Report to the
Department of Trade and Industry

Fish & Fisheries in the SEA7 Area

Prepared by

John D. M. Gordon
Honorary Fellow
Scottish Association for Marine Science
Dunstaffnage Marine Laboratory
Oban
Argyll
PA37 1QA

This document was produced as part of the UK Department of Trade and Industry's offshore energy Strategic Environmental Assessment programme. The SEA programme is funded and managed by the DTI and coordinated on their behalf by Geotek Ltd and Hartley Anderson Ltd.

CONTENTS

EXECUTIVE SUMMARY

The SEA7 area includes the west coast of mainland Scotland with its numerous sea lochs, the continental shelf with the Hebridean Islands, the continental slope of the northern Rockall Trough, the Rockall Trough and its seamounts, the Rockall and Hatton Banks and the abyssal depths to the west of Hatton Bank. All these areas, except the abyssal depths support a diverse variety of fisheries using demersal, pelagic and static gears. SEA7 lies within ICES Sub areas VI and XII. These areas were devised for shallow-water fisheries and have been recently subdivided to take into account the expansion of fisheries into deep-water and to allow separate reporting of fish landings from national and international waters. The primary fishery management tool in the SEA7 area is the Total Allowable Catch (TAC) and when quotas become restrictive misreporting of catches can seriously distort landings data for some species. In the SEA7 misreporting has been and is prevalent between the west of Scotland (ICES Sub-area VI) and the North Sea (Sub-area IV) and between west of Scotland and Irish waters (ICES Sub-area VII). ICES Working Groups often make adjustments for what are termed “unallocated landings” and these data are used in this report.

A wide variety of data sources have been used in this report ranging from literature reviews, site specific surveys, fishery surveys and ICES reports.

Relevant aspects of the biology of 39 species or species groups have been described. Brief descriptions are given of the fishery for each species, including the method of fishing and the long term trends in the landings from each of the management areas are described.

The demersal bottom trawl fisheries of the shelf and upper slope can be divided into four main categories. A mixed roundfish otter trawl fleet targets cod, haddock anglerfish and whiting with a bycatch that includes saithe, megrim and lemon sole. The demersal fishery is mostly by Scottish trawlers using “light trawls” although vessels from Ireland, Northern Ireland, England, France and Germany also participate in the fishery. The mixed Nephrops fishery will be described in a separate report but the bycatch of haddock, cod, whiting and saithe are relevant to this report. The level of discarding of fish, especially of haddock and whiting, is high in the *Nephrops* trawl fisheries.The bottom trawl targeting anglerfish, megrim and hake has undergone considerable change in recent years with a move to deeper waters on the outer shelf and upper slope. It is probably that this deeper fishery is exploiting the mature adult anglerfish thus putting additional pressure on the stocks. Many vessels have changed to fishing with large twin-rig trawls with mesh sizes >100mm. The fishery for saithe takes place along the edge of the continental shelf and is mainly by French trawlers. The change in the fishing patterns of the Scottish fleet and the move to deeper water has resulted in significant discarding of over quota saithe.

The deep-water bottom trawl fisheries of the Rockall Trough began in the late 1980s as markets were developed for the bycatch of the French fishery for blue ling. This developed into targeted fisheries for roundnose grenadier, black scabbardfish, orange roughy and deep-water sharks. The fishery is dominated by France and TACs were introduced in 2003. Scottish vessels target anglerfish and only land small amounts of deep-water species.

The fishery on the Rockall Bank has a long history with haddock being the dominant species. In 1977 the UK declared a 200 mile exclusive fishery zone around Rockall and the fishery was managed. However, in 1997 the UK relinquished this claim and the Bank reverted to international waters. The international fleets have moved in and there are concerns about the

status of the stocks. NEAFC have adopted a proposal to close an area of the Bank to bottom trawling.

A large part of the Hatton Bank was also included in the 200 mile fishery zone around Rockall. Since 1997 a Spanish deep-water trawl fishery has developed on the Bank targeting mainly roundnose grenadier and Baird's smoothhead.

The main pelagic fisheries of the west of Scotland are for herring, mackerel, horse mackerel and bluewhiting. Historically the drift net herring fishery was the major fishery on the west coast of Scotland but with marked fluctuations in landings. Pair-trawling began in the 1970s and the fishery was closed between 1977 and 1981. Now most of the catch is by Scottish vessels but foreign vessels, especially Dutch and German, make a significant contribution. The mackerel fishery takes place mostly in the fourth and first quarter of the year and exploits mackerel returning from the summer feeding grounds of the northern North Sea to the spawning grounds off south west England and Ireland. Horse mackerel is generally taken in the fourth and first quarter of the year mainly by Irish vessels. The rapid expansion of the blue whiting fishery on the upper slope in recent years has been a cause of major concern to ICES and the species is considered to be being harvested at an unsustainable level. Blue whiting is a straddling stock with major components of the fishery in both national and international waters. Parts of both of these components lie within the SEA7 area.

The industrial fisheries in the SEA7 area are for sandeels and Norway pout. The sandeel fishery is small and the Norway pout fishery, mainly by Denmark, is subject to considerable annual fluctuations.

Static gear fisheries comprise a Norwegian longline fishery targeting ling and tusk on the edge of the continental shelf and Greenland halibut on the Hatton Bank, a Spanish longline fishery for hake and sometimes sharks and a deep-water gill net fishery targeting anglerfish and sharks.

The Darwin Mounds, an area at about 1000 m depth in the northern Rockall Trough, has been closed to trawling to protect the unique fauna, including corals. Parts of the Rockall Bank have been closed to protect haddock but proposals to close areas of the Rockall Bank and the Hatton Bank to protect corals have been deferred.

Aspects of the interactions between the fisheries and the oil and gas industries of particular relevance to the SEA7 area are discussed.

1. INTRODUCTION

This report concerns fish and fisheries (excluding shellfish) of the area designated by the DTI as Strategic Environment Assessment Area 7 (SEA7). It covers a vast area from the west coast of mainland Scotland to the Maury Channel and comprises sea lochs, firths, the continental shelf (including the Minches), the outer continental slope west of the Hebrides, the deep water of the Rockall Trough and its seamounts, the Rockall Bank, parts of Hatton Bank and the deepwater to the west of Hatton Bank (Maury Channel) (Figure 1.1).

The eastern margin of SEA7 comprises the greatly indented fjordic coastline of the Scottish Highlands. Currie (1972) estimated that the coastline from the Mull of Galloway to Cape Wrath if stretched out would amount to about 1600 km. The northeastern margin of SEA7 is contiguous with that of SEA4 extending from Cape Wrath to about 60°N 07°W (a point on the UK median line with Faroe Islands). This boundary is in the area of the Wyville-Thompson Ridge, which lies at a depth of about 500 m, and separates the faunistically different deep waters of the Atlantic from those of the Faroe Shetland Channel (an extension of the Norwegian Basin) (Gordon 2001a). The northern boundary then follows the UK median line with the Faroe Islands in a westerly direction to about 59° 50´ N 21° 48´ W. To the south of this boundary within the Rockall Trough lies the Rosemary Bank. Further west and forming one of the northern boundaries of the Rockall Trough lies the George Bligh Bank. To the north of the boundary lies Lousy Bank. Even further west the boundary is close to the northern extent of the Hatton Bank before ending in the deep water Maury Channel which lies between Hatton Bank and the Mid-Atlantic Ridge. The boundary line then extends southwards to about 57°22´ N 23° 57´ W before it extends in an easterly direction following the median line between UK and Ireland EEZs. It crosses the southern tail of the Hatton Bank, the southern part of the Rockall Bank and in crossing the Rockall Trough it passes over the Hebrides Terrace Seamount, onto the continental shelf and to the northern coast of Northern Ireland.

The whole of SEA7 lies within the ICES area, specifically Sub-areas VI and XII. The ICES Sub-areas and Divisions (Figure 1.2) were devised for reporting continental shelf fisheries. ICES Sub-area VI was divided into Divisions VIa and VIb. The purpose of Division VIb was to enable separate reporting of the shallow water fish stocks of the Rockall Bank. Part of Hatton Bank lies within Division VIb and the remainder is in Sub-area XII. Sub-area XII covers a vast area including a large portion of the northern Mid-Atlantic Ridge. In 1977 the UK claimed a 200 mile exclusive fishery zone around Rockall, a rock of about 25 m in diameter that stands about 19 m above sea level. This zone included a large part of Hatton Bank which effectively meant that this area was regulated and therefore deep-water fish landings from Sub-area XII, mainly by USSR and Soviet bloc countries, after 1977 could mostly be attributed to the Mid-Atlantic Ridge. All this changed in 1997 when the UK relinquished its claim to the fishery zone, retaining only a 12 mile limit around the rock itself (Figure 1.3). The whole of the Hatton Bank and a large part of the Rockall Bank became international waters and the fishing fleets moved in. The haddock fishery on the Rockall Bank, the blue whiting fishery on the slopes of the banks and the deep-water fishery on the Hatton Bank were rapidly expanded by these new fleets.

As the fisheries moved into deeper water the inadequacy of the existing ICES statistical Sub-areas and Divisions for reporting landings became a problem for management. Figure 1.4, which shows the ICES statistical areas superimposed on the bathymetry illustrates this problem. Deep-water fish landings reported from ICES Division VIa are almost all from the continental slope to the west of the Hebrides. However, deep-water fish landings reported from ICES VIb could derive from the slope of the Rockall Bank or from the northern portion of the Hatton Bank. The greater part of the Hatton bank lies within ICES Sub-area XII and

landings of deep-water fish from from this area could derive from Hatton Bank or from the Mid-Atlantic Ridge. ICES recognised the problem and identified the need for improved reporting of the location of deep-water catches. At the same time the regulatory body for the international waters of the northeastern Atlantic, the North-East Atlantic Fisheries Commission (NEAFC), recognised the need to separate landings from international waters from those from areas of coastal state jurisdiction. This question was addressed, at the request of NEAFC by the ICES Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (ICES 2003a).

As a result changes were made to the ICES statistical areas as described in Eurostat (Council Regulation (EEC) No 3880/91 as amended by Commission Regulation (EC) No 448/2005 of 15 March 2005). ICES Division VIb was split into VIb1 and VIb2 (Figure 1.5). The division between the two is the boundary between coastal state jurisdiction and international waters such that VIb1 represents international waters. Sub-area XII was divided into Divisions a, b and c. (Figure 1.6). Division XIIb separates the Hatton Bank from other parts of Sub-area XII.

Hopefully these changes will lead to more reliable reporting of catch location and for management purposes identify the component of the catch from international waters. It is not clear whether there might be retrospective allocation of catches to the new areas. The changes should also make it possible to separate catches from the Hatton Bank from those of the Mid-Atlantic Ridge.

Misreporting of catches in the SEA7 area has been and probably still is a major problem. ICES Working Groups use the term ‘unallocated landings’ for adjustments made to officially reported landings to correct for misreporting or differences between official statistics and data supplied by national scientists. Misreporting by area is most prevalent between ICES Sub-areas VI (west of Scotland) and IV (North Sea). There is a perception that misreporting of gadoids has been less significant in recent years. The problem of misreporting is summed up in the following quote from the Working Group on the Assessment of Northern Shelf Demersal Stocks (ICES 2003b). “For anglerfish and megrim in Division VIa the existence of a restrictive precautionary TAC in Division VIa but no catch restrictions in the adjacent areas of the North Sea up until 1998 is suspected to have led to extensive reporting of catches from VIa into IVa. Such an effect is apparent in the reported distribution of catches by one nation where catches of anglerfish and megrim reported from the statistical rectangles immediately east of the 4ºW boundary (the E6 squares) have accounted for a disproportionate part of the combined VIa/North Sea catches of these species. This proportion has reached up to 57% in the case of anglerfish and 75% in the case of megrim. As it is strongly suspected that the large majority of catches reported from the E6 squares are actually taken in Division VIa”. Misreporting is also prevalent in the pelagic fisheries, herring and mackerel, although in this case it usually involves the reporting of fish caught in ICES Division IVa to ICES VIa. Misreporting of catches makes it difficult to ascertain the true quantity of fish landed from SEA7. Given that most of the misreported landings are reported into the statistical squares adjacent to 4ºW the true location of capture of many of the fish caught in Sub-area VI is unknown. These problems will be considered in more detail in the appropriate sections of this report.

2. FISH COMMUNITIES AND SOURCES OF INFORMATION

2.1 Fauna lists

The fauna of the west of Scotland continental shelf (including sea lochs) has been described by Gordon (1981) and Gordon and de Silva (1980). As part of this review fauna lists were compiled for sea lochs and adjacent sea areas of the Firth of Lorne. These are reproduced in this report as Appendices 1 and 2. The deep-water demersal fauna from SAMS surveys (see 2.4.3) of the Rockall Trough is given by depth zone in Appendix 3. The deep-water fauna of the Hatton Bank is not completely documented but some information on the species caught by longline and by trawl is included in Appendices 5, 6 and 7 of this report.

