min haul) in North Spanish Shelf groundfish surveys (2002–2008).

20 Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge

20.1 Ecoregion 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 murinus, 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, such as Bigelow's ray *Rajella bigelowi,* 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 2007 and 2008

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

NEAFC has been adopted management measures for the MAR areas under its regulatory area. These include effort limitations, area and gear restrictions (http://www.neafc.org/measures). These recommendations include:

- Recommendation III (2006): Since 2006 NEAFC has prohibited fisheries with gillnets, entangling nets and trammelnets in depths below 200 m and introduced measures to remove and dispose of unmarked or illegal fixed gear and retrieve lost gear to minimize ghost fishing;
- Recommendation VII (2009): Since 2009 effort was limited and set at 65% of the highest level put into deep-sea fishing in previous years for the relevant species;
- Recommendation XVI (2008): The access to the new bottom fishing areas (considered as other areas not mapped as actual existing bottom fishing areas) was limited;
- Recommendations IX (2007) and IX (2008): Bottom fishing (Bottom trawling and fishing with static gear, including bottom-set gillnets and longlines) was forbidden in some areas of Hatton Bank and Rockall Bank;
- Recommendation XIV (2009): During 2009 five areas (including three seamounts), on the Mid-Atlantic Ridge in the high seas in the North East Atlantic, were closed temporarily to bottom fisheries (fishing gears which is likely to contact the seabed) under its policy for area management.

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).

In 1998, the Azorean government implemented local 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. During 2009 additional measures were implemented, including area restriction (temporary closure of the Condor Bank) and gear restriction by vessel type (licence and gear configuration).

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 (EC Reg no 1539/2008).

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.

Landings data from this ecoregion are also collated by NEAFC, and further studies to ensure that these data are consistent with ICES estimates are required.

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 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. The length frequency of samples is illustrated in Figure 20.3, and the absence of records of the youngest size classes in this survey will be a gear effect.

Information on elasmobranchs recorded on MAR is available from the literature (Hareide and Garnes, 2001) and was summarized in ICES, 2005. Some information on deep-water sharks was presented (Vinnichenko and Fomin, 2009 WD) and this is detailed in Sections 3 and 5.

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

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.

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

Vinnichenko, V.I. and Fomin K.Yu. 2009 WD. Russian research and fisheries of sharks and skates in the Northeast Atlantic in 2008. Working document presented to ICES WGEF 12 pp.

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	2008
Azores	Rajidae	99	117	103	83	68	70	89	72	50	62	70	72
France	Rajidae					2	.	.	.	.		0	0
Spain	Rajidae				24	29				.		0	
Azores	Bluntnose six-gill shark	n.a.	n.a.	n.a.	n.a.	n.a.	7	2	1	1	1	1	.
Azores	Sharks	n.a.	n.a.	6	18	22	n.a.	n.a.	n.a.	3	4	8	10
Total		99	117	109	125	121	77	91	73	53	63	71	73

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	2008
UK	Rays and skates	1	+	6	+	.			.
UK	Sharks	-	7	-	-	113			.
Total		1	7	6	0.8	113	.	.	.

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	2007	2008
UK	Rays and skates	+	+	-	-	-		.	.
Norway	Rajidae						6	.	1
Total		0.3	0.4	-	-	-	6	.	1

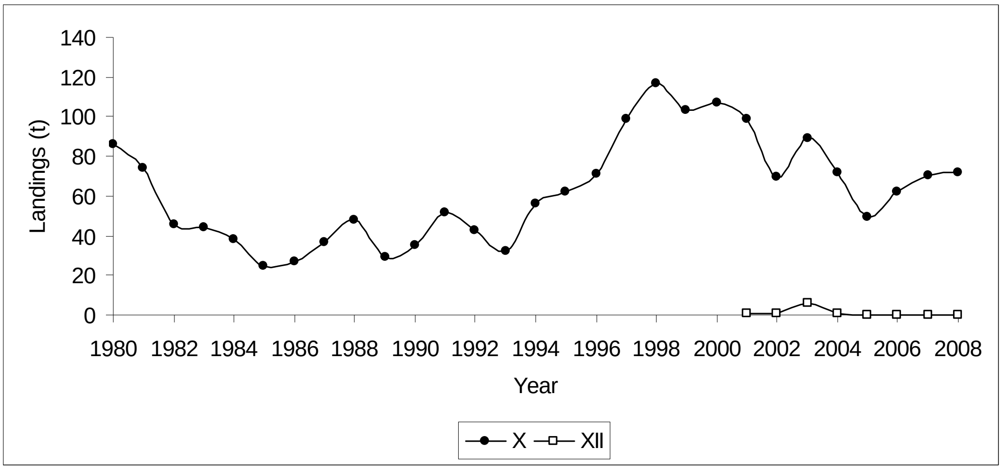


Figure 20.1. Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Historical landings of rays from Azores (Ices Subarea X) and MAR (ICES Subarea XII).

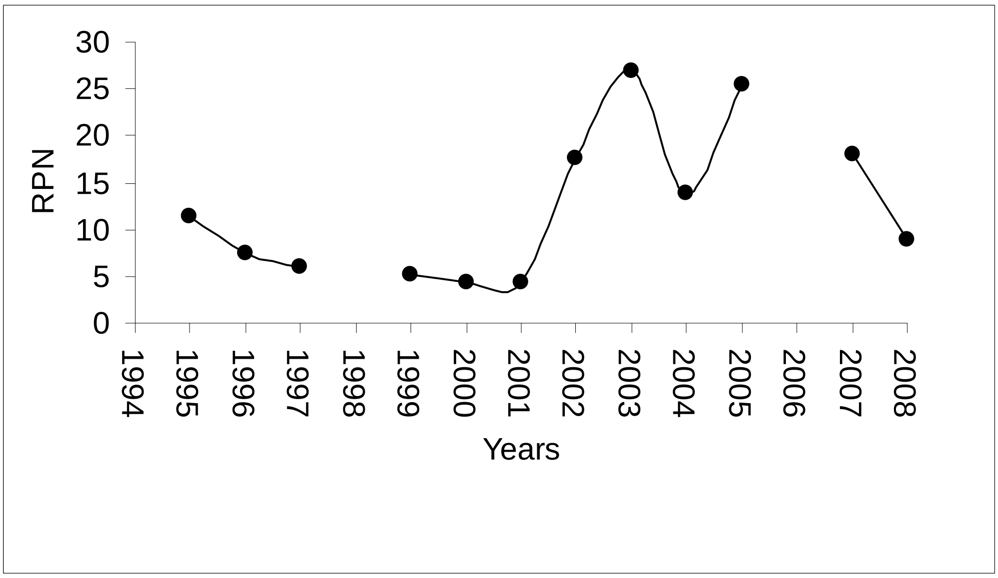


Figure 20.2. Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Survey annual Relative Population Numbers (RPN) of Raja clavata from the Azores (ICES X).

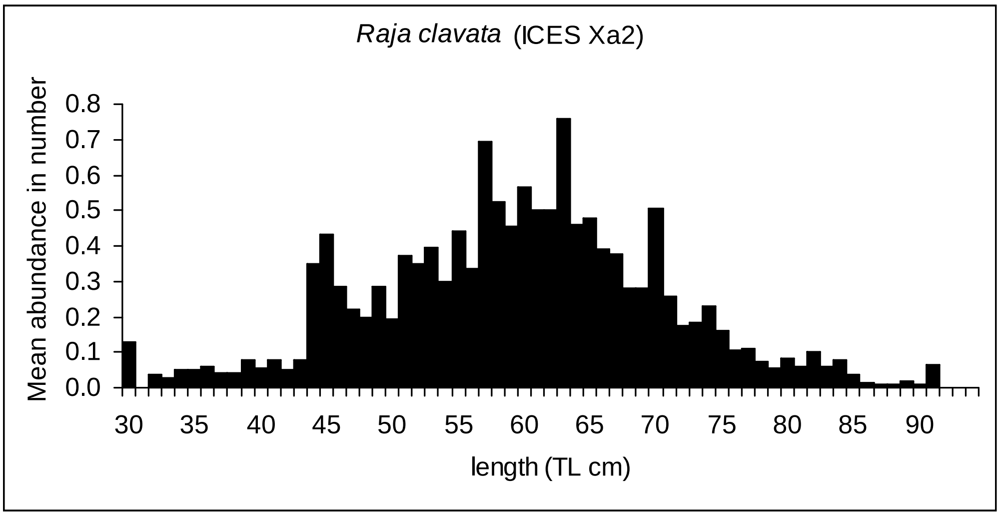


Figure 20.3. Demersal elasmobranchs in the Azores and Mid-Atlantic Ridge. Length frequency of *Raja clavata* caught at the Azorean demersal spring bottom longline surveys during the period 1995–2008.

21 Other issues

21.1 Evaluation of recent species-specific landings data for skates

This Section provides an overview on ToR (b), to "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".

Background

Within the EU, skates landings have traditionally been reported at the family level (mixed skates and rays) or at even a more generic level. However some nations have reported varying proportions of skates to species level, especially for the main species. Some nations also report landings of other batoids, such as stingrays and electric rays.

This situation has caused a lot of concerns to WGEF and in 2007 WGEF stated that the data collected for skates (Rajidae), and possibly other elasmobranchs, from market sampling and discard surveys were compromised by inaccurate species identification. As a consequence WGEF recommended that the ICES Planning Group on Commercial Catch, Discards, and Biological Sampling (PGCCDBS) provided the necessary supporting information to ensure that data collection (including species identification) and raising procedures (by gear, season, ICES Division and nation) for skate and ray sampling were standardized across laboratories.

In 2008 PGCCDBS analysed five examples (France, Portugal, Spain – AZTI, Spain – IEO and UK – Scotland) where estimates of landings were calculated at species level from the quantity landed of "mixed skate". PGCCDBS considered that methods of estimating the landings of individual species from identified groups of "mixed species" were well established and could be used on a routine basis. It also concluded that each country was in a position to estimate landings of individual species from grouped "mixed species" landings.

From 2008 onwards EC regulations stated that landings of *Leucoraja naevus, Raja clavata, Raja brachyura, Raja montagui, Amblyraja radiata* and *Dipturus batis* in ICES Division IIa and Subarea IV should be reported separately (Council Regulation (EC) No 40/2008 (16/01/2008).

At this meeting 2008 species-specific landing data for skates reported in the North Sea were analysed (see also Section 15). Here we provide a brief overview of the data presented by Member States with reference to the major concerns on species identifications which might reflect deficiencies that need to be corrected in future, particularly as these issues may well apply to other ecoregions, for which species-specific data will be collected from 2009.

UK (England and Wales)

In 2008 altogether 2486 t of 'batoids' were reported from UK-registered fishing vessels, of which 1055 t (42.5%) were recorded to species level and 1431 t recorded at a generic level, although there was considerable regional variation in the proportion of batoids that were reported to species level (Table 21.1). In Subarea IV (North Sea) the proportion of identified species was just under 50%.

The species composition of batoids being taken by UK-registered vessels by ICES region is demonstrated in Table 21.2. In Subarea IV, misidentification problems do not appear to be a major issue, although the proportions of *R. brachyura* and *R. monta-*

gui need to be viewed with some caution.

UK (Scotland)

A smaller proportion of Scottish landings were reported to species level, with small quantities of *Raja brachyura* and *Dipturus batis* reported (see Table 15.6).

The Netherlands

Up to 2008, the Netherlands reported skate landings at family level. From 2000 to 2007 the species composition of these landings was estimated from a market sampling programme conducted by researchers from IMARES. The results demonstrated that the species composition (based on market sampling) did not differ greatly between years (Table 21.3). In 2008, species-specific landings data were made available by the Dutch government. The fishers and market workers were presumably responsible for species identification.

In 2008 only a small proportion (~12%) of rays and skates were not discriminated to species level. The estimated landings of *Raja brachyura* (ca. 3%) appear to have decreased dramatically compared with previous years (2000–2007), when *R. brachyura* accounted for 14–31% of skates (Table 21.3). This difference may reflect misidentification between *R. brachyura* and *R. montagui*. In addition, it is possible that mixed landings of these sister taxa may be included within landings for *R. montagui* and also in the unspecified skate landings.

France

French landings have been reported at species level annually. The proportion of French landings assigned to Subarea IV has decreased between 1983 and 1997 and it has been more or less stable in the more recent years. The species composition of landings in Subarea IV is presented in Table 21.4.

Within the French landings data for which species were identified, the relative proportions of species varied between years (Figure 21.1). For example, the proportion of *Leucoraja naevus* has declined, whereas the proportion of *Raja clavata* has increased. This may reflect either differences in relative abundance of the species or spatial-temporal changes in the fishing grounds.