2.2 Coastal fish and fisheries investigations in the SEA7 area

2.2.1 Bottom trawling surveys in the Firth of Lorne and adjacent sea lochs

In 1969 the Scottish Association for Marine Science (SAMS) (previously the Scottish Marine Biological Association) began a seasonal sampling programme of the fish populations of the sea lochs in the Oban area using a bottom otter trawl. The early surveys centred on the Firth of Lorne, Loch Linnhe, Loch Etive, Loch Creran, Loch Spelve and Loch Sunart. In later years the surveys were extended to the southwest of the island of Mull, the upper Sound of Mull and the Passage of Tiree (Sea of the Hebrides). These surveys supported two PhD projects one on clupeids (de Silva, 1973 a) and the other on gadoids (Cooper, 1979). The basic catch data have been published in a series of SAMS Internal Reports. The following scientific publications have been published using these data:- Cooper (1980, 1983), de Silva (1973 b,c,d), Gordon (1977, a, b, c, d, 1990) and Gordon and Duncan (1979).

2.2.2 Egg and larval surveys in the Firth of Lorne and adjacent sea lochs

Egg and larval surveys using a 2 m young fish trawl were routinely carried out by SAMS in conjunction with the bottom trawling surveys between 1969 and 1976. The larval collections were identified by Sir Frederick Russell and many of the specimens were used to illustrate his book on the eggs and planktonic stages of British marine fishes (Russell, 1976). The data were used by de Silva and Cooper for their PhD projects and by Duncan for her MSc project (Duncan 1993).

2.2.3 Littoral and sub-littoral studies in the Firth of Lorne and adjacent sea lochs

A significant component of the research on fish ecology at SAMS from the early 1970s to the late 1990s was based on detailed investigations of the biology and ecology of juvenile flatfish species in sandy bays and the intertidal (Burrows et al. 1994, 2001; Gibson, 1973, Gibson and Robb, 1996; Gibson et al. 1993, 1996).
There are numerous other publications concerning littoral or sub-littoral fish and fish assemblages (Gibson and Ezzi, 1978, 1979, 1980, 1981, 1987; Gibson and Robb, 1997; Kislalioglu and Gibson, 1977; Nash and Gibson, 1982).

2.2.4 Rocky shore studies in the Firth of Lorne

The exploitation of wrasse as a means of controlling sea lice in aquaculture led to joint research between SAMS and the University Marine Biological Station (UMBS) on the assessment of wrasse stocks (reviewed by Sayer et al., 1996 and Sayer 1996). This work was then expanded with support from the Ministry for Agriculture Fisheries and Food to examine the factors affecting the distribution of inshore juvenile gadoids (Sayer et al., 2001). The research area continues as a component of the SAMS Northern Seas Programme (Burrows et al., 1999; Magill and Sayer, 2002, 2004).

2.2.5 Sea trout in the Firth of Lorne area

In the 1970s and 1980s SAMS studied the migrations and diet of sea trout in some of the sea lochs of the Firth of Lorne area (Pemberton, 1976 a, b and Gibson and Ezzi, 1990). A conference on sea trout in Scotland provides other information on the west of Scotland fishery and the distribution of the species (Picken and Shearer, 1990).

2.2.6 Loch Ewe, Loch Torridon and Gairloch

Fisheries Research Services have maintained out-stations at Loch Ewe and Loch Torridon since the 1960s. The ecology of flatfish on a sandy beach in Loch Ewe was studied in detail in the 1960s (Edwards and Steele, 1968; Edwards et al., 1969, 1970; Steele and Edwards, 1970 and Steele et al. 1970). Sarno et al. (1994 a,b) studied the movements and diet of saithe and pollock on a reef in Loch Ewe. A study of the feeding relationships of the larger fish species in Loch Gairloch was carried out by Hall et al. (1990)

2.2.7 Joint Nature Conservation Council (JNCC) sea loch surveys

From the mid-1980s to the early 1990s, the Joint Nature Conservancy Committee commissioned a series of sublittoral surveys of the sea lochs on the west coast of Scotland and the Western Isles. The reports from these surveys are listed at www.jncc.gov.uk/mit/sloch.htm and summarized in Howson et al. 1994. The surveys were primarily diver-based and are relatively qualitative presence or absence lists at a number of locations in each sea loch system.

2.3 Continental shelf fish and fisheries investigations in the SEA7 area

An important feature of the continental shelf of the SEA 7 area is the numerous islands, most notably the Outer Hebrides, that separate the inner shelf (Minch) from the outer shelf. The Inner Hebrides also have a strong influence on the fish and fisheries of the area. Lying to the west of the Outer Hebrides is the St Kilda group of islands now designated a World Heritage Site.

2.3.1 Population studies

Bailey et al (1979) in their description of the fish and shellfish resources of the seas around the Outer Hebrides, noted that although the fish fauna was similar to other areas around Scotland the demersal fisheries were quite different . They attributed this to the rougher terrain, the proximity to deep water and the effect of exposure on the size of vessel that can fish effectively in unsheltered waters. Trawl fisheries, especially on the inner shelf were late

in developing compared with the North Sea and traditionally the pelagic fisheries, especially for herring were the most important. The very important trawl fishery for *Nephrops* only dates back to the 1950s These and other shellfish fisheries will be described in a separate report by Chapman (2006).

2.3.2 Fisheries Research Services (FRS) surveys and monitoring

FRS have been carrying out routine groundfish surveys in Quarter 1 (usually in March) since 1981. The area covered is Sub-area VI, the northern part of the Irish Sea and Northwest Ireland. Since 2000 the depth range covered has been from 20 to 500 m. The target species are cod, haddock, whiting, saithe and herring. Length age frequency distributions are constructed for all these species. All other species are recorded and, at least, length data are collected. Indices of abundance at age are calculated for the target species and these data are used by the ICES Northern Shelf Assessment Working Group and the Herring Assessment Working Group.

The mackerel recruit survey in Quarter 4 covers the same area as the Quarter 1 groundfish survey. These surveys began in 1985 and are generally carried out in November. The target species now include cod, haddock, whiting, saithe and herring but the time series for the demersal species are as yet too short to be of value to ICES for stock assessment purposes..

Every summer FRS carries out an annual herring acoustic survey in the northern part of Division VIa.

In addition to the above research vessel surveys FRS charters vessels for specific projects and sends scientists on commercial vessels to sample discards (30 + trips per annum in Sub-area VIa).

Market sampling of landings is routinely carried out at the ports of Kinlochbervie, Lochinver, Ullapool and Mallaig. Length frequency and age data have been collected since 1962 and are used by ICES Working Groups. Monthly commercial landings data by statistical square from 1960 onwards for all commercial species are held on database.

2.3.3 Ecosystem simulation model

Ecopath has been used to model the trophic flows for the west of Scotland ecosystem (ICES Sub-area VIa) for the period 1995 to 2000 (Haggan and Pitcher, 2005). The fish species were grouped into 20 categories (dominant species and groups such as other demersal, other pelagic and inshore).

2.3.4 ICES Working Groups

Information on the annual reported landings are published in the STATLANT database which can be downloaded from the ICES website (www.ices.dk). As mentioned above (introduction) these data are the officially reported landings and for various reasons may not reflect the true landings for some species. Information on the quality of the data, adjustments made for misreporting of landings, discarding etc can be found in ICES Working Group Reports. The Working Groups relevant to the west of Scotland shelf are as follows.

Herring Assessment Working Group for the Area South of 62°N (herring and sprat)

Working Group on the Assessment of Northern Shelf Demersal Stocks (cod, haddock, whiting, anglerfish and megrim)

Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy (mackerel and horse mackerel)

2.3.5 Fisheries Sensistivity maps

The UK Offshore Operators Association Ltd (UKOOA) have published a report entitled "Fisheries Sensitivity Maps in British Waters" (Coull et al., 1998). These provide a compilation of the known spawning and nursery grounds for the main commercial species around the whole of the UK. The report also provides monthly seismic sensitivity charts and fishing effort and value charts.

2.4 Rockall Trough

Some of the earliest explorations of deep-sea fishes were in the Rockall Trough in the 1860s and since then there have been many biological and fisheries related surveys (Gordon 2003). The recent interest in the area can be traced back to the early 1970s when new deep-water fishing opportunities were being investigated to compensate for the closure of many distant water areas, such as Iceland, to UK and other European fleets.

2.4.1 UK MAFF surveys

The UK Ministry of Agriculture Fisheries and Food (MAFF) carried out surveys in 1973, 1974 and 1978 over a wide area of the deep-water continental margin of the British Isles (Bridger 1978). The eastern slope of the Rockall Trough from Donegal northwards to the Wyville Thompson Ridge was considered to have the greatest potential with the highest biomass of marketable or potentially marketable species. The western slope bordering the Rockall Bank was not suitable for trawling. The data from these MAFF surveys, which now form a useful record of the unexploited resource, have been reanalysed as part of an EC DG XIV Project 94/017 (Gordon and Swan, 1997a).

2.4.2 German surveys

Germany also carried out surveys in the 1970s and 1980s and some of the results on the commercial and potentially commercial species, especially of the northern Rockall Trough (SEA7 area), have been described by Ehrich (1983). The total catch data for all the surveys was collated and analysed as a contribution to an EC FAIR project (EC95/0655) (Gordon, 1999a). This project also provided new information including descriptions of fisheries, analysis of archived material, market sampling, discard studies and biological parameters. The final consolidated report the project (*Developing deep-water fisheries: data for their assessment and for understanding their interaction with and impact on a fragile environment*) is available on the SAMS web-site (www.sams.ac.uk).

2.4.3 Scottish Association for Marine Science surveys

In 1975 SAMS began a study of the fish populations of the Rockall Trough that concentrated on the Hebridean Terrace at the southern limit of SEA7 area. The emphasis was on seasonal

sampling at depths ranging from 250 m to 3000 m. The total catch data and biological data on the dominant species up until 1992 was analysed with support from EC Project DGXIV 92/10 (Gordon and Swan, 1993). Further trawling was done in 1999 and these data have been used, with support from JNCC, to investigate the effects of fishing on deep-water fish species (Basson et al., 2002). The database associated with this latter project also incorporates data from French research surveys in the Rockall Trough in 1996 and 1999 and from FRS surveys.

A complete presence or absence list, based on all the sampling gears, of all the demersal fish species by depth zone is given in Appendix 3. In general, only a few species comprise the bulk of either the numerical abundance or biomass at any given depth. The type of sampling gear also has a significant effect on the relative abundance of different species (Gordon and Bergstad, 1992). The abundance and biomass data for all species by trawl type and depth zone is given in Appendix 4.

2.4.4 Irish surveys

Ireland began a series of bottom trawl and longline surveys using chartered commercial vessels in the early 1990s. The major renewal of the Irish fleet in 2000 and 2001 opened up the potential for deep-water fishing and in 2001 a team of scientific observers collected information on catch and discards and carried out biological sampling. The data were apportioned to areas one of which was the "West of Scotland" with the coordinates 55 30´ N to 58º 50´ N and 08º 00´ to 11º 30´. In a detailed report information on the catch per unit of effort (CPUE) by depth and the length composition is given for a wide range of both exploited and discarded species (Nolan, 2004).

2.4.5 Scottish Surveys (FRS)

FRS began biannual surveys of deep-water fishes in1998 and they are now to be on an annual basis. These are the only ongoing monitoring surveys in the Rockall Trough.

2.4.6 Atlas of deep-sea fishes

Haedrich and Merrett (1988) published a summary atlas of the deep-water demersal fishes of the whole North Atlantic Basin. It shows the depth distribution and relative abundance of 67 of the more important species. The Rockall Trough data are from the earlier SAMS surveys and this atlas places them in a wider Atlantic context.

2.4.7 Seamounts

Located within the Rockall Trough are several seamounts (Hebridean, Anton Dhorn and Rosemary). The first large catch of orange roughy (*Hoplostethus atlanticus*) by a research vessel was from the vicinity of Rosemary Bank (Freytag, 1979). There is a considerable degree of secrecy surrounding the location of the recent orange roughy fisheries in ICES Division VIa but anecdotal evidence suggests that most catches were from the vicinity of these seamounts.

2.4.8 ICES Working Groups

ICES inaugurated a Study Group on the Biology and Assessment of Deep-water Fisheries Resources in 1994 (Working Group since 2001). This has met in plenary and by correspondence in alternate years and their reports are a useful source of biological and

fishery data. Reporting of unfamiliar species can be difficult and the members of the Group have often supplied more reliable information on landings than is available in the official statistics (STATLANT).

The terms of reference of the Working Group on the Biology and Assessment of Deep Sea Fisheries Resources (WGDEEP) do not include all the deep-water species. The principal species relevant to the SEA7 area are ling (*Molva molva*), blue ling (*Molva dypterygia*), tusk (*Brosme brosme*), roundnose grenadier (*Coryphaenoides rupestris*), argentine (*Argentina silus*), black scabbardfish (*Aphanopus carbo*), orange roughy and greater forkbeard (*Phycis blennoides*). Additional information, when available, is compiled on the biology and landings for several other species including Baird's smoothhead (*Alepocephalus bairdii*), roughhead grenadier (*Macrourus berglax*), rabbit fish (*Chimaera monstrosa*) deep-water cardinal fish (*Epigonus telescopus*) and bluemouth (*Helicolenus dactylopterus*). Deep-water sharks were initially included in this Working Group but are now included in the remit of the Working Group on Elasmobranch Fishes. The anglerfish or monkfish (*Lophius piscatorius*) and the megrim (*Lepidorhombus whiffiagonis*) are assessed by the Working Group on the Assessment of Northern Shelf Demersal Stocks. Blue whiting (*Micromesistius poutassou*) is assessed by Northern Pelagic and Blue Whiting Fisheries Working Group.

The reports of the Working Groups are assessed by the ICES Advisory Committee on Fisheries Management (ACFM) and published annually until 2003 as ICES Cooperative Research Reports. From 2004 the advice has been combined with that of the Advisory Committee on the Marine Environment and the Advisory Committee on Ecosystems as ICES Advice (available on www.ices.dk)

2.5 Rockall Bank

The Rockall Bank extends 25 miles north and 100 miles southwest of Rockall encompassing depths from 65 to 220 m (Blacker, 1982). Rockall itself is a granite rock about 25 m in diameter that stands about 19 m above sea level. Blacker (1982) uses the term Rockall Plateau to include the George Bligh Bank to the northeast and the Hatton Bank to the north west.

The topography of the Rockall Bank and the history of the fishing activities on the bank have been described by Blacker (1982). More than 80 species of fish have been recorded on the Bank and its slopes and Blacker comments that the fauna is similar to that at similar depths on the Hebridean shelf.

Fisheries Research Services carry out a Rockall groundfish survey in Quarter 3 (September) every second year (annually from 1985 to 1997). The survey covers the whole of the plateau down to depths of 250 m.

The Rockall Bank is the only shallow water area within ICES Division VIb and therefore the statistics compiled by STATLANT for shallow water species (e.g. cod, haddock and whiting) and the assessments (e.g. in the Working Group on the Assessment of Northern Shelf Demersal Stocks) for ICES Division VIb apply exclusively to the Rockall Bank.

2.6 Hatton Bank and surrounding abyssal plain

2.6.1 Russian surveys on Hatton Bank

The Soviet Union investigated the Hatton Bank and adjacent underwater rises between 1965 and 1975 (Vinnichenko, 2000). In addition to oceanographical observations biological data was collected on the fish species caught by trawl and longline. Commercial concentrations of roundnose grenadier with a bycatch of smoothheads and sharks were found in 1976. In 1977 a large part of the Bank was closed to the Soviet fleet with the introduction of the UK 200 mile fishing limits. However, surveys continued in the remaining international waters throughout the 1970s and 1980s. Russian investigations on Hatton Bank have resumed in recent years and biological data on commercial and non-commercial species are reported to ICES WGDEEP.

2.6.2 Norwegian surveys on Hatton Bank

In 1991 Norway carried out a wide ranging longline survey of deep-water areas of the northern northeast Atlantic (Stene and Buner 1991). Three sets were made on the Hatton Bank and the catch is shown in Table 2.1. The catches were dominated by elasmobranch fishes, notably the squalid sharks.

Table 2.1 Catch of deep-water sharks from three longline sets on the Hatton Bank (data from Stene and Buner, 1991)

	Station		Station 5	Station 7	Station 8
	Latitude N		59.24 - 59 11	57 00-57 02	57 55 - 58 00
	Longitude W		16 55 17 01	19 44 - 20 00	18 54 19 02
	Depth range m		494 - 951	731 - 987	847 - 931
	No sets		7	6	7
Family	**Common name**	**Scientific name**	**% by Wt**	**% by Wt**	**% by Wt**
Scyliorhinidae	Blackmouth dogfish	*Galeus melastomus*	1.2	0.4	
Squalidae	Leafscale gulper shark	*Centrophorus squamosus*	24	46.2	15.8
Squalidae	Portuguese dogfish	*Centroscymnus coelolepis*	1.6	17.7	3.2
Squalidae	Birdbeak dogfish	*Deania calceus*	15.9	8.9	2.1
Squalidae	Greater lantern shark	*Etmopterus princeps*	18.8		10.6
Squalidae		*Etmopterus pusillus/ Centrosyllium fabricii?*		5.4	49.1
Squalidae	Velvet belly	*Etmopterus spinax*	1	6	
Rajidae	Skates	*Raja spp*	1		0.7
Chimaeridae	Rabbit fish	*Chimaera monstrosa*	2.7	0.3	2
Gadidae	Blue ling	*Molva dyperygia*	10.2	6	6.3
Gadidae	Tusk	*Brosme brosme*	12.9	5	6.3
Gadidae	Greater forkbeard	*Phycis blennoides*	0.3		
Moridae	Mora	*Mora moro*	9.7	4.2	3.8
Pleuronectidae	Halibut	*Hippoglossus hippoglossoides*	0.8		

Norway carried out an experimental trawl survey with M/S Koralnes on the Hatton Bank in 1998. A total of 43 fish species were caught but the catches were dominated by roundnose

grenadier (*Coryphaenoides rupestris*), Baird's smoothhead (*Alepocephalus bairdii*) and Portuguese dogfish (*Centroscymnus coelolepis*) amounting to 50, 21 and 11% respectively of the catch by weight (Table 2.2) (ICES, 2000)

Table 2.2 Dominant species caught by Norwegian longline and trawl surveys on the Hatton Bank

Species	**Longline, 1999**, % by weight	**Trawl, 1998** % by weight
Centrophorus squamosus	25.97	0
Centroscymnus coelolepis	17.16	10.9
Centroscymnus crepidater	12.24	0
Reinhardtius hippoglossoides	7.41	1.2
Centroscymnus fabricii	8.72	0
Molva dypterygia	7.05	1.4
Deania calceus	5.95	0
Etmopterus princeps	6.67	0
Mora moro	3.26	0
Coryphaenoides rupestris		49.7
Alepocephalus bairdii		20.9
Others	5.57	15.9

Norway also carried out an exploratory longline survey with M/S Loran in1999 at 67 stations and at depths between 600 and 1800 m. The total catch comprised 45 species with a total weight of 88.9 tons (round weight). The species caught and the percentage by weight of the total catch are given in Appendix 5 The dominant species were *Centrophorus squamosus (26%), Centroscymnus coelolepis (*17%) and *Centroscymnus crepidater (*12 %) while blue ling (*Molva dypterygia*) and Greenland halibut (*Reinhardtius hippoglossus*) amounted to approximately 7 % each (Table 2.2). The mean catch rate (kg per 1000 hooks) by species and by 100 m depth zone is given in Appendix 6. Another longline survey was carried out in 2000 and good concentrations of Greenland halibut were found. The commercial fishery that developed is described in Section 4.

2.6.3 Spanish surveys on Hatton Bank

A Spanish deep-water exploratory trawl fishery was carried out on the Hatton Bank (Sub-area XII) in 1996 and 1997 (Piñeiro et al 2001). Five freezer trawlers were involved and they used the "Pedreira" trawl (vertical opening 2.5 – 2.8 m) that is also used for deep-water fishing in the Northwest Atlantic Fisheries Organisation (NAFO) regulatory area. The vessels ranged from 47 – 68 m overall length with engine powers between 800 and 2000 HP. The estimated catch of the main species, based on data collected by scientific observers, together with information on discards and effort are given in Table 2.3.

A commercial freezer trawler was chartered in early 1999 and explored the fishing opportunities on the Mid-Atlantic Ridge , Reykjanes Ridge and Hatton Bank (Duran Munoz et al., 2000). Most of the fishing effort (163 out of a total of 196 hours) was on Hatton Bank. Some of the most important species caught by depth zone are given in Appendix 7.

Table 2.3 Estimated total catches, discards (t) and yield (kg/h) caught by Spanish fleet on Hatton Bank (Sub-area XII) in 1996-7 (modified from Piñeiro et al., 2001)

		1996			1997		
Scientific name	Common name	Catch (t)	Discards (t)	kg/hr	Catch (t)	Discards (t)	kg/hr
Centroscymnus spp*		534	1.6	79.4			
Centroscymnus coelolepis	Portuguese dogfish				555	2.1	65.4
Coryphaenoides rupestris	Roundnose grenadier	1136	68.8	169	1800.3	80.4	212.2
Molva dypterygia	Blue ling	367.9		54.7	410.7	1.5	48.4
Aphanopus carbo	Black scabbardfish	252.9	69.4	37.6	98.4	0.6	11.6
Alepocephalus bairdii	Baird's smoothhead	230.3	31.9	34.3	1158	22.5	136.5
Alepocephalus spp.					2534	105.6	298.7
Effort		hours/hauls			hours/hauls		
Surveyed by observers		2241/405			2828/509		
Estimate for fleet		6723/1215			8484/1527		

* mainly *Centrosymnus coelolepis*

In 2005 Spain began a two year multi-disciplinary survey of the Hatton Bank with the emphasis of habitat mapping in relation to the distribution of deep-water corals.

2.6.4 Abyssal depths to the west of Hatton Bank

Nothing is known of the abyssal fish in the Maury Channel. Lying within the Channel is the Endymion Spur and there is anecdotal information that the Faroese fished for orange roughy in this area.

3. FISH SPECIES: BIOLOGY AND FISHERY

This section summarises the relevant aspects of the biology of individual species. The fishery for each species is described. Data on the national and international landings that are most appropriate to the SEA7 area are presented. For the most important commercial species, many of which comprise part of mixed fisheries, the status of the stock and the management are described in Section 4.

Gordon and De Silva (1980) and Gordon (1981) have published a species by species account of the fishes of the west of Scotland shelf. This review includes records of rare fish from the older literature such as the *Scottish Naturalist* and from the lists published annually until 1986 by ICES in *Annales Biologique*.

Common names of fishes can cause confusion, especially for rare species and the deeper water species. A useful compendium of the common and scientific names of the fishes of the British Isles down to depths of about 200 m is given by Wheeler (1992). Additions to the list were compiled by Wheeler et al (2004). The latter also has two appendices listing (1) the deep-sea pelagic fishes from west of the British Isles and (2) the deep-sea demersal fishes from west of the British Isles.

Gordon (2003) described the long history of biological investigations on deep-water fishes of the Rockall Trough and the deep-water fisheries of the ICES area were described by Gordon et al. (2003). During 2001 the Irish Sea Fisheries Board (Bord Iascaigh Mhara (BIM)) engaged a team of scientific observers to collect data from exploratory fishing mostly on the continental slope to the west of Ireland and Scotland. The resulting report provides a species by species account of the basic biology and information on size distribution and catch per unit of effort (CPUE) (Nolan, 2004). The data are grouped by fishing area and the box described as West of Scotland lies within the SEA7 area (see 2.4.4)

The species order follows the standard practice of most fish textbooks and the scientific nomenclature is as used in *The Fishes of the North-eastern Atlantic and the Mediterranean* (Whitehead et al., 1984, 1986)

3.1 Sharks and dogfish

The sharks of the SEA7 area can conveniently be grouped into coastal, pelagic and deepwater.

Coastal

There are only two common coastal species, the spurdog *Squalus acanthias* and lesser-spotted dogfish *Scyliorhinus canicula.*

3.1.1 Spurdog *(Squalus acanthias)*

Biology

The spurdog was chosen as a case study species for an EU funded FAIR project entitled *Development of Elasmobranch Assessments* (DELASS) (Heessen, 2003).

The spurdog has a worldwide distribution in temperate and boreal waters. It occurs on the continental shelf mostly at depths between 10 and 100 m although it is occasionally caught in the deeper waters of the continental slope. Spurdog tend to aggregate in large shoals of the same size or sex. Female spurdog begin to mature at about 70 cm total length (TL) and 50% are mature between 74 and 83 cm TL. They are viviparous (produce live young) with a gestation period of about 22 - 24 months. The young, numbering about 13, have a mean length at birth of about 26 cm. Tagging experiments in the 1960s indicated a winter migration from Scotland to Norway with a return migration in the summer (Holden, 1965). These experiments also suggested that there might be a northern and a southern stock of spurdog. However, recent investigations and a re-analysis of the data from earlier experiments lead to the consensus that there is a single Northeast Atlantic stock.

Unlike teleosts (bony fish) sharks do not have otoliths that can be used for age determination. Instead, other hard parts such as spines and skeletal elements have been used. Some attempts have been made to age spurdog using the dorsal spine but tagging experiments have placed the results in doubt. Tagging returns suggest a longevity in excess of 40 years.

Spurdog have a very varied diet which is dominated by fish of many different species.

Fisheries

The following is a summary of information on spurdog fisheries from Heessen (2003). The fishery is long established in the ICES area but it was not until the 1930s that landings began to increase significantly reaching a peak in 1968 of over 50000 t. The annual landings of spurdog from 1970 onwards are shown in Figure 3.1 together with the landings for the North Sea and the west of Scotland (including Rockall). The landings show a steady decline in recent years.

Most landings of spurdog from the west of Scotland are bycatch of bottom trawlers and seine netters which are mainly targeting whitefish. There remain some local and seasonal directed fisheries. Currently more than half the landings of spurdog from the ICES area come from the North Sea and west of Scotland. In 1996 Scottish vessels landed 43% of the total Northeast Atlantic catch of spurdog of 16000 t.