Germany

No landings discriminated by species in 2008 were provided.

Denmark

Danish landings in 2008 were not reported by species.

Belgium

In 2008 Belgium provided landing data mostly discriminated to species (Table 21.5), nearly 67% were discriminated by species. Compared with the previous years there were no major changes in the amount of skates landed. Nearly 68% of Belgian skate landings were from Subarea IV. In this subarea the landings with comprised primarily of *R. clavata* (59%), followed by *R. brachyura* (28%) and *R. montagui* (12%).

Identification issues

Table 21.6 summarizes the potential inconsistencies found.

What is apparent is that there is confusion between *Raja brachyura* and *R. montagui*.

Raja brachyura is a large-bodied species with a patchy distribution, and is locally abundant in parts of the southern North Sea (IVc). The smaller *R.montagui* is normally more abundant in the slightly deeper waters of IVb, c. UK (England and Wales) reported a greater proportion of *R. brachyura* (6.4%) than *R. montagui* in IVc, and vice versa in IVb. Belgian data indicated a much greater proportion of *R. brachyura* (27.8%) than *R.montagui*. Dutch data indicated a much greater proportion of *R.montagui* than *R. brachyura* (3.2%). In the Bay of Biscay, both France, and Basque Country (Spain) have reported data for spotted ray (between 0.5% and 9.5% of total catches in the last 10 years), but no species-specific data for *R. brachyura.* In the Division IXa Portugal reports landings of both species, however the specific composition in the landings of Basque Country (Spain) and Portugal is based in the extrapolation of proportions of species obtained as result of special port sampling carried out some years ago.

To resolve this problem, either improved training in species identification of these species, or these two species are allowed to be landed as a combined unit and it is ensured that there is sufficient market sampling (by gear, season and location) to split the landings, is required.

Recommendations

Taking into account the inconsistencies and deficiencies mentioned above and the fact that EC require that landings of skates and rays be better discriminated by species in other ICES subareas from 2009 (Table 21.7) WGEF recommends that:

- Due to changes that might occur in the specific composition of landings the sampling methodology be continuously appraised and updated;
- More detailed landings data discriminated by species (by gear, ICES rectangle and season) be available for analysis at WGEF;
- National laboratories ensure that appropriate identification material and training be available at port offices and for the fishing industry.

WGEF reiterates that improved species-specific data are required so that better assessments of the state of skate resources can be made and so that ICES can provide appropriate management advice.

In particular it is strongly recommended that dedicated studies for the development and implementation of sampling schemes towards the improved evaluation of fishing fleets and métiers catching rays and skates be undertaken on an appropriate temporal and spatial scale.

21.2 Photo-identification guide to elasmobranchs in the ICES area

This Section provides an overview on ToR (f), to "finalize the manuscript of a photo-ID key for elasmobranchs in the ICES area".

Several countries have provided guides for the identification of elasmobranchs, presented in slightly different formats. These guides are used mainly to improve the identification for fish samplers and fishers on vessels and in sampling ports and markets. Some examples of the design of guides can be seen in Figures 21.2–6.

WGEF urge that national laboratories finalize national guides in the coming year and make electronic copies of photographs (with appropriate © details) available to other laboratories.

21.3 Biological sampling of deep-water elasmobranchs during NEACS surveys

WGEF were given the following ToR: "to review the biological parameters that should be collected on the NEACS survey by stock in addition to those specified by PGNEACS".

Many deep-water sharks are data poor stocks and as such the collection of data from NEACS surveys would be of great use in the assessment and management of these species/stocks. There are several issues that need to be addressed, and WGEF have the following comments for PGNEACS:

21.3.1 Species identification

Several of the deep-water sharks and skates taken in the surveys can be easily misidentified, and the taxonomic knowledge of some families is poor. For example the genera *Centrophorus* and *Apristurus* are known to be problematic taxa. To improve species identification in surveys, efforts should be made to take and provide photographic images of the species (e.g. to the Zeus software; see ICES, 2008b), and national laboratories should be encouraged to retain any specimens of questionable identity, and one specimen of each species, where practicable.

There are ongoing international programmes to catalogue the DNA of various organisms, including fishes, such as:

Frozen Ark Project (http://www.frozenark.org/consortium.html);

FISHTRACE (http://www.fishtrace.org/);

Genome 10K.

Hence, preserving a small number of tissue samples in a suitable preservative and supplying these specimens to participants in such projects should be encouraged.

WGEF, WGDEEP and PGNEACS should work intersessionally to further develop existing identification keys/material, and distribute and test their utility on surveys.

21.3.2 Stock identification

Stock identification is obviously a major issue for the assessment process, and little is known about the stock structure of any deep-water elasmobranch. In the short term it is unclear as to what funding would be available for examining stock structure. Techniques that may provide useful include genetic studies and biological markers (e.g. cestodes in the spiral valve). Any project proposals could benefit from access to precollected samples, although given that resource may not become available, national laboratories may not want to collect and retain samples prior to such a project being developed.

Hence, the sampling proposed below is suggested to operate at a species-level across the survey area, and such data will also help inform on the stock identity. In future, sampling requirements may need to be refined if and when there is a better understanding of stock units.

21.3.3 Length and sex composition

Data on the length distributions, using total length for sharks and skates, and appropriate lengths for chimaeroids, as specified by PGNEACS (ICES 2008a) should be collected by sex at all stations. Additional data on the width of skates could also be useful, so that length–width conversion factors can be collected.

Such data will allow the length and sex compositions of all elasmobranchs to be examined in space and time, which would permit ICES to provide advice on potential spatial management, providing that survey coverage is adequate.

21.3.4 Biological sampling

Data on the sex, total weight, maturity stage and fecundity should be collected for all species, although such data need not be collected every year for all species (see Table 21.8).

It is suggested that the most commercially important species and the 'rare' and unusual species are sampled every year, with some of the more commonly occurring species that are of low/no commercial importance sampled on alternate surveys (e.g. squaliform sharks in year 1, and scyliorhinid sharks and holocephalans in year 2).

Maturity stages could initially follow the stages outlined below for oviparous (Table 21.9) and viviparous species (Table 21.10). These tables differ slightly from those originally proposed by Stehmann, 2002, and agreement and standardization of maturity keys for ICES-coordinated surveys is still required.

Fecundity data should be collected for uterine fecundity as a part of routine biological sampling, but only for those individuals that are not thought to have aborted/lost some pups.

The collection of such data could allow the preliminary identification of sites where important life-history stages (e.g. pregnant females) occur and so allow ICES to provide advice on potential spatial management.

PGCCDBS, PGNEACS, IBTSWG and WGEF could usefully convene a workshop on maturing staging of elasmobranchs and holocephalans, so that agreed maturity scales can be developed. Currently there are subtly different stages being used.

It is unlikely that chondrichthyan egg-cases will be collected by the survey gears, although the presence of egg-capsules should be recorded, especially if occurring in large numbers. Furthermore, when undertaking biological sampling of oviparous elasmobranchs, the fully formed capsules of each species encountered could usefully be retained and supplied to national zoology museums to facilitate the future development of egg-case field guides (e.g. the Shark Trust's egg case hunt, http://www.eggcase.org/).

21.3.5 Age structure

Although spines, caudal thorns and vertebrae can be used in age and growth studies, most national laboratories lack the expertise to read such structures. PGCCDBS could usefully convene a workshop examining the utility of age reading such structures, although this would require the participation of experts from outside national laboratories. If such a workshop is convened, then surveys should collect spines, etc. in preparation. Until then, there is limited rationale for deep-water surveys to collect spines or other ageing material.

21.3.6 Optimal sampling regimes

Analyses of existing data should be undertaken prior to recommending optimal sample sizes, although full sampling of the less common species should be implemented, and this should not cause too much of an additional work load.

21.4 References

ICES. 2008a. Report of the Planning Group on the North-east Atlantic Continental Slope Survey (PGNEACS), 29 January–1 February 2008, Galway, Ireland. ICES CM 2008/LRC:02. 38 pp.

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

Stehmann, M.F.W. 2002. Proposal of a maturity stages scale for oviparous and viviparous cartilaginous fishes (Pisces, Chondrichthyes), Archive of Fishery and Marine Research. 50(1): 23–48.

Table 21.1. The proportion of batoids landed by UK-registered vessels that were recorded to species level by ICES Division (2008 data).

ICES Division	Reported UK landings (tonnes):			Recorded to species level (%)
	Total batoids	Species level	SKA	
IVa	0.0	0.0	0.0	0.0%
IVb	79.8	25.6	54.2	32.1%
IVc	339.2	179.3	159.9	52.9%
VIa	5.7	4.2	1.5	73.2%
VIb	0.4	0.0	0.4	0.0%
VIIa	255.9	120.0	135.9	46.9%
VIIb	73.6	59.6	14.0	81.0%
VIIc	2.8	2.2	0.6	77.6%
VIId	201.6	38.9	162.7	19.3%
VIIe	469.2	73.7	395.4	15.7%
VIIf	638.9	247.4	391.5	38.7%
VIIg	108.9	75.1	33.8	69.0%
VIIg	164.4	141.5	22.9	86.1%
VIIJ	143.6	87.9	55.7	61.2%
VIIK	0.5	0.0	0.5	0.0%
VIIIA	1.3	0.0	1.3	0.3%
VIIIB	0.2	0.0	0.2	0.0%
Total	2486.3	1055.5	1430.8	42.5%

Table 21.2. 2008 UK (E&W) landings data; species composition of batoids by ICES Division.

Group	Species	IVb	IVc	VIa	VIIa	VIIb	VIIc
BATOIDS – SKATES	*Amblyraja radiate*	-	-	-	-	-	-
	Dipturus batis	0.0%	0.1%		-	0.3%	-
	D. nidarosiensis	-	-	5.1%	-	14.4%	38.9%
	D. oxyrinchus	-	-	-	-	2.6%	1.1%
	Leucoraja circularis	0.0%	-		0.1%	-	-
	L. fullonica	-	-		-	-	-
	L. naevus	0.8%	-	76.8%	0.7%	54.4%	29.9%
	Raja brachyura	1.9%	6.4%		1.6%	0.1%	-
	R. clavata	79.3%	92.2%	18.1%	97.6%	28.0%	30.2%
	R. microocellata	-	-		-	-	-
	R. montagui	18.0%	1.4%		0.0%	-	-
	R. undulate	-	-	-	-	-	-
	Rostroraja alba	-	-		-	0.1%	-
BATOIDS – OTHERS	*Torpedo marmorata*	-	-	-	-	-	-
	T. nobiliana	-	-	-	-	-	-
	Dasyatis pastinaca	0.0%	-		-	-	-

Table 21.2. continued. 2008 UK (E&W) landing data; species composition of batoids recorded to species level by ICES Division.

Species	VIId	VIIe	VIIf	VIIg	VIIh	VIIj	VIIIa
A. radiata	-	0.6%	0.0%	-	0.4%	-	-
D. batis	0.0%	3.0%	1.5%	2.8%	7.5%	5.8%	-
D. nidarosiensis	-	-	0.0%	7.0%	10.2%	21.7%	-
D. oxyrinchus	1.1%	0.0%	-	5.3%	3.3%	11.4%	-
L. circularis	-	0.1%	3.8%	4.8%	0.3%	-	-
L. fullonica	0.0%	0.1%	0.6%	10.9%	1.3%	1.0%	-
L. naevus	-	38.6%	4.0%	9.1%	69.8%	45.9%	25.0%
R. brachyura	27.9%	43.9%	31.1%	23.5%	2.6%	0.7%	50.0%
R. clavata	58.9%	3.0%	27.6%	24.8%	0.1%	12.5%	-
R. microocellata	1.9%	4.4%	28.0%	11.3%	4.4%	0.2%	25.0%
R. montagui	6.1%	5.2%	3.3%	0.3%	0.0%	0.0%	-
R. undulata	4.1%	1.1%	-	-	-	-	-
R. alba	-	-	-	0.2%	-	0.9%	-
T. marmorata	-	0.0%	-	-	-	-	-
T. nobiliana	-	-	0.0%	-	-	-	-
D. pastinaca	-	-	-	-	-	-	-

Table 21.3. Dutch annual landings of skates and rays in the North Sea and eastern English Channel. Data from 2000–2007 were estimated based on market sampling programmes, 2008 data correspond to the official declarations.