The mean reported landings of Scottish vessels by ICES statistical rectangle are shown in Figure 3.2 for the years 1997-2001. They show that a high proportion of the landings are from the west coast of Scotland.

The total landings by Scottish based vessels from 2000 to 2004 for ICES Divisions VIa and VIb are given in Table 3.1 (Anon., 2001, 2002, 2003, 2004, 2005)

Table 3.1 Landings of dogfish (t) by Scottish vessels

Year	2000	2001	2002	2003	2004
ICES Div. VIa	1687	1494	1319	2401	1836
ICES Div. VIb	295	338	271	207	165

The experimental stock assessment on spurdog carried out by the DELASS project concluded that the Northeast Atlantic stock was estimated to be severely depleted. In 2005 ICES gave advice on this species for the first time, stating that the stock was depleted and in danger of

collapse. They recommended that target fisheries should cease and bycatch in mixed fisheries should be reduced to the lowest possible level. They proposed applying a TAC (Total Allowable Catch) for the whole northeast Atlantic and that it should be zero for 2006.

3.1.2 Lesser-spotted dogfish *(Scyliorhinus canicula)*

This species is very common on the West of Scotland shelf. It feeds on bottom living decapods and fish and is a significant predator on Norway lobster (*Nephrops norvegicus*). It has no commercial value in Scotland but it is landed in southern Europe and the Mediterranean. It is one of the few sharks that appears to be increasing in biomass in the ICES area, most probably because most discarded individuals survive on being returned to the sea.

Pelagic

The pelagic sharks for which some landing statistics are available for the SEA7 area are the basking shark *Cetorhinus maximus* and the porbeagle *Lamna nasus*. Other sharks in this group that are caught but not recorded separately in the landing figures include the thresher shark (*Alopias vulpinus*), tope (*Galeorhinus galeus*), six-gilled shark (*Hexanchus griseus*) and frilled shark (*Chlamydoselachius anguineus*).

3.1.3 Basking Shark *(Cetorhinus maximus)*

Biology

Kunzlik (1988) has reviewed the available knowledge on the basking shark. They are widely distributed in the North Atlantic where they feed on plankton which they filter from the water through a wide mouth and large gills.

Southall et al (2005) have collated information on the distribution of basking sharks on the European shelf based on tagging, surveys and public sightings. These studies show that they are widely distributed on the west of Scotland shelf, especially in the Minch and around the inner Hebrides. To explain the absence of sightings in the winter months it was often proposed that they hibernated in deep-water. However, recent work with archival tags has shown that they make extensive horizontal and vertical migrations to locate feeding hotspots, often associated with frontal systems. No prolonged open-ocean movements were observed (Sims et al., 2003)

Fishery

The basking shark fishery was one of the earliest directed fisheries for pelagic sharks in the northeast Atlantic (Heessen, 2003). Norway has always been the main country to exploit basking shark in a wide ranging fishery from the Barents Sea to the Kattegat, in the wider North Sea and to the west of Scotland and Ireland. There were also smaller Irish and Scottish fisheries. Most of the Scottish catch was from the west coast.

Basking sharks are fully protected under UK and EU legislation and were recently included in Appendix-II of the CITES convention, meaning that they may only be exported, re-exported or introduced from the high seas if a permit has been issued by the relevant national authorities. There is also a UK Biodiversity Action Plan for basking shark.

3.1.4 **Porbeagle *(Lamna nasus)***

Biology

The porbeagle is widely distributed in the northern North Sea and off the west of Scotland with the highest reported catches around the Shetland Islands (Gauld, 1989). In the SEA7 area the reported catches between 1954 and 1987 were mostly in the Minch and at Rockall. The diet consists mostly of cephalopods and pelagic and demersal fish. The porbeagle is viviparous and produces about four young with a length at birth of between 60 and 75 cm TL.

Fishery

The targeted fishery for porbeagle has been intermittent and has been around Orkney and Shetland. Landings from the west coast of Scotland were incidental. The landings by quarter for ICES Division VIa between 1954 and 1987 are shown in Table 3.2 and amounted to 224 t (Gauld, 1989)

Table 3.2. Landings (t) of porbeagle from ICES Division VIa 1954-1987

ICES Division	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Total
VIa	5	91	23	106	224

3.1.5 **Frilled shark *(Chlamydoselachus anguineus)***

This predominantly deep-water species with a global distribution has occasionally been recorded from the Scottish shelf (Gordon and de Silva 1981). With the advent of deep-water fishing along the continental slope it has been reported in small numbers from bottom trawl research surveys.

3.1.6 **Six-gilled shark *(Hexanchus griseus)***

There are a few records of this species from the west of Scotland shelf (Gordon and de Silva, 1980). However it is primarily a deep-water species occasionally being caught in surveys in the Rockall Trough. There are reports that it might migrate towards the surface at night (Lorance et al., 2000).

Deep-water sharks

At least 12 species of shark are caught regularly in the deep-water trawl and longline fisheries of the Rockall Trough and Hatton Bank. The most important family both by abundance and commercial value is the Squalidae, of which the most regularly landed species are the Portuguese dogfish (*Centroscymnus coelolepis*) and leafscale gulper shark (*Centrophorus squamosus*). Other squalids caught but not usually landed include long-nose velvet dogfish (*Centoscymnus crepidater*), kitefin shark (*Dalatias licha*), birdbeak dogfish (*Deania calceus*), greater lanternshark (*Etmopterus princeps*), velvet belly (*Etmopterus spinax*), black dogfish (*Centroscyllium fabricii*) and knifetooth shark (*Scymnodon ringens*). The livers of some species are sometimes kept for their oil. The family Scyliorhinidae (catsharks) is represented by the blackmouth dogfish (*Galeus melastomus)*, mouse catshark (*Galeus murinus*) and

several species of the genus *Apristurus.* All catches of catsharks in SEA7 area are discarded. In southern Europe and the Mediterranean there is a market for blackmouth dogfish.

Information on the depth distribution, abundance and biomass of the demersal deep-water sharks of the Rockall Trough have been compiled by Gordon and Swan (1997b) and Gordon (1999b). Figure 3.3 shows the depth distribution and abundance of some of the common species of squalid sharks.

Data on length distributions of deep-water sharks are included in the study of their diet by Mauchline and Gordon (1983a). Some of the rarer chondrichthyan fishes of the Rockall Trough have been described by Clarke (2000).

The deep-water shark species caught during surveys on the Hatton Bank are listed in Table 2.1 and Appendices 5, 6 and 7.

3.1.7 Portuguese dogfish *(Centroscymnus coelolepis)*

Biology

The Portuguese dogfish is widely distributed in the NE Atlantic. In the Rockall Trough it is distributed between about 650 and 1750 m with a peak of abundance and biomass at about 1000 m. In the Rockall Trough the length of male fish was generally in the range 85-99 cm and of females from 85-114 cm Very few small individuals have been recorded in the northeastern Atlantic. There is a lack of knowledge on migrations, though it is known that females move to shallower waters for parturition and vertical migration seems to occur (Clarke et al. 2001).

The diet in the Rockall Trough comprised mainly of fish and squid (Mauchline and Gordon 1983a). Pieces of whale blubber have also been recorded and their shape suggests that they are scoop bites from either dead or living whales.

Clarke et al. (2002) used dorsal fin spines to estimate the age of this species at between 21 and 70 years but the lack of juveniles meant that there could be no validation of these estimates.

The reproduction in the Rockall Trough area has been studied by Clarke et al. (2001) and Girard and Du Buit (1999). The average length of females at first maturity was about 102 cm and on average about 14 young were produced. There is no evidence to support a seasonal reproductive cycle. In common with many shark species there was evidence for segregation by sex and maturity stage. There was a tendency for immature fish to occupy deeper water.

Fishery

Portuguese dogfish (*Centroscymnus coelolepis*) is taken in several mixed trawl fisheries in the Northeast Atlantic and in mixed and directed long-line fisheries. The species composition of the shark catch changes with depth but only the Portuguese dogfish and leaf-scale gulper shark are routinely landed. The proportion of these two species in the catch will depend on the depth of occurrence of the target species. In the French mixed trawl fishery the landings of Portugese dogfish are combined with those of the leafscale gulper shark and referred to as ‘siki’. There is also a gillnet fishery that targets deep-water sharks that has recently been

described; in the SEA7 area these fisheries take place in the Rockall Trough and at Hatton Bank (Hareide et al., 2005).

Older records of shark landings were seldom identified to species (partly because species codes did not exist for many species) In the main fisheries it is usually possible to estimate the 'siki' component. The following account refers to 'siki' which comprises mostly the two species, Portuguese dogfish and leafscale gulper shark

Figure 3.4 represents the best estimate of the landings of siki for the ICES area. In Sub-area VI landings steadily increased during the 1990s but recently there has been a decline. Most of the landings are probably from the French bottom trawl fishery in the Rockall Trough. On the Hatton Bank deep-water sharks are taken in the Norwegian long-line fishery that targets Greenland halibut (*Reinhardtius hippoglossoides*) and in the Spanish trawl fishery targeting roundnose grenadier (*Coryphaenoides rupestris*).

Given the poor quality of the data the assessment of the status of the stocks is difficult. However, based on the reported declines in catch per unit of effort (CPUE) in several fisheries ICES has expressed concern about the status of the stock and has recommended a zero TAC for deep-water sharks.

3.1.8 Leaf scaled gulper shark *(Centrophorus squamosus)*

Biology

This species is widely distributed in the North East Atlantic. In surveys in the Rockall Trough and at Hatton Bank the population is dominated by males and immature females at depths between about 450 and 1000 m. Data on stock identity are inconclusive, though available evidence suggests that this species is highly migratory (ICES 2002a).

The diet comprises mainly fish and cephalopods (Mauchline and Gordon, 1983a). The reproductive biology has been described by Clarke et al. (2001) and Girard and Du Buit (1999). The length of first maturity of females is about 124 cm. The number of young is unknown as no pregnant females have been found. Segregation by sex and depth was not as obvious as in the Portuguese dogfish

Fishery

As noted above the landings of this species are either not ascribed to a species or more frequently combined with those of the Portuguese dogfish under the generic term 'siki'. The fishery and status of the stocks have been described in Section 3.1.7

3.1.9 Blackmouth catshark *(Galeus melastomus)*

Biology

The blackmouth catshark occurs mostly on the upper continental slope (Wheeler, 1969) but has also been caught in shallower water including a west of Scotland sea loch (Gordon, unpublished record). It is a benthic species feeding mainly on molluscs, cephalopods, crustaceans and fish. Mature females are on average about 40 cm and about 13 egg cases are produced.

Fishery

This species has no market value in northern Europe and despite being moderately abundant is discarded. It is landed as a bycatch of the Atlantic fisheries of southern Europe and in the Mediterranean.

3.2 Skates and Rays (Family Rajiidae)

Most rays are caught as a bycatch in the mixed bottom trawl fishery for roundfish. Figure 3.5 shows the reported landings of rays for ICES Sub-area VI (west of Scotland) for the years 1973 to 2000 for Scotland and for all other countries combined (data from Heessen 2003).). Figure 3.6 shows the distribution of landings by Scottish vessels of all skates and rays by ICES statistical rectangle averaged for the years 1997 to 2001.

The skates and rays are not normally recorded at the species level in the landings. During the DELASS project a pilot study was carried out to identify the species landed by Scottish vessels. Table 3.3 shows the estimated total landings for the west of Scotland.

Table 3.3 Estimated total landings (gutted weight in kg) of skates and rays into the west of Scotland, 2000-2001, by species. (Modified from Heessen (2003)

Common name	Scientific name	2000	2001
Cuckoo ray	*Leucoraja naevis*	490876	454506
Spotted ray	*Raja montagui*	494181	300352
Thornback ray	*Raja clavata*	59209	175929
Common skate	*Dipterus batis*	121549	183886
White skate	*Raja alba*		3073

Gordon and Duncan (1989) described the depth distribution and the diet of the deep-water rays of the Rockall Trough. At depths between 250 and 3000 m a total of 12 species were recorded but none were abundant.

3.3 Family Chimaeridae

This family is represented by four species in the SEA7 area. The two species of the upper to mid slope which have overlapping distributions are the shallower *Chimaera monstrosa* and the deeper *Hydrolagus mirabilis*. The bycatch of *Chimaera monstrosa* is sometimes landed, possibly together with some larger *Hydrolagus mirabilis*. In the deeper water there are two species, *Hydrolagus affinis* and *H. pallidus*, which attain a larger size but are in low abundance.

3.3.1 Rabbit fish *(Chimaera monstrosa)*

Biology

In the Rockall Trough the rabbit fish occurs at depths between about 250 and 1500 m but has its centre of distribution at about 500 m. It has also been reported on the continental shelf

(Gordon and de Silva, 1980). It produces large egg capsules from which the young emerge at a length of about 10 cm. The diet consist mostly of benthic organisms with a high incidence of anemones and echinoderms (Mauchline and Gordon, 1983a).

Fishery

The bycatch of chimaerids can be quite large in the mixed trawl fishery but until recently it was discarded. In recent years some rabbit fish (mostly *Chimaera monstrosa*) have been landed (Table 3.4)

Table 3.4 The reported landings (t) of rabbit fish from ICES Divisions VIa and VIb

Year	2000	2001	2002	2003	2004
ICES Division VIa	2	31	5	36	6
ICES Division VIb	1	54	7	13	11

3.4 Family Clupeidae

3.4.1 Herring *(Clupea harengus)*

Biology

The herring is widely distributed throughout the northern Northeast Atlantic with a southern limit in the Bay of Biscay. It is a pelagic species dispersing over the surface at night and remaining close to the bottom during the day. It feeds on plankton and copepods are dominant in its diet.

Herring are demersal spawners returning each year to the same spawning areas to lay their sticky eggs on stones and gravel. These eggs are shed in a single batch. Based on the spawning area and the timing of spawning the herring are divided into sub-populations or races. The spawning areas around the British Isles are shown in Figure 3.7 (Coull et al., 1998). An area of both spring (March/April) and autumn (August/September) lies to the west of the Outer Hebrides. Other autumn spawning grounds in the SEA7 area are off the Inner Hebrides and off the coast of Northern Ireland.

Herring nursery areas also extend along the entire west coast of Scotland, including the Hebrides (Figure 3.8) (Coull et al., 1998).The biology of herring on these inshore nursery grounds of the Firth of Lorne area has been described by de Silva (1973 a, b). They comprise of fish in their first year of life and consist of autumn spawned fish (probably from the Minch) and spring spawned fish from the Clyde. They generally migrate from the sea lochs to the more open coastal areas after the first year. Some of the west coast of Scotland herring larvae drift with the currents into the North Sea nursery grounds (Daan et al., 1990).

The diet of these juvenile herring on the nursery grounds comprises mostly of copepods. Older fish, while continuing to consume copepods, also consume mysids. euphausiids and fish larvae (de Silva, 1973c).

Fishery

The herring fisheries collapsed in the mid 1970s and only recovered after a closure of the fisheries between 1977 and 1981. The west of Scotland herring are assessed as a separate stock from those of the North Sea. The west of Scotland (ICES Division VIa) has been further subdivided into a northern and a southern sector. The southern sector is relatively small and encloses the waters to the west and north of Ireland. Sub-division VIa (north) begins at 56º N and extends to the boundary of with ICES Division IVa at longitude 4ºW. There are three herring fisheries in the area. A Scottish and Irish fleet of pair trawlers operate mostly in coastal waters, the Minch and around Barra. A Scottish fleet of single boats fishing by seine net and bottom trawl (in recent years mainly by the latter) that operate mostly in the northern North Sea but also fish in the northern part of ICES Division VIa. An international fleet of freezer trawlers, mainly registered in the Netherlands, Germany, France and UK (England), operates in deeper water along the shelf edge (ICES 2004).

The management of the west of Scotland fishery is difficult because the data on reported landings of herring are unreliable due to misreporting of fish into the area that were caught in other areas, notably from the North Sea. Figure 3.9 shows the reported landings by country for ICES Division VIa north with Scotland taking the bulk of the catch. Figure 3.10 shows the distribution of these Scottish landings indicating that the greatest reported landings are from the north of the SEA7 area. The total landings for ICES Division VIa (north) shown in Figure 3.11 include landings, unspecified to a country, not officially reported to ICES but identified by the ICES Working Group. The working group has also estimated the amount of misreporting and adjusted the landings for assessment purposes. These adjusted totals are also shown in Figure 3.11. In 1997 Scotland introduced separate licences for ICES Divisions VIa and IVa with a requirement that only one be carried at any given time and misreporting of catches was perceived to have decreased. However in 2000 this regulation was rescinded and as a consequence misreporting seems to have increased.

The herring fishery in ICES Division VIa (south) is mainly prosecuted by the Irish fleet that also operates in the north of ICES Sub-area VII (Divisions b & c). The pattern of the fishery has changed with time and currently the most important component lies in Division VIa (south). As in Division VIa (north) misreporting and underreporting have been a problem in this fishery but changes in management are thought to have improved the reliability of the data

3.4.2 Sprat *(Sprattus sprattus)*

Biology

Sprats are a short lived species and their abundance is very much dependent on the strength of the recruiting year classes. They spawn in most of the waters around the UK including the entire inner shelf of the SEA7 area (Coull et al., 1998) (Figure 3.12). Unlike herring the eggs are pelagic and the sprat is a batch spawner between May and August (de Silva, 1973d).

The nursery areas on the west coast of Scotland tend to be in inshore waters and sea lochs but the timing of the movement into these areas is more variable than it is for herring (de Silva, 1973a, b). Unlike herring they remain in the sea lochs for longer periods. The diet of the sprat in the inshore areas consists mostly of copepods and unlike herring the diet of all age groups was similar (de Silva 1973c).

Mature fish also migrate inshore during the winter months and in some years are exploited by the fishery.

Fishery

The landings of sprat from the west coast of Scotland are variable presumably reflecting variable recruitment of a short-lived species and marketability (Table 3.4).

Table 3.4 Landings of sprats (t) by Scottish based vessels between 2000 and 2004 (Scottish Fisheries Statistics)

Year	**2000**	**2001**	**2002**	**2003**	**2004**
ICES Div. VIa	4014	1232	2575	2543	n/a

3.5 Family Argentinidae

There are two species of argentine in the SEA7 area, the lesser silver smelt (*Argentina sphyraena*) and the greater silver smelt (*Argentina silus*). Only the larger sized greater silver smelt, frequently referred to simply as argentine, has a commercial value.

3.5.1 Argentine *(Argentina silus)*

The argentine is a deep-water species being confined to depths between about 150 and 700 m on the upper continental slope. It is a semi-pelagic species and is seldom taken in large numbers by bottom trawls. The target fishery for this species used pelagic trawls (see below) and usually the small catches by bottom trawls are discarded. In the SAMS surveys most fish were in the length range 25 to 40 cm. It feeds mainly on planktonic organisms such as euphausids, amphipods, chaetognaths, squids, ctenophores and small fishes (Mauchline and Gordon, 1983b).

At the start of the Dutch fishery in the Rockall Trough in 1989 a major part of the landings consisted of specimens older than 20 years with a maximum age of 40 years. By 1994 fish of age greater than 20 had virtually disappeared (Heessen and Rink, 2001). The argentine has a prolonged spawning season with an apparent peak during the second half of the year (Ehrich,1983).

Fishery

The reported the landings of argentines by country for ICES Divisions VIa and VIb are shown in Figures 3.13 and 3.14. The main fishery takes place on the west of Scotland slope (Heessen and Rink, 2001). The fishery peaked in the late 1980s and early 1990s and was mainly attributable to Norwegian and Irish fleets. The same vessels would also target blue whiting. The Dutch fishery began in 1989 and since then this has been the most consistent fishery. The Dutch fleet of pelagic freezer trawlers, some sailing under foreign flags, also specialise in small pelagics including herring and horse mackerel. The fishery began to increase again in 2001 largely due to Scottish and Irish effort. Quota management was introduced by the EU in 2003 with TACs of 441, 4971 & 349 t for Ireland, the Netherlands and UK respectively. Reported landings decreased dramatically and failed to achieve the TACs.

The fishery in ICES Division VIb is spasmodic. Russia has reported relatively small landings since 1999 as bycatch of their fisheries for blue whiting and haddock on the Rockall Bank.

3.6 Family Alepocephalidae

The alepocephalids, together with the macrourids (Section 3.10) are among the most diverse families of deep-water demersal fishes. Their distribution extends from the upper continental slope to abyssal depths. However, in the SEA7 area only one species (*Alepocephalus bairdii*) is abundant.

3.6.1 Baird's Smoothhead *(Alepocephalus bairdii)*

The depth range of Baird's smoothhead in the Rockall Trough is from about 450 to 2200 m but they are most abundant between about 750 and 1500m. They are the dominant species by weight, depending on trawl type between 1000 and 1500 m (Gordon and Bergstad, 1992). The diet consists of a wide variety of mainly pelagic prey items. The very high proportion of unidentifiable material is probably associated with gelatinous plankton (Mauchline and Gordon, 1983b). Allain and Lorance (2000) and Allain (1999, 2001) have described the age, growth and the reproduction of this species.

Fishery

The smoothhead achieves neutral buoyancy by reducing the density of its skeleton and by having a very high water content. As a result the flesh has been considered unpalatable and they are routinely discarded in the Rockall Trough trawl fishery. Depending on the fishing depth and the season discarded smoothheads can account of a significant part of the total catch.

It was therefore surprising that in the recent Spanish trawl fishery on Hatton Bank considerable quantities of smoothheads were landed (Table 3.5)

Table 3.5. Reported landings of smoothheads (t) by Spain from ICES Sub-areas VI/VII and XII (Hatton Bank)

Year	ICES Sub-areas VI and VII	ICES Sub-area XII
1995		
1996		230
1997		3692
1998		4643
1999		6549
2000	978	4146
2001	4689	3132
2002	n/a	12538
2003	0	6834
2004	1203	1203

3.7 Family Merluccidae

3.7.1 Hake *(Merluccius merluccius)*

Biology

The hake is widely distributed on the west of Scotland continental shelf but the main fishing areas are concentrated in the deeper water at the edge of the continental shelf (Casey and Pereiro, 1995; Hickling, 1935). The general biology of the hake in the northeast Atlantic has been described by Casey and Pereiro (1995). However, most of the information on the biology of hake in ICES Division VIa derives from Hickling (1935). Spawning occurred in Scottish waters from May to August. In the absence of tagging the evidence for movements of hake are based on circumstantial historical data on seasonal catch rates. Recent genetic studies (Lundy *et al*., 1999) seem to indicate a complex population structure.

Hake undertake diurnal migrations remaining close to the bottom during the day and moving to near the surface at night to feed. Young hake feed on a variety of pelagic invertebrates and small fish and older fish consume a wide variety of pelagic fishes.

Fisheries

ICES has divided the stocks of hake into a southern and a northern component. The northern component extends from the Bay of Biscay northwards and includes Sub-area VI and the northern North Sea (Division IVa). However the main fishery on the stock is in the northern Bay of Biscay and to the west of Ireland. The landings from west of Scotland and the northern North Sea amount to about 12% of the total catch.

Figure 3.15 shows the reported landings by country for ICES Division VIa. There has been a steady decline since a peak in the late 1980s and early 1990s. The present catches are probably mostly taken as bycatch of bottom trawlers, by longliners and by gillnetters. The landings from ICES Division VIb (Figure 3.16) are almost all attributable to Spain but have declined to a very low level in recent years.

3.8 Family Gadidae

3.8.1 Cod *(Gadus morhua)*

Biology

Cod are widely distributed on the west coast of Scotland (Gordon and de Silva, 1980). For the purposes of assessment and management the west of Scotland (Sub-area VI) cod are treated as a separate stock from those of the North Sea (ICES Sub-area IV (see below). Tagging has revealed that cod migrate in late summer and early autumn from the west coast to the north coast and return in the late winter and early spring. There appears to be limited movement of cod between the west coast of Scotland and the North Sea.

Cod has a very high fecundity and spawning, which can occur between January and April, occurs all around the British Isles but in localised areas (Figure 3.17) (Coull et al., 1998). In the SEA7 area there is a significant spawning area are around the outer Hebrides. Around the British Isles cod nursery areas tend to be located in inshore areas (Figure 3.18) where the

juveniles are often associated with rocky shores (Magill and Sayer, 2004). Cod remain pelagic until they reach a length of about 7 cm after which they become demersal. There was no evidence for diel migration of cod in the pelagic phase (Bailey, 1975). Adult cod feed on a wide range of fish and invertebrates (Wheeler, 1969).

Fishery

The cod fishery on the west of Scotland is predominantly by bottom trawlers. It is a mixed fishery that also targets haddock, anglerfish and whiting with bycatches that include saithe, megrim and lemon sole. It is widely distributed over the area but highest landings are from the area north of the Outer Hebrides and in the South Minch to the south and east of Barra.

The total landings of cod for the years 1984 to 2003 from the west of Scotland, after relatively minor adjustments by the ICES Working Group for unallocated landings and discards, are shown in Figure 3.19. They show a dramatic decline since the 1980s.

The total reported landings by country are shown in Figure 3.20. In recent years Scottish landings as a percentage of the total reported landings have increased and now account for 60 to 70% of the total. This change is as a result of a decline in the French landings. Scottish landings now account for between 85 and 95 % of total UK landings from this Division.

The reported landings by country for ICES Division VIb (Rockall) are shown in Figure 3.21. They show a dramatic decline in recent years.

3.8.2 Haddock *(Melanogrammus aeglifinus)*

Biology

The haddock is widely distributed on the west coast of Scotland continental shelf (Gordon and de Silva, 1980) and there is some evidence from tagging of a winter migration of adults from the North Sea to northwest coast of Scotland. The nursery grounds are offshore and are widely distributed in the SEA7 area over the continental shelf (Figure 3.23) (Coull et al., 1998). Once the juveniles have settled in deeper water they and the adults feed on a wide variety of benthic fauna and on some fish, such as sandeels.