SPECIES	2000	2001	2002	2003	2004	2005	2006	2007	2008
A. radiata	1 (0.2%)	2 (0.2%)				1 (0.2%)			
L. naevus	3 (0.5%)	4 (0.5%)				1 (0.2%)			0 (<0.1%)
R. brachyura	136 (19.6%)	115 (13.8%)	250 (31.1%)	185 (26.9%)	116 (20.7%)	169 (29.8%)	156 (25.3%)	215 (28.9%)	16 (3.2%)
R. clavata	265 (38.2%)	315 (37.7%)	227 (28.1%)	185 (27.0%)	217 (38.7%)	132 (23.3%)	252 (40.9%)	250 (33.6%)	201 (39.9%)
R. montagui	288 (41.5%)	399 (47.8%)	329 (40.8%)	317 (46.1%)	228 (40.6%)	263 (46.5%)	209 (33.8%)	278 (37.4%)	286 (56.8%)
Ray unknown									0 (<0.1%)
Skate									0 (<0.1%)
Skates and Rays									74

Table 21.4. France annual rays and skates landing data by species (Subarea IV).

Species	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Leucoraja naevus	40.8	89.0	48.8	45.7	46.5	26.2	15.1	16.2	8.4	10.8	5.5	2.0	1.2
Raja clavata	1.6	2.6	11.3	6.5	8.3	3.3	12.7	3.2	7.5	6.0	2.8	3.4	0.6
Raja montagui	2.9	2.2	1.0	0.3	0.5	0.1	1.7	0.3	1.1	1.4	0.4	0.3	0.0
Dipturus batis	4.1	9.2	67.4	61.6	54.7	47.7	31.4	32.4	39.9	36.5	16.7	13.5	9.7
Dasyatis pastinaca													
Myliobatis aquila													
Leucoraja circularis										1.3	1.0		0.0
Leucoraja fullonica	4.6	14.2	8.5	12.1	15.9	8.8	4.5	3.6	2.0	2.2	1.2	0.6	0.5
Torpedo marmorata													
Dipturus oxyrinchus									1.5	5.9	3.7	2.9	0.8
Raja	10.3	21.9	11.8	0.0	0.5	0.0	0.1		0.6				
Rajidae	20.9	20.6	84.4	66.8	121.2	102.5	90.2	96.2	108.2	82.6	116.0	58.6	72.6
Elasmobranchii			0.2	0.0					0.6	1.0			

Species	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Leucoraja naevus	0.7	0.2			0.6	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.5
Raja clavata	0.3	0.2		0.0	0.4	13.7	2.3	0.5	0.4		0.7	0.3	2.1
Raja montagui	0.0	0.0			0.0	2.0	0.0	0.0	0.0		0.0		0.1
Dipturus batis	15.6	15.0		1.1	2.7	3.7	1.0	0.1	0.1	0.4	0.1	0.0	0.0
Dasyatis pastinaca								0.0	0.0	0.0	0.0	0.1	0.0
Myliobatis aquila							0.1						
Leucoraja circularis	0.0				0.0	0.0							
Leucoraja fullonica	0.2	0.2		0.0	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Torpedo marmorata						0.0	0.1						
Dipturus oxyrinchus	0.7	0.3		0.0	1.4	1.2	0.8	1.3	1.5	0.2	0.0	0.1	0.7
Raja													
Rajidae	70.0	49.6	47.0	39.0	26.0	38.2	52.4	38.7	40.9	41.3	54.7	55.6	64.0
Elasmobranchii				0.8	1.5		4.6	0.3					

Table 21.5. Belgian landings of skates in ICES Subarea IV in 2008. 67% were identified to species level.

SPECIES	TONNES	%
A. radiata	0.1	0.0
L. naevus	3.0	1.2
R. brachyura	69.2	27.8
R. clavata	147.2	59.2
R. montagui	29.2	11.8
D. batis	0.0	0.0
Raja species	122.7	
TOTAL	371.4	100.0
% not species identified	33.0	

Table 21.6. Inconsistencies in the identification of skate species in different ICES Division/Subarea.

ICES DIVISION/SUBAREA	SPECIES	INCONSISTENCY	COMMENT
VIIa Irish Sea	*Leucoraja circularis*	UK (E&W)	Outside species normal distribution, may refers to smalleyed ray
VIIb–c West of Ireland	*Dipturus nidarosiensis* *Dipturus batis* *Dipturus oxyrinchus* *Rostroraja alba*	UK (E&W)	Port sampling to confirm the proportions of long-nosed, common and Norwegian skates should be considered
VIId Eastern English Channel	*Dipturus batis* *Dipturus oxyrinchus* *Leucoraja fullonica*	UK (E&W)	possible misidentifications/misreporting
VIIe Western English Channel	*Leucoraja circularis,* *Dipturus oxyrinchus* *Leucoraja circularis*	UK (E&W)	possible misidentifications/misreporting
VIIf Bristol Channel	*Dipturus nidarosiensis* *Dipturus oxyrinchus*	UK (E&W)	Outside normal species distribution
VIIf, g	*Leucoraja circularis*	Belgium	Species rare/absent from VIIf may be confused with *Raja microocellata*
VIIh Southern Celtic Sea	*Amblyraja radiata*	UK (E&W)	Outside normal species distribution
IV North Sea	*Raja brachyura*	France, Netherlands	This species may be contained within reported landings of *Raja montagui*

Table 21.7. Requirements for the landings of skates and rays (Rajidae) according to Council Regulation (EC) No 43/2009 of 16 January 2009 fixing for 2009 the fishing opportunities and associated conditions for certain fish stocks and groups of fish stocks, applicable in Community waters and, for Community vessels, in waters where catch limitations are required.

	IIa and IV	IIIa	VIa–b and VIIa–c, e–k	VIId	VIII and IX
Species reported separately	*Leucoraja naevus* *Raja clavata* *Raja brachyura* *Raja montagui* *Amblyraja radiata*	*Leucoraja naevus* *Raja clavata* *Raja brachyura* *Raja montagui* *Amblyraja radiata*	*Leucoraja naevus* *Raja clavata* *Raja brachyura* *Raja montagui* *Raja microocellata* *Leucoraja circularis* *Leucoraja fullonica*	*Leucoraja naevus* *Raja clavata* *Raja brachyura* *Raja montagui* *Amblyraja radiata*	*Leucoraja naevus* *Raja clavata*
Bycatch quota	Remaining species shall not comprise >25% by live weight of catch retained on board Applicable vessels >15 m length overall				
Species that may not be retained on board and shall be promptly released unharmed to the extent practicable	*Dipturus batis*	*Dipturus batis*	*Dipturus batis* *Raja undulata* *Rostroraja alba* *Raja (Dipturus) nidarosiensis*	*Dipturus batis* *Raja undulata*	*Dipturus batis* *Raja undulata* *Rostroraja alba*
MS excluded			Lithuania		

Table 21.8. Proposal of sampling regime for elasmobranch species.

Family	Scientific name	Common name	Sampling regime
Hexanchidae	*Heptranchias perlo*	Sharpnose sevengill shark	Annual
	Hexanchus griseus	Six-gilled shark	Annual
	Hexanchus nakamurai	Bigeye sixgill shark	Annual
Chlamydoselachidae	*Chlamydoselachus anguineus*	Frilled shark	Annual
Mitsukurinidae	*Mitsukurina owstoni*	Goblin shark	Annual
Etmopteridae	*Centroscyllium fabricii*	Black dogfish	Year 1
	Etmopterus princeps	Great lanternshark	Year 1
	Etmopterus pusillus	Smooth lanternshark	Year 1
	Etmopterus spinax	Velvet belly	Year 1
Somniosidae	*Centroscymnus coelolepis*	Portuguese dogfish	Annual
	Centroselachus crepidater	Longnose velvet dogfish	Year 1
	Centroscymnus cryptacanthus	Shortnose velvet dogfish	Year 1
	Scymnodalatias garricki	Azores dogfish	Annual
	Scymnodon obscurus	Smallmouth velvet dogfish	Annual
	Scymnodon ringens	Knifetooth dogfish	Annual
	Somniosus microcephalus	Greenland shark	Annual
	Somniosus rostratus	Little sleeper shark	Annual
Oxynotidae	*Oxynotus centrina*	Angular roughshark	Annual
	Oxynotus paradoxus	Sailfin roughshark	Annual
Dalatiidae	*Dalatias licha*	Darkie charlie	Annual
	Squaliolus laticaudus	Spined pygmy shark	Annual
Centrophoridae	*Centrophorus granulosus*	Gulper shark	Annual
	Centrophorus lusitanicus	Lowfin gulper shark	Annual
	Centrophorus squamosus	Leafscale gulper shark	Annual
	Centrophorus uyato	Little gulper shark	Annual
	Deania calcea	Birdbeak dogfish	Year 1
	Deania hystricosa	Rough longnose dogfish	Year 1
	Deania profundorum	Arrowhead dogfish	Year 1
Echinorhinidae	*Echinorhinus brucus*	Bramble shark	Annual
Scyliorhinidae	*Apristurus aphyodes*	-	Year 2
	Apristurus laurussonii	Iceland catshark	Year 2
	Apristurus manis	Ghost catshark	Year 2
	Apristurus microps / A. madeirensis	Smalleye catshark	Year 2
	Apristurus nasutus	Largenose catshark	Year 2
	Apristurus melanoasper	Black roughscale catshark	Year 2
	Galeus atlanticus	Atlantic sawtail cat shark	Year 2
	Galeus melastomus	Blackmouthed dogfish	Year 2
	Galeus murinus	Mouse catshark	Year 2
Pseudotriakidae	*Pseudotriakis microdon*	False catshark	Annual
Rajidae	*Amblyraja hyperborea*	Arctic skate	Annual
	Amblyraja jenseni	Jensen's skate	Annual
	Amblyraja radiata	Starry ray	Annual
	Bathyraja pallida	Pale ray	Annual

Family	Scientific name	Common name	Sampling regime
	Bathyraja richardsoni	Richardson's ray	Annual
	Bathyraja spinicauda	Spinetail ray	Annual
	Dipturus batis	Common skate	Annual
	Dipturus linteus	Sailray	Annual
	Dipturus nidarosiensis	Black skate	Annual
	Dipturus oxyrinchus	Long-nose skate	Annual
	Malacoraja kreffti	Krefft's ray	Annual
	Malacoraja spinacidermis	Roughskin skate	Annual
	Neoraja caerulea	Blue ray	Annual
	Neoraja iberica	Iberian pigmy skate	
	Rajella bathyphila	Deepwater ray	Annual
	Rajella bigelowi	Bigelow's ray	Annual
	Rajella fyllae	Round skate	Annual
	Rajella kukujevi	Mid-Atlantic skate	Annual
Chimaeridae	*Hydrolagus lusitanicus*		Year 2
	Chimaera monstrosa	Rabbit fish	Year 2
	Hydrolagus affinis	Smalleyed rabbitfish	Year 2
	Hydrolagus mirabilis	Large-eyed rabbitfish	Year 2
	Hydrolagus pallidus	-	Year 2
Rhinochimaeridae	*Harriotta haeckeli*	Smallspine spookfish	Year 2
	Harriotta raleighana	Narrownose chimaera	Year 2
	Rhinochimaera atlantica	Spearnose chimaera	Year 2

Table 21.9. Maturity scale for oviparous sharks, skates, and chimaeras.

Maturity stage	Males	Females
A (Immature)	Claspers undeveloped, shorter than extreme tips of posterior margin of pelvic fin. Testes small and thread-shaped.	Ovaries small, gelatinous or granulated, but with no differentiated oocytes visible. Oviducts small and thread-shaped, width of shell gland not much greater than the width of the oviduct.
B (Maturing)	Claspers longer than posterior margin of pelvic fin, their tips more structured, but the claspers are soft and flexible and the cartilaginous elements are not hardened. Testes enlarged, sperm ducts beginning to meander.	Ovaries enlarged and with more transparent walls. Oocytes differentiated in various small sizes (<5 mm). Oviducts small and thread-shaped, width of the shell gland greater than the width of the oviduct, but not hardened.
C (Mature)	Claspers longer than posterior margin of pelvic fin, cartilaginous elements hardened and claspers stiff. Testes enlarged, sperm ducts meandering and tightly filled with sperm.	Ovaries large with enlarged oocytes (>5 mm), with some very large, yolk-filled oocytes (ca. 10 mm) also present. Uteri enlarged and wide, shell gland fully formed and hard.
D (Active)	Clasper reddish and swollen, sperm present in clasper groove, or flows if pressure exerted on cloaca.	Egg capsules beginning to form in shell gland and partially visible in uteri, or egg capsules fully formed and hardened and in oviducts/uteri.