Fishery

The fishery for haddock by Scottish vessels in the SEA7 area is concentrated on the south Minch and to the west of the Outer Hebrides (Figure 3.24)

Haddock on the west of Scotland are caught by several components of the Scottish fleet. Bottom trawlers with a codend mesh of 110 mm fish a variety of grounds along the west coast and to the north of the Hebrides. This fleet has tended to move further offshore to target anglerfish (*Lophius* spp.). *Nephrops* trawlers also land haddock as a bycatch. Both fleets discard substantial quantities of small haddock. Scottish seine netters also fish the same grounds as the trawlers and discard less small haddock. French trawlers targeting deep-water species along the shelf edge and continental slope also land small quantities of haddock**.** Figure 3.25 shows the estimated annual international catch of haddock from Division VIa for the years 1978 to 2004. These data comprise the reported landings, an adjustment for

unallocated landings and an ICES Working Group estimate of the weight of discarded haddock.

Figure 3.26 shows the reported landings for ICES Division VIa by country for the years 1973 to 2004 The Scottish share of the total UK landings has increased and now represents > 80% of the total.

The haddock fishery, both by trawling and longline, on the Rockall Plateau has a long history (Blacker, 1982) (see Section 4.2.4). Figure 3.27 shows the reported landings by country between 1980 and 2004. The major change in the fishery arose when a large part of the Rockall Bank became international waters (See Section 1). The reported landings by the Russian fleet increased markedly and ICES are concerned that due to the remoteness of the fishery the unreported landings may be much greater.

3.8.3 Whiting *(Merlangius merlangus)*

Biology

The whiting is widely distributed and on the west of Scotland shelf (Gordon and de Silva, 1980) and on the Rockall Bank.

For the purposes of assessment and management, whiting to the west of Scotland is treated by ICES as a separate stock from that of the North Sea. The biological stock structure is poorly understood but a study of the parasites suggested that the whiting from the west coast of Scotland were significantly different from those from around Orkney and Shetland and the northern North Sea (Kabata, 1967) None of the whiting tagged in the North Sea and around Orkney and Shetland were recovered on the west coast of Scotland (Hislop and MacKenzie, 1976).

Whiting has a high fecundity and is a batch spawner with prolonged spawning period from about February to June. Spawning occurs widely throughout its range but some areas have been identified as of particular importance. These include the North Minch extending to part of the North Coast (Coull et al., 1998) (Figure 3.28)

The eggs and larvae are pelagic and on the west of Scotland the young remain pelagic until they attain a length of about 10 cm when they begin to be taken by fine-meshed bottom trawls from July onwards (Gordon, 1977a). The nursery grounds tend to be located inshore (including the sea lochs) and whiting remain in these areas for one or two years. Two year old fish are more frequently caught in the deeper sea lochs indicating that depth is an important factor in determining juvenile distribution. Cooper (1980) found evidence to suggest that the inshore distribution was an inshore migration rather than a passive dispersal from the spawning area as appeared to be the case for some other gadoid species. On a broader scale Coull et al., (1998) also show the importance of inshore areas as nursery (Figure 3.29).

Adult whiting is an active predator feeding on a wide variety of prey. Crustaceans and fish are the dominant prey items with fish becoming more important with increasing size (Gordon, 1977b). Whiting tend to grow slowly after the first year, but growth rates are very variable. They reach maturity at about two years and can live for about seven or eight years.

Fishery

The fishery for whiting by Scottish vessels in the SEA7 area is spread over a wide area of the continental shelf (Figure 3.30).

Whiting in Division VIa are caught by essentially the same fleet that lands haddock. However, discarding is probably greater because of other additional factors such as low market value and restrictive quotas. Figure 3.31 shows the reported landings of whiting by country for ICES Division VIa. There has been a dramatic decline in the reported landings although ICES believe that there might be significant unreported landings. Scottish landings of whiting account for more than 90% of the total UK landings and between about 60 and 80 % of the international landings of this species. Figure 3.32 shows the ICES Working Group's estimates of the weight of whiting discarded. It can amount to between 35 and 55% of the estimated total catch.

The whiting landings from ICES Division VIb (Rockall) are relatively small (Figure 3.33).

3.8.4 Blue whiting *(Micromesistius poutassou)*

Biology

The main blue whiting spawning grounds (Figure 3.34) are along the continental slope to the west of Scotland at depths of about 300 to 600 m. Spawning takes place between February and April. After spawning the populations disperse on a feeding migration to the northern North Sea and the Norwegian Sea (Bailey, 1982). The eggs and larvae drift northwards to nursery grounds. The distribution of these nursery grounds is shown in Figure 3.35. Blue whiting remain on the nursery grounds for 2 to 4 years before returning to spawn.

Blue whiting appear to be a relatively short lived species (5-7 years) and grow to about 20 cm at age 1. They become mature at about 20 cm (Knijn et al., 1993). The diet of the adults on the spawning grounds has not been studied. A small population in a Scottish sea loch were feeding on mysids and euphausiids (Gordon 1977c). Studies in other areas indicated that crustaceans and small fish are the most important food items.

Fishery

Blue whiting is widely distributed in the North Atlantic from Gibraltar to the Barents Sea and although genetic and other evidence suggests that there may be several populations the boundaries are not clear. For this reason blue whiting is treated by ICES as a single stock. The fishery for blue whiting was established in 1977. Initially most of the catches were taken in a semi-pelagic trawl fishery on spawning and post-spawning fish along the upper continental slope to the west of the British Isles (ICES Divisions Vb, VIa,b and VIIb,c). The mixed industrial trawl fishery in the North Sea (Sub-area IV) and the Norwegian fishery (Sub-area II) catches juvenile blue whiting. The combined fishery on almost all the life history stages amounted to 2.3 million t in 2003 making it the largest fishery in the Atlantic.

Figure 3.36 shows the reported landings of blue whiting by country for ICES Division VIa. This shows that the total fishery has expanded rapidly in recent years. The fishery in Division VIb only developed significantly after most of the area became international waters (Figure 3.37).

3.8.5 **Norway pout *(Trisopterus esmarkii)***

Biology

The Norway pout is a small gadoid fish that only reaches a length of about 20 cm and lives for about three years. It is widely distributed on the west coast of Scotland (Gordon and de Silva, 1980) where, after the pelagic phase, the juveniles spread into inshore waters and sea lochs (Gordon, 1977d; Cooper, 1980)

Spawning occurs over a wide area in offshore waters of the west and north of Scotland (Coull et al., 1998) (Figure 3.38). Areas of higher concentration exist to the west of the Inner Hebrides and to the north of the Outer Hebrides In shelf waters spawning occurs from January to April while in deeper waters it is from March to May. They feed on copepods, decapod larvae, mysids and euphausiids (Gordon, 1977d).

Fishery

Norway pout on the west coast of Scotland are treated as a separate management unit by ICES, although there is no evidence that they are a separate biological stock from those in the northern North sea. The fishery in ICES Division VIa is mainly carried out by Denmark and there is considerable annual variation in landings. The reported landings of Norway pout from 1974 to 2004 are shown in Figure 3.39 The landings have steadily decreased since the mid 1990s.

3.8.6 **Saithe *(Pollachius virens)***

Biology

The juveniles (<3 yr) and the adults of saithe have distinctively different distributions. The juveniles are located in coastal areas that cover the entire west coast of Scotland as shown in Figure 3.40. (Coull et al., 1998). At about 2 - 3 yr they migrate to deeper water along the outer continental shelf. This migration takes place in the spring. The age at maturity is between 4 and 6 years. Spawning takes place from January to April to the west of the Outer Hebrides at about 200 m depth as indicated in Figure 3.41 (Coull et al., 1993). Larvae and post-larvae are distributed widely and in May the 0-group appear along the coasts.

The diet of juvenile (0-group) saithe in sea lochs comprised both pelagic and demersal organisms with copepods, amphipods, decapods and polychaetes being the dominant taxa (Kislalioglu and Gibson, 1977; Sarno et al., 1994a). Adult saithe feed mostly on euphausiids and fish (du Buit, 1982).

Fishery

The fishery for saithe by Scottish vessels in the SEA7 area is concentrated on outer shelf (Figure 3.42) Prior to 1999 saithe from the west of Scotland were assessed by ICES separately from a combined North Sea and Skagerrak stock. Tagging experiments by various countries have shown that exchange takes place between all stock components in the northeast Atlantic and now the assessment for saithe applies to all three areas combined.

The west of Scotland fishery in Sub-area VI comprises two components. There is a French and to a lesser extent a German bottom trawl fishery operating along the shelf edge and a Scottish fishery operating inshore. Figure 3.43 shows the reported landings by country for the years 1992-2004 for Division VIa. Landings from Division VIb have been low (<300 t) in recent years.

Because of a lack of quota there is significant discarding of saithe by Scottish trawlers. ICES estimated this to be about 9000 t in 2004.

3.8.7 Tusk *(Brosme brosme)*

Biology

Tusk are caught, mostly by longline, mainly at the shelf edge and on the upper continental slope at depths between about 150 and 450 m . They are not abundant in trawl catches because of their preference for rocky ground. Tusk have a northerly distribution in the Atlantic being found off East Greenland, around Iceland, the northern part of the British Isles and around Norway including the Skagerrak (Bergstad and Hareide, 1996; Magnússon et al., 1997). Although there is evidence of a genetic separation between the east and west Atlantic, there was no genetic evidence to support stock separation within the northeastern Atlantic. However the wide separation of fishing grounds might support the use of separate management units. It is not known whether the tusk migrates within its area of distribution. Spawning appears to take place in the Hebrides and Rockall areas in March and April (Magnússon et al., 1997). It is assumed that the nursery grounds are in deep water on rough bottom. The diet consists mainly of crustaceans and small fish such as Norway pout.

Fishery

The fishery for tusk is dominated by Norway. About 90% of the catch is by longline. Tusk is usually a bycatch of the fishery that targets ling. The fishery prosecuted by the high-seas longline fleet that has been described in detail by Bergstad and Hareide (1996). These are highly mechanised vessels that freeze the catch on board. They also target cod and the effort expended on the different fisheries depends on the availability of quota.

In ICES Division VIa the Norwegian fleet accounts for a high proportion of the landings (Figure 3.44). The French bottom trawl fishery targeting saithe and deep-water species also has a bycatch of tusk. In Division VIb Norwegian landings are dominant and the UK landings are probably caught by Spanish owned longliners on the UK fishing vesselregister (Figure 3.45).

3.8.8 Blue ling *(Molva dypterygia)*

Biology

The blue ling is a deep-water species of the continental slope. On the slope to the west of the Hebrides it occurs at depths from 300 to about 1300 m with a peak abundance at about 800 m. Blue ling has a northerly distribution around Iceland, in the Rockall Trough and around the north of Scotland to the Faroe Islands and Norway (Bergstad and Hareide, 1996; Magnússon et al., 1997). Blue ling aggregates for spawning and this forms the basis of some of the targeted fisheries, notably in the northern Rockall Trough and at locations around

Iceland. Spawning occurs from about mid March to mid-April in Scottish waters. Blue ling is also present on the Hatton Bank (Durán Muñoz and Román Marcote, 2001) Blue ling has a mainly piscivorous diet but also consumes larger crustaceans (Mauchline and Gordon,1984a)

Fishery

The development of the deep-water fishery for blue ling is described in Section 4.2.3). In ICES Division VIa some blue ling are landed from the Norwegian longline fishery that targets ling and tusk but the bulk of the landings are from the French deep-water trawlers and also from the Scottish fleet. The reported landings by country are shown in Figure 3.46. French trawlers used to take more than 95% of the catch but the catch of Scottish trawlers has been increasing since the mid 1990s.

The blue ling landings from Division VIb are more variable (Figure 3.47). Some of the landings are certainly from the west of the Rockall Plateau and Hatton Bank. Some may also be from the northern banks of the Rockall Trough where the aggregations are found.

3.8.9 Ling *(Molva molva)*

Biology

There is currently no evidence of genetically distinct populations of ling (Bergstad and Hareide, 1996; Magnússon et al., 1997). Spawning aggregations of ling have not been observed and the eggs are distributed over a wide area of the Northeast Atlantic. In Scottish waters spawning takes place between March and June. Ages of up to about 14 years have been reported but most fish in the Norwegian longline landings are between about 5 and 8 years. Ling have a mainly piscivorous diet feeding on species such as Norway pout, blue whiting, argentine, herring and cod. Squid, crustaceans and echinoderms are also consumed.

Fishery

The reported landings of ling by country from ICES Division VIa are shown in Figure 3.48. The main fisheries in Division VIa are the Norwegian targeted longline fishery and trawl fisheries by France and Scotland that take ling as a bycatch. The reported landings from Division VIb are dominated by Norway (Figure 3.49).

3.8.10 Greater forkbeard *(Phycis blennoides)*

Biology

The greater forkbeard has a wide distribution in the eastern Atlantic and the Mediterranean. In the Rockall Trough it occurs at depths between about 250 and 1000 m. It feeds on mostly on crustaceans, but larger individuals also consume small squid and fish.

Fishery

Historically the landings were mainly from the French deep-water trawl fishery in the Rockall Trough. However, the morid fish *Mora moro,* was sometimes included in the landings. In recent years other countries have begun landing the greater forkbeard from both

longline and trawl fisheries. The reported landings by country for ICES Division VIa are shown in Figure 3.50.

3.9 Family Moridae

Four dominant species of the family Moridae occur in the Rockall Trough; North Atlantic codling (*Lepidion eques*), *Halargyreus johnsonii*, Mora (*Mora moro*) and Blue hake (*Antimora rostrata*). Aspects of their biology have been described by Gordon and Duncan (1985) and their diets by Mauchline and Gordon (1980. 1984a). *Lepidion* and *Halargyreus* are seldom landed because of their small size but they often comprise a significant proportion of the discards from the trawl fishery. Mora has a larger body size and is generally landed as a bycatch from the trawl fishery in the Rockall Trough. In the early years of the fishery the landings of Mora and greater forkbeard were combined. *Antimora rostrata* is a deeper living species and is the dominant species by weight at depths of around 2000 m in the Rockall Trough (Appendix 4).

3.10 Family Macrouridae

The macrourid fishes are a highly diverse family of mostly demersal fishes of which 12 have been reported from the Rockall Trough from the shelf/slope break to abyssal depths (Appendix 3). However, only two species are exploited because the remainder are either of a small size or in low abundance. These species are the roundnose grenadier (*Coryphaenoides rupestris*) and roughhead grenadier (*Macrourus berglax*). Roundnose grenadier is a species of the warmer Atlantic water while the roughhead grenadier tends to be associated with colder water masses. The roughhead grenadier is very rare in the Rockall Trough but both species are found on the Hatton Bank.

Although not commercially exploited several macrourid species are dominant in terms of either numerical abundance or weight at different depth zones (Gordon and Bergstad, 1992) (Appendix 4). The diet of the macrourid fishes of the Rockall Trough was described by Mauchline and Gordon (1984b) and for some of the deeper living species by Gordon and Duncan (1987a). Seasonal aspects of the reproduction of several species have been described by Gordon (1979 a,b,) and Gordon and Duncan (1987a). The biology of *Nezumia aequalis* was described by Coggan *et al.* (1999). Swan and Gordon (2001) have estimated ages of juvenile macrourids and, for some species, have validated these ages using marginal increment analysis.

3.10.1 Roundnose grenadier *(Coryphaenoides rupestris)*

General accounts of survey abundance, length frequency and depth distributions of roundnose grenadier are given by Bridger (1978), Ehrich (1983), Gordon (1979c) and Gordon and Swan (1993; 1997b). It has a wide depth range from about 450 to 1800 m in the Rockall Trough.

In common with most macrourids the roundnose grenadier has a very diverse diet consisting of copepods, decapods and fish as the dominant items and mysids euphausiids, amphipods and cephalopods of secondary importance (Mauchline and Gordon, 1984b)

The age and growth of this species has been described by Gordon (1978); Kelly *et al.* (1997); Allain and Lorance (2000) and Lorance *et al.* (2003). Gordon and Swan (1996) and Swan and Gordon (2001) validated the ages of juvenile fish. Roundnose grenadier is a long-lived

species with ages of up to 72 years being reported from the Skagerrak (Bergstad 1990). However in the Rockall Trough fishery most fish were less than 30 years. The roundnose grenadier in the Rockall Trough has a prolonged spawning period from July until at least November (Kelly *et al.*, 1996).

Fishery

The fishery for roundnose grenadier in the Northeast Atlantic began in the late 1960s when USSR trawlers conducted a wide ranging fishery. It is not possible to ascribe the landings to particular areas but it is probable that most were from the Reykjanes Ridge and the northern Mid-Atlantic Ridge. Some exploitation within the SEA7 area undoubtedly occurred on the Hatton Bank and some of the northern banks of the Rockall Trough such as Bill Bailey and Lousy Banks. The present fishery in the SEA7 area has two components, the Rockall Trough and the Hatton Bank.

The Rockall Trough fishery began in 1989 when France developed a market for a species that was previously discarded in the blue ling fishery (see Section 3.8.9). Figure 3.51 shows the reported landings by country for ICES Sub-area VIa from 1988 to 2004. The bulk of the landings have been by France with only small landings being reported by Faroe, Ireland, Germany, Norway and the UK. There was an increase in the UK landings in the years leading up to the introduction of quotas in 2003. The Rockall Trough fishery takes place along the entire continental slope to the west of the Hebrides and as far north as the Wyville Thompson Ridge. Initially the fishery was at depths between about 800 and 1000 m and there was a high discard rate, up to 30 %, of smaller fish. However, as smaller fish became acceptable to the market the fishery has extended into deeper waters to exploit the smaller fish that occur at greater depths.

The landings from Hatton Bank are more difficult to interpret because the landings are from both Divisions VIb and Sub-area XII. Most landings from Division VIb can be allocated to Hatton Bank but allocating the landings from Sub-area XII between Hatton Bank and the Mid-Atlantic Ridge is more difficult. On the basis that Spain, after some exploratory surveys, never developed a Mid-Atlantic Ridge fishery the Sub-area XII Spanish landings are apportioned to Hatton Bank in this report. It is assumed that most Russian landings are from the Mid-Atlantic Ridge for the purposes of this report. Fig 3.52 shows the reported landings for Division VIb to which have been added the Spanish landings from Sub-area XII There is no information on the location of the fishery on the Hatton Bank but some information from a Norwegian trawl survey suggests that the northern area (59 - 60ºN and 15 - 18ºW) at depths of about 1000 to 1500 m yielded the best catch rates.

3.10.2 **Roughhead *grenadier (Macrourus berglax)***

Biology

The roughhead grenadier is relatively abundant in the Faroe Shetland Channel (Bullough et al. 1998) but has seldom been reported south of the Wyville-Thompson Ridge in the Rockall Trough. It is present on the Hatton Bank where it is associated with the fishery for Greenland halibut. There is no information on its biology in this area.

Fishery

The roughhead grenadier is caught as a bycatch in longline fisheries targeting Greenland halibut. It has a very rough scaly skin and mainly for this reason it does not have a high market value and is often discarded. The annual reported landings for Sub-areas VI and VII (presumably all from Hatton Bank) since 1999 have ranged between 9 and 44 t. Only Norway has reported landings from Sub-area XII and they range from 2 to 27 t.

3.11 Family Trichiuridae

3.11.1 Black scabbardfish *(Aphanopus carbo)*

The black scabbardfish is a deep-water species that is widely distributed in the northeastern Atlantic. It is commercially fished on the slope to the west of the British Isles, off the Iberian Peninsula, around Madeira and on the Mid-Atlantic Ridge. In the Rockall Trough it has a depth range of about 500 to 1200 m with a peak of abundance at about 600 m (Ehrich, 1983). The eggs, larvae and smallest juveniles are unknown. The fish caught in the Rockall Trough are all immature sub-adults. Mature fish are found further south of mainland Portugal and at Madeira. Black scabbardfish is probably one of the faster growing deep-water species (Morales-Nin *et al.*, 2002). The diet, which is mostly of fish, has been described by Mauchline and Gordon (1984c).

Fishery

ICES divides black scabbardfish into a southern and a northern stock for the purposes of assessment although the biological evidence for such a division is lacking. The stocks are separated on the basis of the method of capture, longline in the south and bottom trawl in the north. The trawl fishery is part of the mixed fishery for roundnose grenadier, blue ling and deep-water sharks although sometimes black scabbardfish is the target species. Figure 3.53 shows the reported landings of black scabbardfish by country for ICES Division VIa. Most of the landings are from the French trawl fishery. No landings were reported by France in 1999 and a mean of the 1998 and the 2000 landings has been inserted. Scottish landings increased in the years before the introduction of a TAC.

Figure 3.54 shows the reported landings of black scabbardfish by country for ICES Division VIb together with the Spanish landings from Sub area XII. This is considered to be a reasonable estimate of the landings from Hatton Bank (see Section 3.10.1).

3.12 Family Trachichthyidae

3.12.1 Orange roughy *(Hoplostethus atlanticus)*

Biology

The orange roughy is a deep-water species which has a global distribution and there are or have been important fisheries off Australia, New Zealand, Namibia, Chile, the Indian Ocean and the northeast Atlantic. In the SEA 7 area it occurs at depths between about 800 and 1800 m but is most abundant at about 1200 – 1400 m. Orange roughy is typically associated, although not exclusively, with steep slopes and seamounts.

Orange roughy is often cited as an example of a long-lived deep-water species with ages of up to 140 yr estimated from fish in New Zealand waters. Similar ages have been estimated for fish from the Rockall Trough (Allain and Lorance, 2000). Gordon and Duncan (1987b) have described aspects of the biology of orange roughy in the Rockall Trough and Porcupine Seabight. Mauchline and Gordon (1984c) found that the diet comprised mostly decapods although mesopelagic fish were also found in the stomachs of larger individuals. The females reach maturity at a length of about 50 cm and spawning takes place over a short period in winter (Du Buit, 1995).

Fishery

Figure 3.55 shows the estimated landings by country of orange roughy for Sub-area VI (WGDEEP estimates). The landings peaked very rapidly in the early 1990s and have remained a low level ever since. It is thought that most of the landings were from a fishery that targeted aggregations around the seamounts of the Rockall Trough. A similar situation exists in ICES Sub-area VII where most of the Irish catch is from the targeted 'peaks' fishery on aggregations and a relatively smaller amount from the mixed trawl fisheries ('flats' fishery).

3.13 Family Carangidae

3.13.1 Horse Mackerel *(Trachurus trachurus)*

The horse mackerel or scad is a shoaling pelagic fish. For management purposes ICES divides the northeastern Atlantic stock of horse mackerel into three components, a western stock, a North Sea stock and a southern stock The western stock comprises the commercial fishery in ICES Divisions IIa, IIIa (western part), Vb, IVa, VIa and some Divisions of Sub-areas VII and VIII. The main commercial landings are to the west of Ireland and Scotland, off the Norwegian coast and in the western Skagerrak. The horse mackerel is a highly migratory species that seems to follow similar patterns to mackerel (*Scomber scombrus*). One part of the western stock overwinters in deeper water to the west of Ireland and then migrates northwards along the edge of the continental shelf to feeding grounds in the northern North Sea and the Norwegian Sea. Spawning takes place from about April to July over a wide area including to the west of Ireland and Scotland. Horse mackerel is a relatively longlived species with reported ages of up to 40 years. It feeds mostly on zooplankton (Macer, 1977).

Fishery

The report of the ICES Working Group on Mackerel, Horse Mackerel, Sardine and Anchovy (ICES 2006) gives quarterly distribution maps of the catches. In the SEA7 area they are found predominantly along the outer edge of the continental shelf and to the north of Ireland. The landings for 2004 by quarter for Sub-area VI are as follows:-

	1st quarter	2nd quarter	3rd quarter	4th quarter	Total
Sub-area VI	2772	78	11785	7293	21928

The reported landings from ICES Sub-area VI by country are shown in Figure 3.56 for the years 1980 to 2004. Landings peaked in the mid 1990s. Ireland takes the largest share of the catch.

3.14 Family Ammodytidae (sandeels)

Biology

There are five species of sandeel that occur in Scottish waters but about 90% of the commercial catch of sandeels consists of one species, *Ammodytes marinus*. It is predominantly an offshore species. Sandeels are a shoaling species that lie buried in the sand during the night and emerge during the day to feed in midwater (Knijn et al., 1993). During the winter they remain in the sediment only emerging to spawn. Spawning takes place from November to February and is widespread over the shelf in the SEA7 area (Figure 3.57) (Coull et al., 1998). The eggs are demersal being laid in sticky clumps on sandy substrates. The larvae are pelagic and after about 2 – 5 months they adopt the demersal habit.

Fishery

The landings from the sandeel fishery from the west of Scotland have declined considerably in recent years (Figure 3.58). The landings are almost entirely by the Scottish fleet.

3.15 Family Scombridae

3.15.1 Mackerel *(Scomber scombrus)*

Biology

The mackerel is a widely distributed and commercially important pelagic species. It is a fast growing species and most fish are sexually mature by three years of age. They have a prolonged spawning season with the eggs being shed in batches. Young mackerel feed on copepods, other small crustaceans and fish larvae. Older fish feed on pelagic crustaceans, mainly copepods and euphausiids, and juvenile pelagic fish such as herring, Norway pout and sandeels.