Table 21.10. Maturity scale for aplacental and placentally viviparous sharks.

MATURITY STAGE	MALES	FEMALES
A	Immature: Claspers undeveloped, shorter than extreme tips of posterior margin of pelvic fin. Testes small and thread-shaped, sperm ducts straight.	Immature: Ovaries small, gelatinous or granulated, but no differentiated oocytes visible. Oviducts small and thread-shaped, width of shell gland not much greater than the width of the oviduct.
B	Maturing: Claspers longer than posterior margin of pelvic fin, their tips more structured, but the claspers are soft and flexible and the cartilaginous elements are not hardened. Testes enlarged, sperm ducts beginning to meander.	Maturing: Ovaries enlarged and with more transparent walls. Oocytes differentiated in various small sizes (usually <5 mm) and pale in colour. Oviducts small and thread-shaped, width of the shell gland greater than the width of the oviduct, but not hardened.
C	Mature: Claspers longer than posterior margin of pelvic fin, cartilaginous elements hardened and claspers stiff. Testes enlarged, sperm ducts meandering and tightly filled with sperm.	Mature: Ovaries large with very large, yolk-filled oocytes, (often 10–30 mm in diameter). Shell gland fully formed and hard. Uteri fully developed but without yolky matter (Stage D) or embryos (Stages E–F) and not dilated (Stage G).
D	Active: Clasper reddish and swollen, sperm present in clasper groove, or flows if pressure exerted on cloaca.	Early gravid: Uteri filled with yolky matter, which may appear unsegmented, or if segmented, without visible embryos.
E		Mid-term gravid: Uteri filled with yolk sacs and small developing embryos that can be counted.
F		Late gravid: Uteri filled with well-developed term pups, and the yolk sac has been absorbed (or is very small).
G		Post partum: Similar to stage C, but with a greater number of degenerating follicles and uteri dilated.

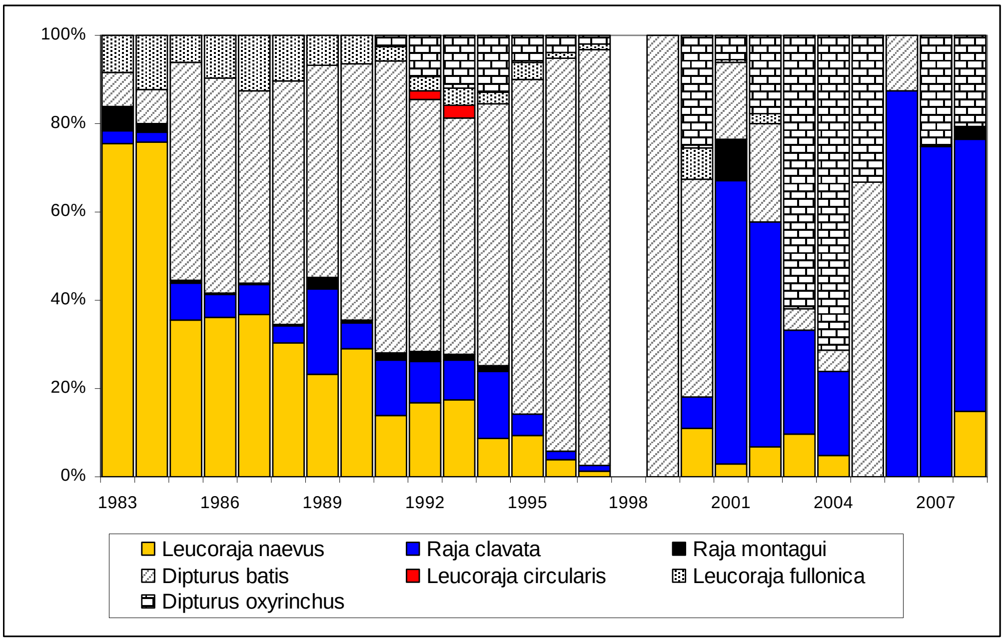
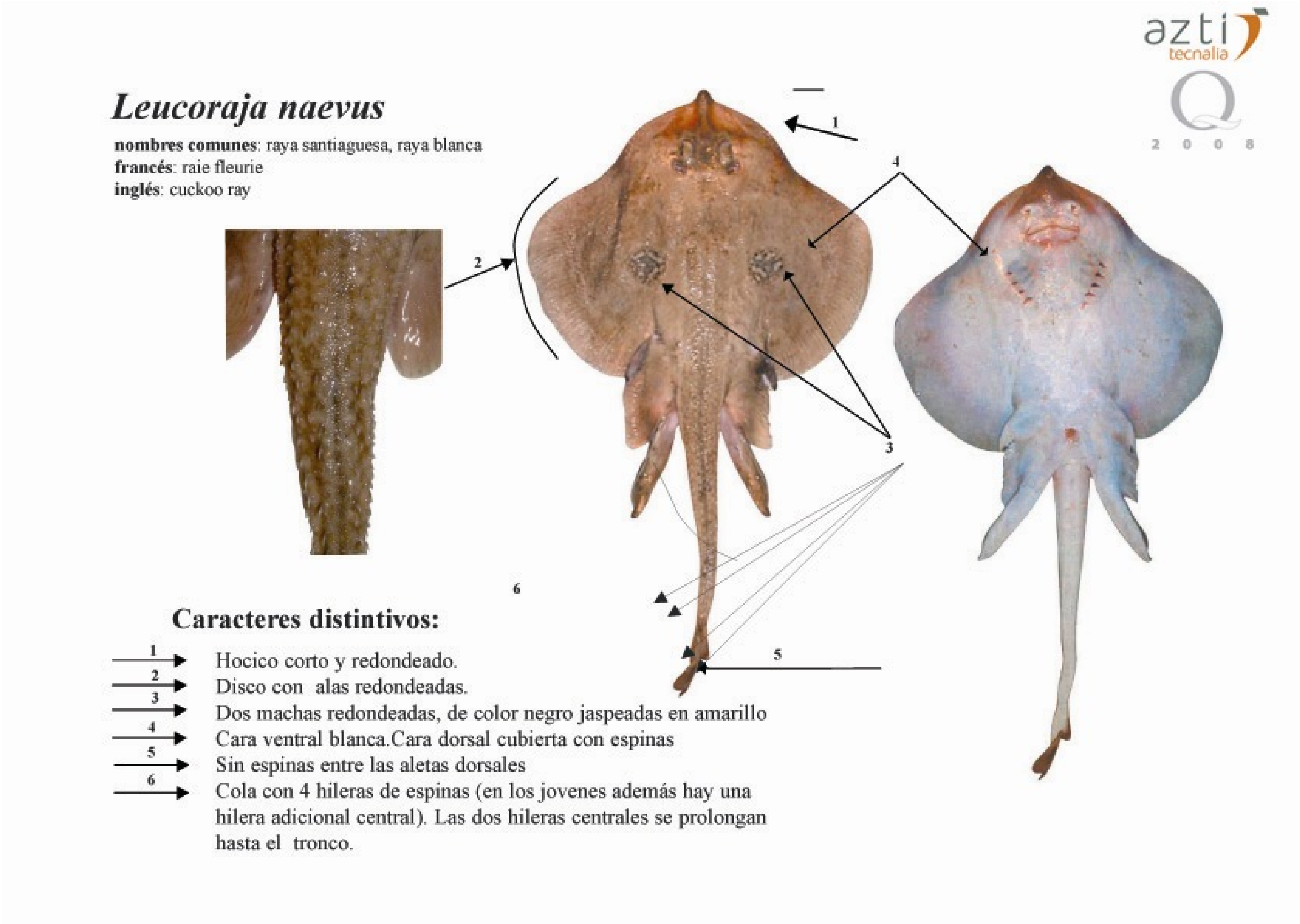
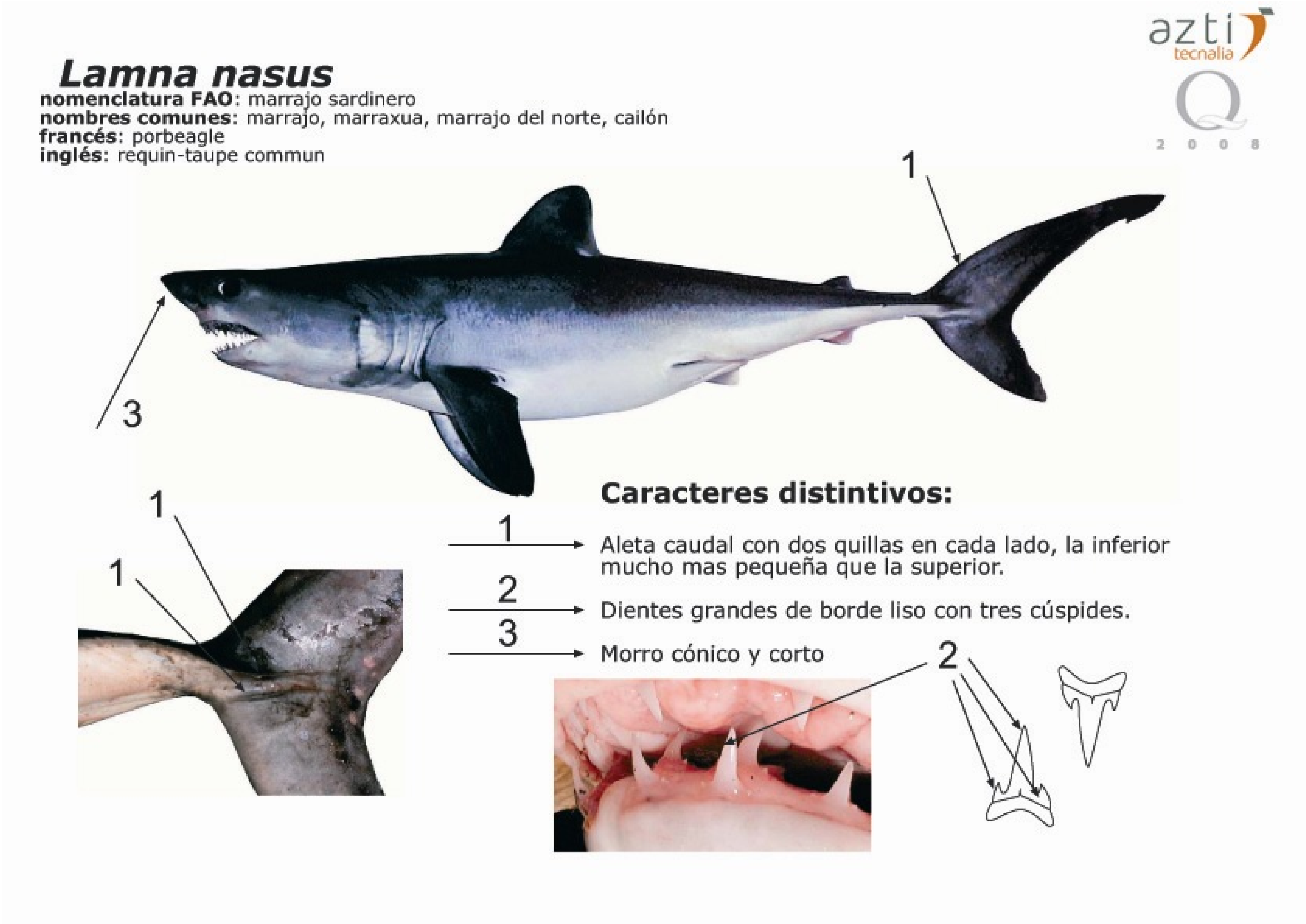


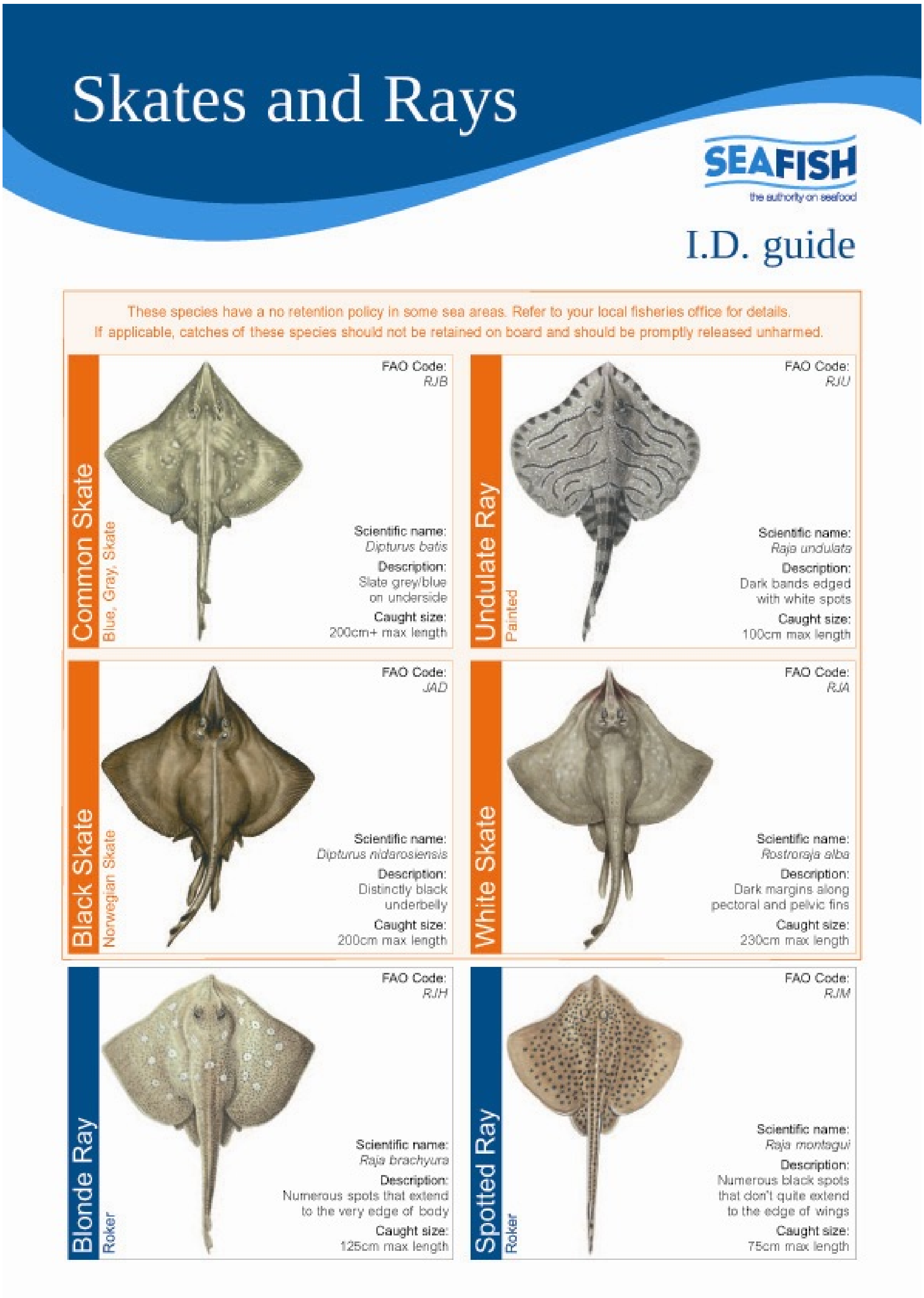
Figure 21.1. ICES Subarea IV. Proportions of skates reported in French landings (1983–1997, 1999–2008). Skates not reported to species level excluded.



Figures 21.2a. Illustration showing the design of the Basque Country' (Spain) guide to the identification of elasmobranchs (Source: AZTI).



Figures 21.2b. Illustration showing the design of the Basque Country' (Spain) guide to the identification of elasmobranchs. (Source: AZTI).



Figures 21.3. Illustration showing the design of the SeaFish/Shark Trust guide to the identification of skates and rays.

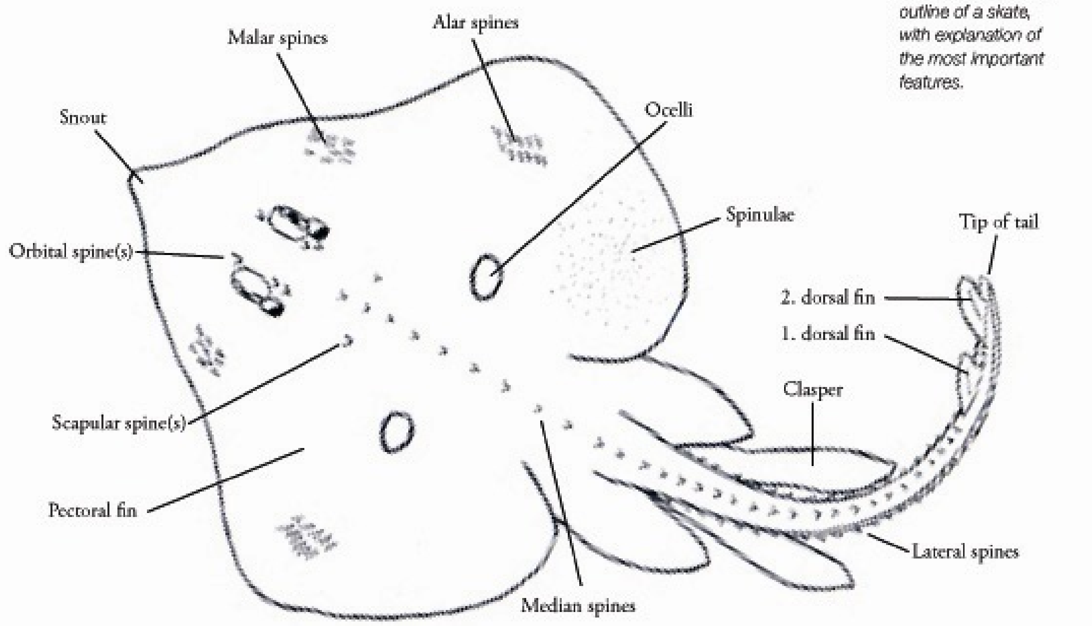


Figure 1: *Schematic outline of a skate, with explanation of the most important features.*

This is a preliminary edition. Identification keys can only be improved by testing in practice, and feedback is wanted whether it was easy to understand or not. Contact information is situated at the bottom of the document. Please be aware that the illustrations is schematic!

Spine rows

Spine rows is separated in median and lateral rows. Species with one median row can have 1, 3 or 5 spine rows in total. Species with two median rows can have 2, 4 or 6 spine rows in total. If, for example, a specimen has one median row in the posterior part of the tail, is this defined as one median row. A certain degree of jugdement must be assessed - as a rule is median rows in a straight line, but in some specimens they may be placed in a zigzag pattern.

Spines

"Spines" is spines that is markedly bigger than other irregularities on the skin. Elasmobranchs have placoid scales, which gives the rough skin surface. These small spines are called spinulae (fig. 1, 2, 5, 6 and 7). Alar- and malar spines (fig. 1) is not defined as "large spines" here, because it is a male sexual character.

Tooth rows

Tooth rows is counted in the upper jaw. The vertical rows is to be counted. It is not number of *teeth* in the vertical row, but number of *vertical rows*!

Identification

Several characters must be evaluated. For many species the juveniles are not known to a satisfying degree. Maximum size in kilograms or centimeter refers to Norwegian conditions but is not absolute. Given length (TL) is measured from snout to tip of the tail when the specimen lies straightened on a flat surface. Please read all points for best possible hit. Confer with depth and geographical distribution, and other references.

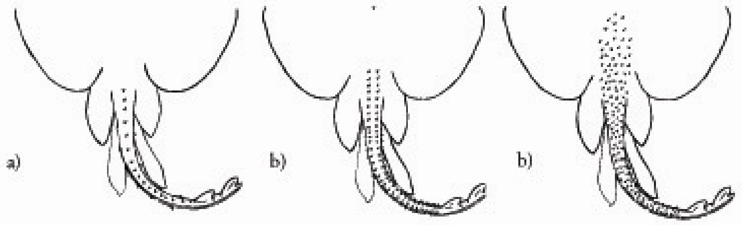
Comments

Sandy ray and ***cockoo ray*** is only known from a few findings. ***Norwegian skate***, ***blue skate*** and ***shagreen ray*** are rare. Young specimens of these, together with young ***longnosed skates*** is poorly known. ***Spotted ray*** and ***blonde ray*** is included in the guide, but all records in Norwegian economic zone is regarded as misidentifications. If the mentioned species is suspected caught, please keep it frozen or in ethanol. A picture with a ruler and tissue sample is also valuable. Let me know!

Figure 21.4a. Illustration showing the design of the Norwegian's guide to the identification of skates and rays.

1. **a)** One median spine row (can be worn off or be near invisible) **2**

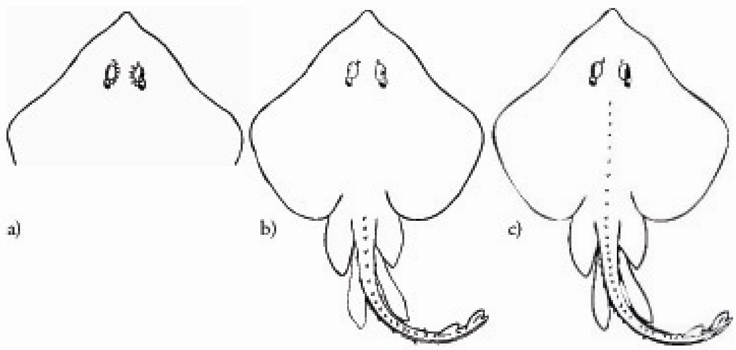
   b) Two median spine rows or irregular spine distribution **5**



2. **a)** More than five spines in a curved row on the inner side of the eyes **5**

   b) Median spine row restricted to the tail and no spines on the back, but may have spines close to the eyes **3**

   c) Median spine row continues from tail and forward on the back **4**



3. **a)** 35-49 median spines. Relatively dark dorsal side. Ventral side dark. May have a curved row of spines on the inner side of the eyes. 41-44 tooth rows. **Norwegian skate**, up to about 50 kilo.

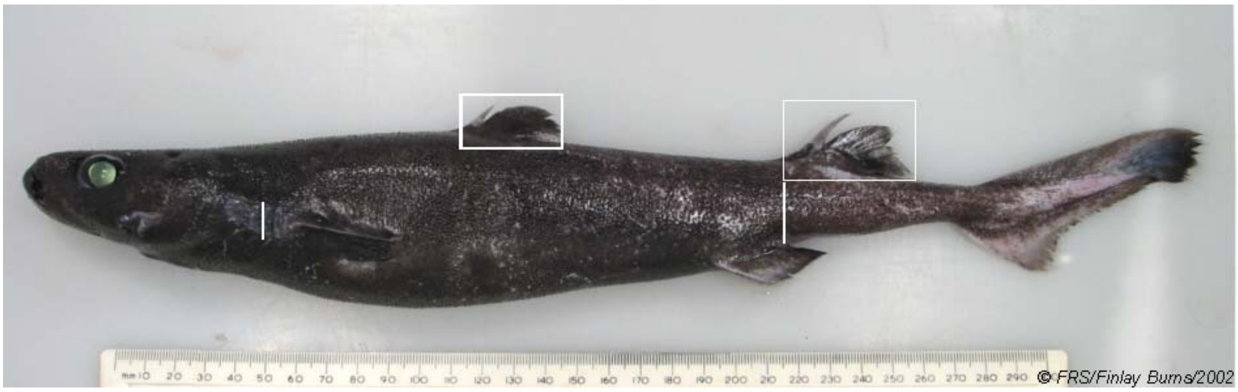
   b) 21-26 median spines. Dorsal side is generally light grey coloured, and covered with small, thin spinulae. Ventral side white with dark areas on posterior parts of pectoral fins. Tail also dark on ventral side. Snout very flexible (fig. 2). 30-34 tooth rows. **Spinetail ray**, up to about 30 kilo.

   c) 12-20 median spines. May have ocelli on pectoral fins. Ventral side bright and brownish. 40-45 tooth rows. **Blue skate**, up to about 110 kilo.

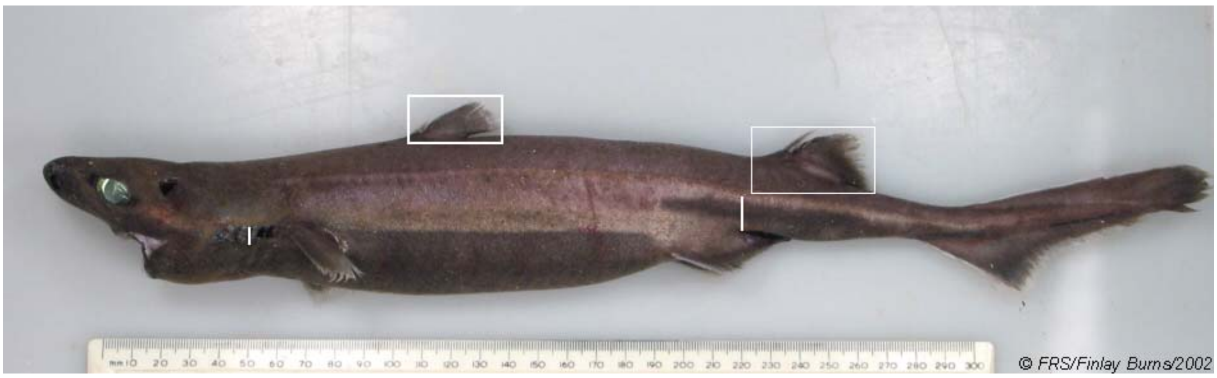
   d) 4-12 median spines. Dorsal side greyish to brownish, often with pale spots. Ventral side may be dark, especially from the mouth and forward to the snout 34-38 tooth rows. **Longnosed skate**, up to about 15 kilo.

Figure 21.4b. Illustration showing the design of the Norwegian's guide to the identification of skates and rays.

Etmopterus princeps (Great lantern shark):



Etmopterus spinax (Velvet belly):

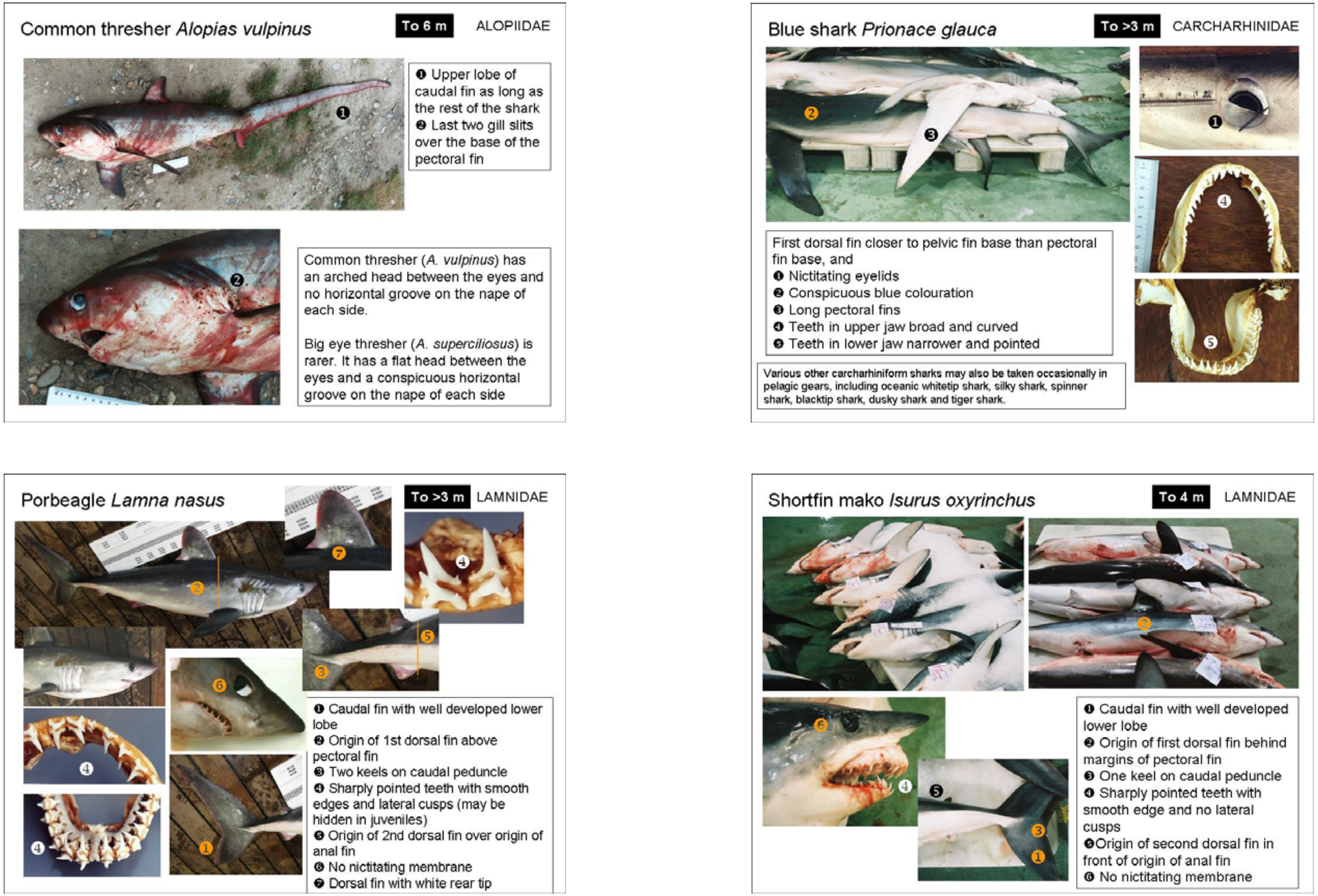


Figures 21.5a. Illustration showing the design of the Scottish' guide to the identification of elasmobranchs (deep-water sharks.) (Source: Marine Scotland).

Hydrolagus pallidus

(Pallid small-eyed rabbitfish)

Figures 21.5b. Illustration showing the design of the Scottish' guide to the identification of Chimaerids (Source: Marine Scotland).



Figures 21.6. Illustration showing the draft design of keys for pelagic sharks (Source: Cefas).

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Annex 2: Suggested ToRs for 2010

The **Working Group on Elasmobranch Fishes** [WGEF] (Chair: Graham Johnston, Ireland) will meet in the Department of Oceanography and Fisheries (University of the Azores), Portugal late June 2010 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 2008 and 2009 species-specific landings data for skates from ICES Subareas IV, VI–IX, and appraise their reliability through comparison with other data sources (e.g. market sampling and discard/observer programmes);

c) Evaluate the status of the demersal elasmobranch stocks in the North Sea, Celtic Seas and Biscay-Iberian ecoregions and undertake assessments for the NE Atlantic stock of spurdog *Squalus acanthias*;

d) Examine the potential benefits of size-based restrictions (minimum landings sizes and/or maximum landing lengths) for elasmobranchs;

e) Undertake preliminary studies to identify important elasmobranch habitats, including nursery grounds;

f) Finalise stock annexes for porbeagle, spurdog, kitefin shark and basking shark;

g) To work intersessionally to finalize the elasmobranch CRR prior to the next meeting;

h) To improve the availability of appropriate identification material for chondrichthyan fishes by (a) working intersessionally to collate and archive electronic copies of photographs; (b) further develop, circulate and test the utility of national photo-identification guides; and (c) develop a standardized user-friendly template.

WGEF will report by 6 July for the attention of ACOM.

Fish Stock	Stock Name	Stock Coord.	Assess. Cood.	Perform assessment	Advice
skx-67-d	Demersal elasmobranchs in the Celtic Sea and West of Scotland			y	Update
skx-347d	Demersal elasmobranchs in the North Sea, Skagerrak and eastern English Channel			y	Update
skx-89a	Demersal elasmobranchs in the Bay of Biscay and Iberian waters			y	Update
dgs-nea	Spurdog (*Squalus acanthias*) in the Northeast Atlantic			y	Update
por-nea	Porbeagle (*Lamna nasus*) in the Northeast Atlantic			y	Update
bsk-nea	Basking shark (*Cetorhinus maximus*) in the Northeast Atlantic			y	Update
cyo-nea	Portuguese dogfish (*Centroscymnus coelolepis*) and leafscale gulper shark (*Centrophorus squamosus*) in the Northeast Atlantic				
sck-nea	Kitefin shark (*Dalatias licha*) in the Northeast Atlantic				

Annex 3: Recommendations

RECOMMENDATION	ACTION
Given that not all national survey data are available on the DATRAS database, WGEF recommend that IBTSWG "Collate available catch records for lesser-known demersal elasmobranchs, specifically common skate *Dipturus batis*, blonde ray *Raja brachyura*, undulate ray *Raja undulate*, sandy ray *Leucoraja circularis* and shagreen ray *L. fullonica* using all available IBTS survey data."	ToR for IBTSWG
Given that there may be changes in fishing patterns that will affect elasmobranch fishes (e.g. the switch from beam trawls to outrigger trawls; see Section 1.7.7) as well as the impacts of management measures, WGEF recommend that WGFTFB be asked to "collate recent information on changes in fisher behaviour relating to the exploitation patterns affecting elasmobranch stocks in the ICES area."	ToR for WGFTFB
Given that several laboratories are now collecting some length data for commercially caught sharks, and that there is the potential for different 'length' measurements to be collected and reported, WGEF recommend that PGCCDBS "determine which national laboratories are measuring large shark species under the DCF, which 'length' measurements are being collected, and agree a standardized protocol for the measuring of large sharks".	ToR for PGCCDBS
Inter-sessionally, the current chairs of WGFTFB and WGEF have discussed convening a theme session on "Elasmobranch Fisheries: Developments in stock assessment, technical mitigation and management measures" at the 2010 ICES ASC, (see below) and recommend that this be considered at the ASC.	
SGBIODIV have recommended that a theme session on "Marine biodiversity: have we halted its loss by 2010 and what do we need to do now?" be convened at the 2010 ASC. Given that the loss of top predators (elasmobranchs) is potentially an important issue for such a theme session, WGEF also support this proposal.	

Elasmobranch fisheries: developments in stock assessment, technical mitigation and management measures

Conveners: Dominic Rihan (BIM, Ireland); Jim Ellis (Cefas, UK); Henk Heessen (IMARES, the Netherlands).

Elasmobranchs (sharks, skates and rays) are taken in a range of targeted and mixed commercial fisheries, and are also of interest to recreational fisheries and wildlife conservation groups. The large size of elasmobranchs and their aggregating nature makes them susceptible to capture in many fisheries from an early age. They are also biologically vulnerable to fishing impacts, given that their life-history strategy involves a late age at maturity, slow growth and low fecundity. Declines and regional extirpations have been documented for a range of elasmobranch populations and there has been an increased concern over the status of several species/stocks in recent years. In 1999, the FAO published its International Plan of Action for Sharks (IPOA–Sharks), giving guidelines for data collection and management measures, and it was recommended that shark action plans be implemented at a national level.

Although elasmobranchs are at a high risk of capture in fishing operations, they have to date received limited attention in terms of bycatch mitigation compared with other charismatic megafauna (e.g. cetaceans and sea turtles). Nevertheless, in the course of research into mitigation devices for release of marine mammals, options to reduce elasmobranch bycatch have been found (e.g. in Mauritanian pelagic fisheries). Other possible mitigation devices aimed specifically at reducing their bycatch have been suggested but not fully developed.

In order to address many of the current issues in elasmobranch fisheries management, it is proposed to hold a theme session at the ICES ASC 2010. This theme session aims to bring together recent studies on elasmobranch fisheries and talks on the following subjects are encouraged:

- Development of stock assessment methods.
- Utility of fishery-independent surveys for examining long-term trends in spatial extent and relative abundance.
- Reconciling fisheries stock assessment and conservation assessment methods (e.g. IUCN criteria).
- Development of Ecological Risk Assessments (ERA) and management plans for species-complexes (e.g. "deep-water sharks", "demersal skates", "pelagic sharks").
- Studies on the efficacy of potential management measures.
- Research with technical mitigation measures used directly or indirectly to reduce elasmobranch bycatch.
- Discard survival of elasmobranchs taken by commercial fishing gears.
- Size restrictions for elasmobranch fisheries: should managers protect the young (e.g. with a minimum landing size, MLS) and/or mature females (e.g. with a maximum landing length, MLL).
- Spatial management for ecologically important elasmobranch habitats.
- Management of highly migratory shark stocks.
- The implementation of National Plans of Actions for Sharks and their outcomes.

Annex 4: Stock annexes

Tope in the North East Atlantic and Mediterranean

Stock distribution

WGEF considers there to be a single-stock of tope (or school shark, *Galeorhinus galeus*) in the ICES area. This stock is distributed from Scotland and southern Norway southwards to the coast of northwestern 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. Hence, WGEF consider the NE Atlantic tope stock to cover the ICES Area (II–X), Mediterranean Sea (Subareas I–III) and northern part of the CECAF area. 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 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.

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.

Recent genetic studies using samples from Australia, North-west America, South Africa, South America and UK also confirm that the main stocks are distinct (Chabot and Allen, 2009).

The fishery

Currently there are no targeted commercial fisheries for tope in the northeastern 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 report 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, and 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).

Catch data

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 2008 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.

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.

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).

Commercial catch composition

No data collated.

Commercial catch-effort data

No data available.

Fishery-independent information

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).

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.

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.

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. As a consequence of 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).

Exploratory assessment models

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).

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.

Stock assessment

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

Quality of assessments

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

Reference points

No reference points have been proposed for this stock.

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 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 southwestern 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.

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Table 10.1. Tope in the North East Atlantic and Mediterranean. Reported species-specific landings (Tonnes) for the period 1978–2008. 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 Northwest African waters.

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

Table 10.1. (continued). Tope in the North East Atlantic and Mediterranean. Reported species-specific landings (Tonnes) for the period 1978–2008. 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 Northwest African waters.

ICES Division IIIa–IV	1991	1992	1993	1994	1995	1996	1997	1998	1999
Denmark	-	-	-	-	-	-	-	-	3
France	16	10	11	12	8	11	5	11	
Sweden	-	-	-	-	-	-	-	-	-
UK	21	15	15	19	25	14	22	12	14
UK (Scotland	-	-	-	-	-	-	-	-	-
Total (IIIa–IV)	37	25	26	31	33	25	27	23	17
ICES Division V–VII									
France	391	235	240	235	265	314	409	312	
Ireland	na	na	na	na	na	na	na	na	na
Spain	na	na	na	na	na	na	na	na	na
Spain (Basque country)	-	-	-	-	-	-	-	-	-
UK	47	53	48	49	38	39	34	41	62
Total (VI–VII)	438	288	288	284	303	353	443	353	62
ICES Division VIII									
France	38	34	40	54	44	78	40	46	+
Spain	na	na	na	na	na	na	na	na	na
Spain (Basque country)	-	-	-	-	-	-	-	-	-
UK					0	0	0	0	0
Total (VIII)	38	34	40	54	44	78	40	46	0
ICES Division IX									
Spain	na	na	na	na	na	na	na	na	na
Total (IX)									
ICES Division X									
Portugal	81	80	115	116	124	80	104	128	129
Total (X)	81	80	115	116	124	80	104	128	129
Other									
France	-	-	-	-	-	-	-	-	386
UK	-	-	-	+	+	-	-	-	-
CECAF area									
Portugal	-	-	-	-	-	-	-	-	-
TOTAL LANDINGS	593	427	469	485	504	536	615	551	593

Table 10.1. (continued). Tope in the North East Atlantic and Mediterranean. Reported species-specific landings (Tonnes) for the period 1978–2008. 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 Northwest African waters.

ICES Division IIIa–IV	2000	2001	2002	2003	2004	2005	2006	2007	2008
Denmark	8	4	5	5	5	8	6	3	4
France	11	11	6	6	3	3	6	6	6
Sweden	-	-	-	-	-	+	0	0	0
UK	13	10	13	11	8	10	13	5	2
UK (Scotland	-	-	-	-	-	-	-	0	0
Total (IIIa–IV)	32	25	24	22	16	21	25	14	12
ICES Division V–VII									
France	368	394	324	284	209	181	293	155	187
Ireland	na	4	1	6	4	na	7	3	4
Spain	na	+	242	3	na	na	na	na	60
Spain (Basque country)	-	+	+	3	15	10	.	.	.
UK	98	72	60	55	65	65	74	44	26
Total (VI–VII)	466	470	627	351	293	256	374	202	277
ICES Division VIII									
France	71	58	49	60	16	29	40	28	35
Spain	na	9	13	10	na	na	na	na	21
Spain (Basque country)	-	9	6	10	10	14	12	1	12
UK		1		3	8	6	5	0	0
Total (VIII)	71	77	68	83	34	49	57	29	69
ICES Division IX									
Spain	na	na	na	na	76	na	na	na	96
Total (IX)					76				96
ICES Division X									
Portugal	142	82	77	69	51	45	45	na	na
Total (X)	142	82	77	69	51	45	45	0	0
Other									
France	-	2	-	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	-	-
CECAF area									
Portugal	2	1	2	98	na	na	na	na	na
TOTAL LANDINGS	713	656	798	622	470	371	502	245	454

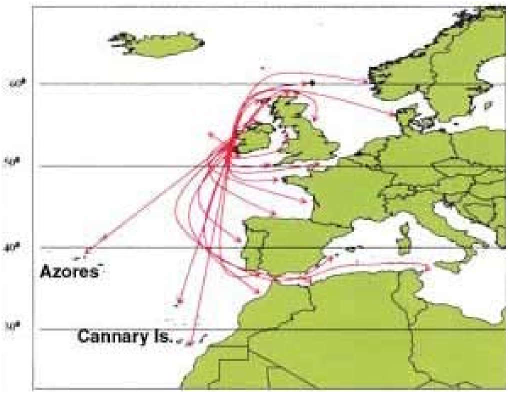

Figure 10.1. Tope in the Northeast Atlantic and Mediterranean. Location of tag returns from the tope tagging programme coordinated by the Central Fisheries Board (Ireland). Source: http://www.cfb.ie/fisheries_research/tagging/tope.htm.

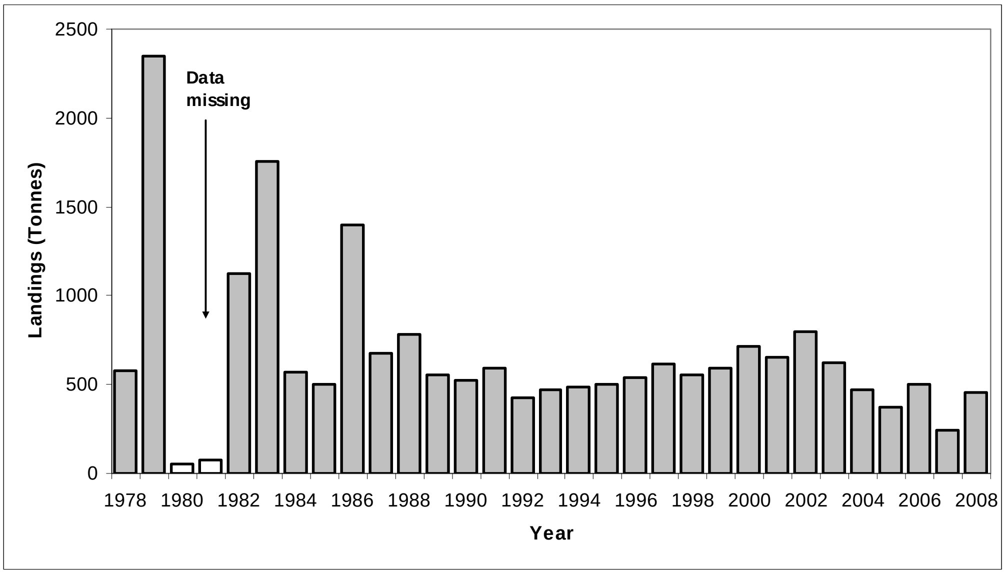

Figure 10.2. Tope in the Northeast Atlantic and Mediterranean. Annual landings of tope. These data are considered an underestimate as some tope are landed under generic landings categories, and no species-specific landings data are available for the Mediterranean Sea and Northwest African waters. Not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

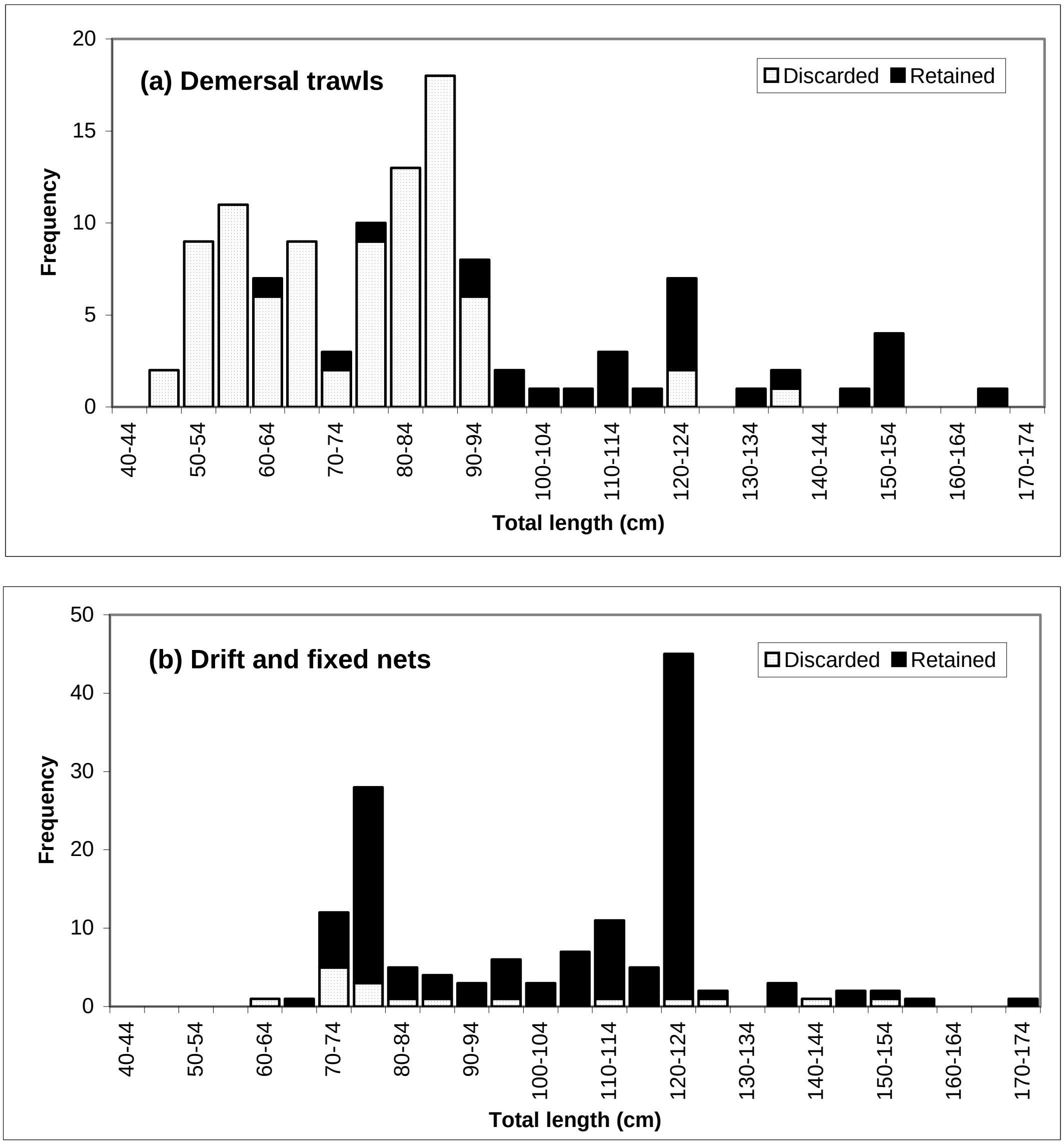

Figure 10.3. Tope in the Northeast Atlantic and Mediterranean. Length frequency of discarded and retained tope in (a) demersal trawl and (b) drift and fixed net fisheries as observed in UK (England and Wales) discard sampling.

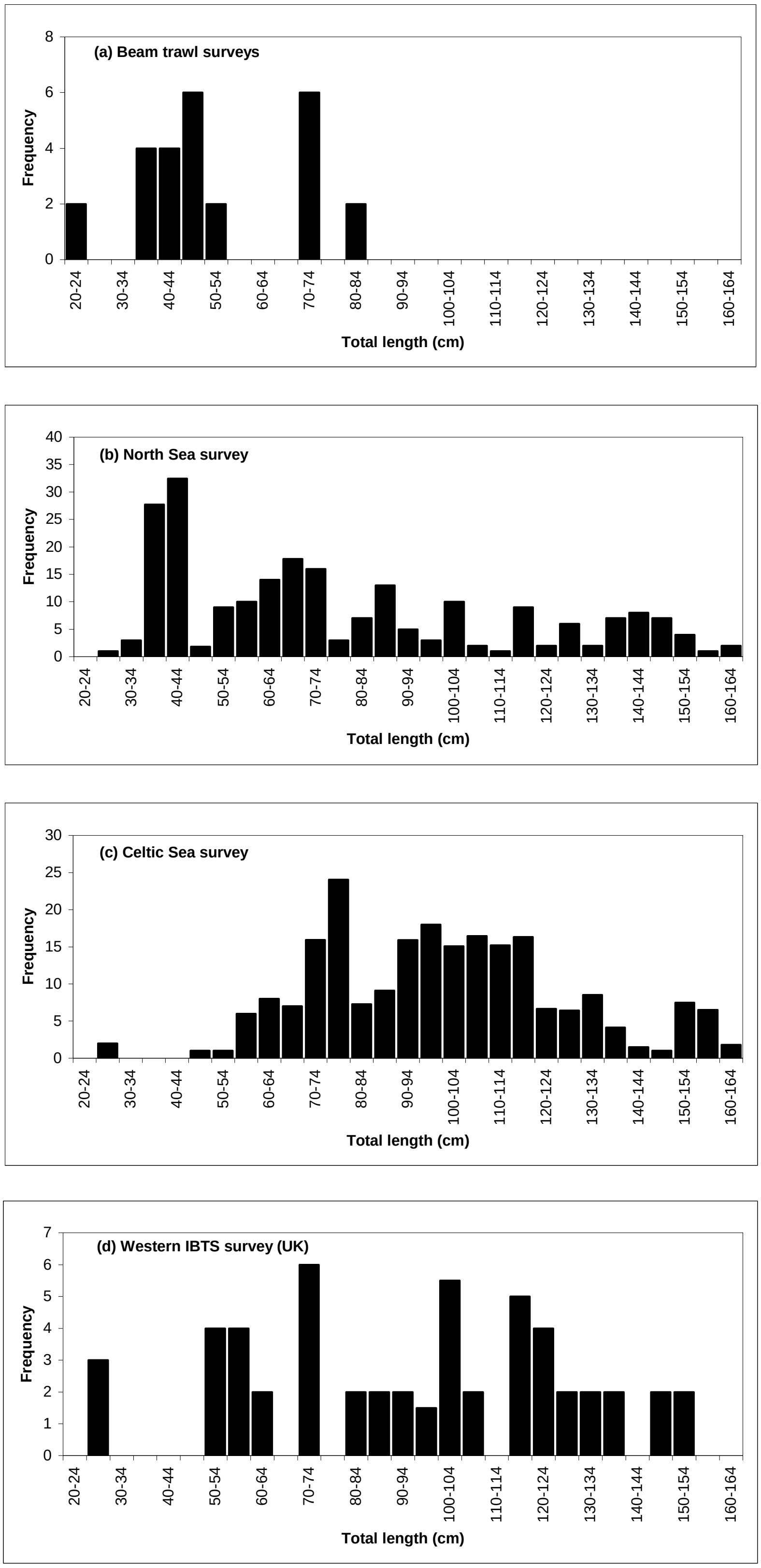

Figure 10.4. Tope in the Northeast Atlantic and Mediterranean. Length frequency graphs for UK surveys including (a) beam trawl surveys in the English Channel, Bristol Channel and Irish Sea; (b) North Sea; (c) Celtic Sea and (d) Irish Sea and Celtic Sea. For further information on these surveys see Sections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

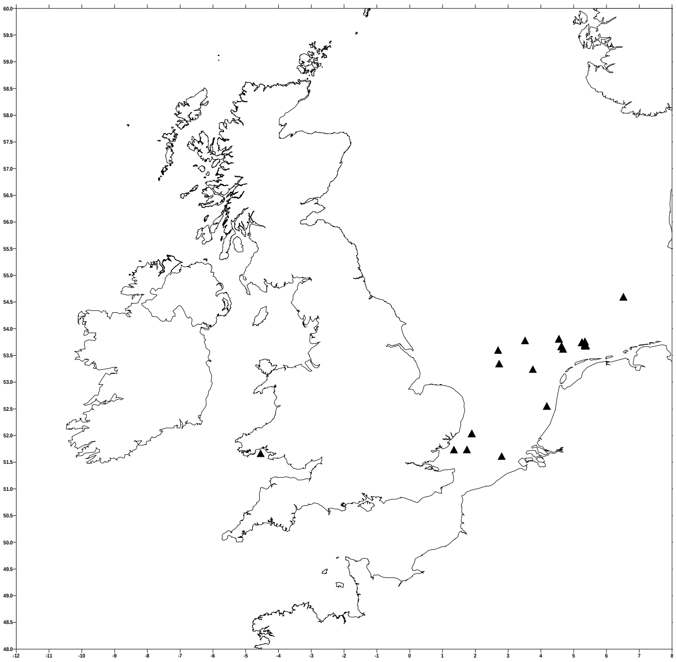

Figure 10.5. Tope in the Northeast Atlantic and Mediterranean. Sites where tope pups (24–45 cm total length) have been reported during UK surveys.

Thresher sharks in the North East Atlantic and Mediterranean Sea

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.

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.

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).

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.

Catch data

Landings

The landings are irregularly reported and rather variable: from 38–210 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 (156 t in 2007), Spain (44 t in 2007) and France (9 t in 2007).

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.

Discards

No data available.

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.

Commercial catch composition

No data available.

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.

Fishery-independent surveys

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

Some length frequency distributions for *Alopias vulpinus* have been collected in the frame of the Data Collection Regulation (DCR) programme by observers on board French vessels between 2003 and 2009 (Figure 11.2).

Life-history information

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; Clo *et al.,* 2008; Corsini-Foka and Sioulas, 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. Quigley *et al.,* 2008 and Ellis, 2004 have provided information on the occurrence of *A. vulpinus* in Irish and North Sea waters, respectively. *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.

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).

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%).

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 (~267 and ~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 southwestern 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).

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

$$W = 9.1069 \times 10^{-6}\ L_F^{\,3.080}\ (r^2 = 0.91)$$

Common thresher

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

Exploratory assessment models

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).

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.

Quality of assessments

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

Reference points

No reference points have been proposed for these stocks.

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 thresher shark as Data Deficient (IUCN, 2006), but their status was re-evaluated in 2007 (Camhi, 2008; Camhi *et al*., 2009), which both species now listed 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.

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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	12	32	na	44	153	3	156	9	1			210

(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	VI–VIII	VII–IX	W Africa	VII–IX	IV–VII		
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		17		13	+				20
1997		22		37	1	53			104
1998		18		24	2	54			87
1999		13		12	+	36			69
2000		107		15		1			132
2001		112		25					138
2002		4		21					32
2003	+	3	+	17		3			31
2004		3	+	33		84			130
2005		9		80		54	+		152
2006		12	+				+		12
2007		12	+				1		9
2008		7	+				1		

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 (L_T)	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 (L_T) 179–237 cm (L_F)*		?	Compagno, 2001
	~303 (L_T) (160 cm L_F)	68	California	Smith *et al*., 2008
Female maturity size	315–400 cm (L_T) 179–226 cm (L_F)*		?	Compagno, 2001
	~303 cm (L_T) (160 cm L_F)	107	California	Smith *et al*., 2008
Maximum size	573 cm at least possibly 610 cm (L_T) 321–341 cm (L_F)*			Compagno, 2001
A max	45–50 years			Cailliet *et al*., 1983
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+

PARAMETER	VALUES	SAMPLE SIZE	AREA	REFERENCE
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 L_F 2.5188	88	NW Atlantic (1961–89)	Kohler *et al*., 1995
Fork length (cm) – total length (cm) relationship	L_F = 0.5474 x L_T + 7.0262	13	NW Atlantic (1961–89)	Kohler *et al*., 1995
Growth parameters	L ∞ = 651 cm T_O = – 2.36 K = 0.100		California	Claro and García-Arteaga, 1994
Productivity (R_{2m}) estimate : intrinsic rebound	R_{2m} = 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 T_D (years)	T_D = 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 (L_T)	6	NE Atl.	Moreno and Moron, 1992
	270–287 cm (L_T) (150–155 L_{PC}) (size at 50% maturity)	200	Taiwan	Chen *et al*., 1997
	180 cm (L_F)		NW Atl.	Kohler *et al*., 1995×
Female maturity size	340 (?) cm (L_T)	10	NE Atl.	Moreno and Moron, 1992
	332–366 cm (T_L)	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
Size at birth (T_L)	135–140 cm	2	Taiwan	Chen *et al*., 1997

Parameters	Value	Sample size	Area	Reference
	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 (T_L)	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 Females:	65	Taiwan	Liu *et al.*, 1998
	W = (1.02 x 10–5)L_T 2.78	175	Taiwan	Liu *et al.*, 1998
	Combined: W = (9.1069 x 10–6) x L_F 3.0802	55	Florida	Kohler *et al.*, 1995
Fork length-total length relationship	L_F = 0.5598 L_T + 17.6660	56	Florida	Kohler *et al.*, 1995
Growth (calculated from vertebral reading)	Males: L ∞ = 218.8 cm (L_T) T_O = – 4.24 K = 0.088/year Females: L ∞ = 224.6 cm (L_T) T_O = – 4.21 K = 0.092/year	321	Taiwan	Liu *et al.*, 1998
Growth (calculated from length–frequency analysis)	Males: L ∞ = 224.4cm (L_T) T_O = – 4.61 K = 0.087/year Females: L ∞ = 230.5 cm (L_T) T_O = – 3.69 K = 0.092/year	821	Taiwan	Liu *et al.*, 1998

Parameters	Value	Sample size	Area	Reference
				(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			

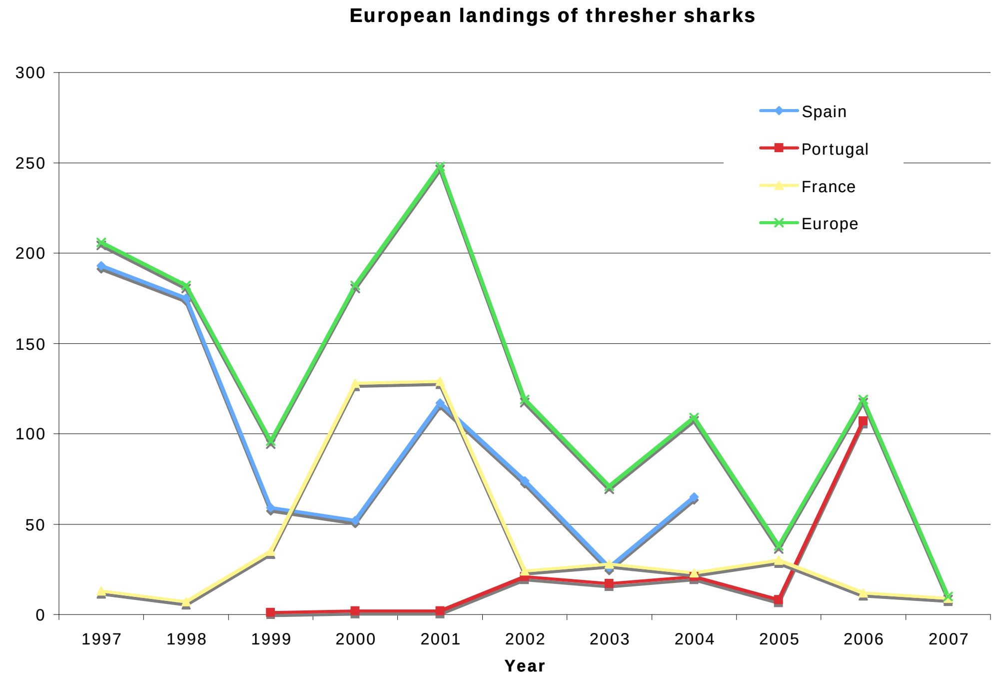

Figure 11.1. Thresher sharks in the North East Atlantic and the Mediterranean Sea. Reported landings of thresher sharks by Spain, Portugal and France (1997–2007, ICCAT and national data).

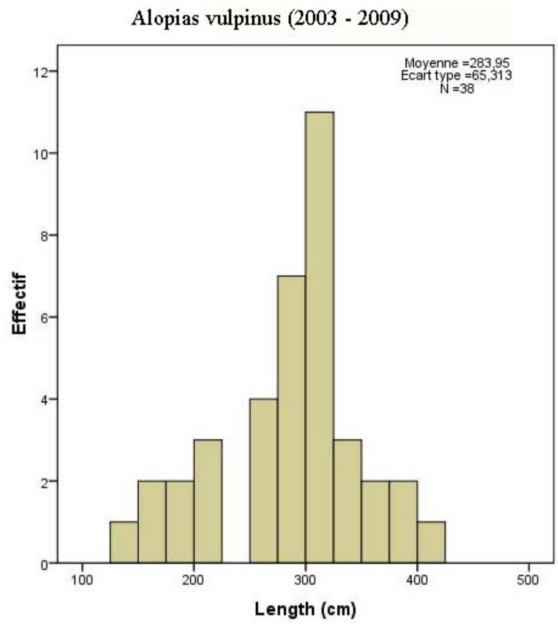

Figure 11.2. Length frequency distributions for *Alopias vulpinus* sampled in the Divisions VIIabcd in the framework of the Data Collection Regulation programme by observers on board French vessels between 2003 and 2009 (Lengths are fork length over the body).