There are two main stocks of mackerel based on the timing and area of spawning (Coull et al., 1998) (Figure 3.59). The western stock spawns between March and July mainly to the south and west of the British Isles. The nursery area for the western stock extends along the entire outer continental shelf to the west of the British Isles including the SEA7 area (Coull et al., 1998) (Figure 3.60). Over the last 20 years there has been a westerly shift of the spawning areas and at the same time there has been a northerly shift in the distribution of juveniles (Walsh et al., 1996) with relatively high concentrations of juveniles over the shelf to the west of Orkney and Shetland. After spawning the adult fish migrate northwards to feeding grounds in the Norwegian Sea and in the Northern North Sea. This northwards migration route and its timing has remained relatively stable (Walsh et al., 1995). Some migrate into shelf waters and remain there for the summer months. There have, however, been significant changes in the route of the southerly migration since the 1970s. In earlier years the migration took place in late summer and autumn and the fish passed through the relatively shallow waters of the Minch. This was the basis of a substantial fishery in the Minch. Now the migration has become later so that the fish are passing through west of Scotland waters in February. The majority of fish pass to the west of the Outer Hebrides instead of through the Minch. The implication of this change for the fishery is described below.

Fishery

For management purposes ICES considers that all the mackerel from Spain to Norway (including the Skagerrak) are a single stock because it is impossible to separate the western and North Sea components when they share the same feeding grounds in the northern North Sea. Nevertheless, ICES continues to recognise the different spawning components.

The estimated catches of the western component increased from a low level in the 1960s to 800000 t in 1993. These were directed fisheries by purse seiners and pair trawlers and large catches were taken in the northern North Sea and the Norwegian Sea. A reduction in the quota reduced the catch to 200000 t in 1995 and since 1998 the catches have remained stable. The North Sea component was heavily fished in the 1960s by purse seiners with catches reaching 1 million tonnes in 1967. The stock subsequently collapsed and catches declined to less than 100000 t in the late 1970s and have probably become even lower. This component is considered to be severely depleted and outside safe biological limits. ICES recommended a total closure of the southern parts of the North Sea and a seasonal closure of the northern North Sea to mackerel fishing. The net result has been that there has been misreporting of mackerel catches from ICES Division IVa into ICES Division VIa.

Figure 3.61 shows the ICES Working Group's estimate of the total western area catch (reported landings by country, unallocated landings not reported to country, estimated discards adjusted for misreported catches into the area) and the estimated weight of fish these misreported catches caught in North Sea but reported to the western area. Figure 3.62 shows the reported landings by country for ICES Division VI which takes no account of the misreporting from the North Sea but serves to show which countries exploit the stock to the west of Scotland. The distribution of reported Scottish landings in 2004 are shown in Figure 3.63.

3.16 Family Scopthalmidae

This family comprises several commercial species such as turbot (*Psetta maximus*) and brill (*Scophthalmus rhombus*) but the quantities caught, mainly by Irish and Scottish vessels, are small, < 200 and 50 t respectively. The only significant fishery is for megrim.

3.16.1 Megrim *(Lepidorhombus whiffiagonis)*

There are two species of megrim in UK waters, *Lepidorhombus wiffiagonis* (megrim) and *L. boscii* (four-spot megrim). The latter has a generally deeper and more southerly distribution. It is seldom caught on the Scottish continental shelf or upper slope.

The megrim occurs along the shelf edge to the west of Scotland at depths greater than about 100 m (Gordon, 1981). Knowledge of the distribution and biology of megrim in the waters to the west of Scotland has significantly increased as a result of European Commission DG Fisheries Study Contract (98/096) entitled *Distribution and biology of anglerfish and megrim in waters to the west of Scotland* (Gordon, 2001b). Monthly landings of megrim by the Irish fleet between 1995 and 2000 from the west of Scotland were analysed. Peak landings per unit of effort were in January and May in most years. Ages of up to 16 years for females and 12 years for males were recorded. Megrim are asynchronous batch spawners and spawning occurred between January and April. The location of spawning fish caught throughout the study indicates that spawning occurs along the whole shelf edge/upper slope and that they

may migrate into deeper water to spawn. Females attain a larger size than males and the disproportionate discarding of smaller males leads to a high proportion of females in the landings.

Fishery

A high proportion of the megrim caught by some fleets is in association with targeted fisheries for anglerfish. Misreporting of anglerfish landings between areas, especially between the North Sea and the west of Scotland, (see Section 3.16), also results in misreporting of associated megrim landings. For the purposes of assessment the ICES Working Group reallocates a proportion of the reported landings of megrim from the ICES statistical rectangles immediately east of 4°W from the North Sea to the west of Scotland. The extent of the estimated area misreporting is shown in Figure 3.64 as a percentage of the total estimated catch.

The recent landings from the west of Scotland are shown in Figure 3.65. These include an adjustment by the ICES Working Group for unreported landings which are referred to as "unallocated". There has been a steady decrease in landings since 1996. A high proportion of the UK landings, especially in recent years, are by Scottish vessels. The Scottish heavy trawl fleet has increasingly been changing to using twin rigs and larger (>100 mm) mesh sizes to target anglerfish in deeper waters. Megrim are also landed by the Scottish light trawl fleet that uses 80 mm mesh to target *Nephrops* on the shelf. Most of the Scottish landings of megrim are from the Butt of Lewis and the slope north of the Hebrides. It is probable that most of the French landings are also from the continental slope. The Irish catches are mostly from the Stanton Banks fishery which also discards large numbers of megrim. This fleet has undergone considerable change in recent years.

3.17 Family Pleuronectidae

3.17.1 Lemon Sole *(Microstomus kitt)*

Biology

Spawning takes place over a wide area (Coull et al., 1998) (Figure 3.66). The diet of the lemon sole is dominated by polychaete worms. The nursery areas have similar distribution to the spawning areas (Coull et al., 1998) (Figure 3.67)

Fishery

The lemon sole is taken as a bycatch in mixed demersal fisheries and the status of the species is not assessed by ICES. Figure 3.68 shows the reported landings by country for ICES Division VIa.

3.17.2 Plaice *(Pleuronectes platessa)*

Biology

The plaice is widely distributed on the west coast of Scotland (Gordon, 1981). It spawns throughout its adult range and localised spawning concentrations occur in the some areas (Coull et al., 1998) (Figure 3.69). Plaice eggs are pelagic and the metamorphosing larvae

enter coastal areas. Sandy beaches are the nursery grounds for plaice. After a year they gradually disperse offshore. Plaice can make quite extensive migrations between spawning and feeding grounds. They are benthic feeders consuming polychaete worms, amphipods, mysids, molluscs and brittle stars.

Fishery

Figure 3.70 shows the reported landings of plaice by country for ICES Division VIa.

3.17.3 Greenland halibut *(Reinhardtius hippoglossoides)*

Biology

The Greenland halibut is a deep-water flatfish that occurs in colder waters. It is widely distributed in the northern waters and is exploited around Greenland, Iceland, the Faroe Islands and Norway. It does not occur in the Rockall Trough. Early Russian investigations showed that it was present on the Hatton Bank (Nizovtsev, 1989). The Greenland halibut spawns in deep-water and is unusual for a flatfish because it is an active predator off the bottom and feeds mostly on other fishes and some crustaceans.

Fishery

A fishery developed on the Hatton Bank in the 1990s and has continued to the present. On the assumption that most of the landings reported from ICES Sub-area XII were from the Hatton Bank the landings for Sub-area XII and Division VIb have been combined (Figure 3.71). The change in status of the Hatton Bank to international waters resulted in a new fishery that peaked in 2001. No landings were reported for 2002 by Spain.

3.18 Family Lophidae

3.18.1 Anglerfish *(Lophius spp)*

There are two species of anglerfish in UK waters; the white anglerfish (*Lophius piscatorius*) and the black anglerfish (*Lophius budegassa*). The black anglerfish has a more southerly distribution and although recorded in Scottish waters it is quite rare. The anglerfish is also frequently referred to by the industry as monkfish or simply as monks.

The anglerfish is widely distributed around Scotland both on the shelf and on the continental slope to depths of about 1000 m. A recent European Commission DG Fisheries Study Contract (98/096) entitled *Distribution and biology of anglerfish and megrim in waters to the west of Scotland* has made a significant contribution to our knowledge (Gordon, 2001b). Biological samples were obtained by chartering commercial vessels, sending observers on commercial vessels and from research vessel surveys. The most obvious result was an almost complete absence of mature females in all surveys. There was a consistent indication that males were more abundant in deeper waters.

The anglerfish has a somewhat unusual reproductive biology. Spawning takes place between November and May (Afonso-Dias and Hislop, 1996).The eggs are pelagic but are retained within a buoyant gelatinous ribbon which can measure up to 10 m in length (Hislop et al., 2001). This aggregation of eggs and newly emerged larvae explains why egg and larval

surveys have revealed little about the location and timing of spawning. The anglerfish has a prolonged juvenile pelagic phase in near surface waters (Hislop et al., 2000). In an attempt to elucidate the early life history of the anglerfish, Hislop et al. (2001) combined data on distribution and growth rates of the pelagic phase into a particle tracking model. One of the predictions of the model is that a large proportion of young anglerfish from a spawning area west of the Outer Hebrides (probably in deep water) will enter the North Sea.

The estimation of the age of anglerfish is difficult but investigations carried out under the EC contract have improved the validity of the estimates of both the early pelagic and the demersal anglerfish (Wright et al., 2002, Woodroffe et al., 2003). Adult ages of up to 13 years have been reported from Scottish waters. The angler fish is primarily a sit and wait predator, using its lure (illicium) to attract prey, mainly fish, to its large gaping mouth.

Fishery

ICES considers that it is likely that the catches in the North Sea (including the Skagerrak) and the west of Scotland belong to the same biological stock and they are currently assessed as a single unit. However, there are some major problems with the assessment and management of the stock. Historically the west of Scotland was managed by a TAC but until 1998 there was no TAC for the adjacent North Sea. As the west of Scotland fishery expanded (see below) the TAC became restrictive and this encouraged misreporting of landings into the North Sea. When TACs were introduced for Sub-area IV they were based on previous reported landings and "are unlikely to have prevented further misreporting or to have improved conservation in either area." Figure 3.72 shows the distribution of reported landings by Scottish vessels for 2004. The reported landings of anglerfish for west of Scotland and the ICES Working Group's estimate of the true landings after adjusting for misreporting are shown in Figure 3.73.

The west of Scotland fishery is mostly by the UK and France with Ireland being the next most important nation. The Scottish fishery is by the two main fleets that target mixed roundfish. The Scottish light trawl fleet accounts for about 65 % of the landings while the Scottish trawl fleet accounts for 20%. The *Nephrops* trawl fishery accounts for about 10% of the landings. The development of a targeted fishery for anglerfish in recent years has resulted in fleet changes such as a move to deeper, offshore grounds and the development of specialised trawls. There is no minimum landing size for anglerfish and discard levels are low. The French vessels landing anglerfish are probably targeting shelf edge or deep-water species and most of their catches will be from west of the Hebrides. Figure 3.74 shows the reported landings by country from ICES Division VIa. It is only indicative because of the misreporting of catches, especially during the 1990s.

Figure 3.75 shows the reported landings for ICES Division VIb.

4. FISHERIES OVERVIEW

4.1 Overall fishing effort

The Scottish Fisheries Protection Agency carries out routine surveillance using a spotter plane. These surveys are concentrated on the most heavily fished areas and do not follow a set pattern. The distribution of sightings of fishing vessels is not random. Despite these limitations they do give an indication of the spatial distribution of fishing effort. Figure 4.1 shows the sightings for a three month period in 2001 and serves to emphasise the importance of fisheries in the SEA7 area.

4.2 Demersal bottom trawl fisheries

The main demersal fleets of the continental shelf in ICES Division VIa are well documented in ICES Reports (eg. ICES 2004). The following fleets are usually identified.

1) Mixed roundfish otter trawl fleet
2) Otter trawl fleet targeting *Nephrops*
3) Otter trawl fleet targeting anglerfish, megrim and hake
4) Otter trawl fleet targeting saithe

However, for the purposes of this report the Rockall Trough deep-water fishery, the Rockall Bank fishery and the Hatton Bank fishery will be described as separate entities.

Figure 4.2 shows the distribution of demersal fishing effort (excluding beam trawl) around the UK (Coull et al. (1998). In the SEA7 area fishing effort is fairly high over the entire shelf but particularly high south of Barra and to the north of the Outer Hebrides.

This map and those for pelagic and Nephrops fisheries in following sections were based on data from the logbooks that UK vessels are obliged to keep. The effort is measured as the time spent fishing (nominal fishing effort). Vessels of less than 10 metres that do not report their catches are excluded. No adjustment has been made for the varying efficiency of the vessels. The data are collected by ICES Statistical rectangle and these data have been smoothed to produce contour maps. Of particular importance to the SEA7 area is the fact that rectangles that cover both shallow and deep-water areas have been adjusted to place more emphasis on the effort into shallower waters.

4.2.1 Mixed roundfish fishery

The mixed roundfish fisheries are similar to those of the North Sea with cod, haddock anglerfish and whiting as the target species and a bycatch that includes saithe, megrim and lemon sole. The demersal fishery is mostly by Scottish trawlers using “light trawls” although vessels from Ireland, Northern Ireland, England, France and Germany also participate in the fishery. The once important fishery for haddock by Scottish seine netters (Danish seine) has declined and many vessels have been converted to use the bottom trawl.

The ICES advice for the management of the mixed trawl fisheries is complicated by the concerns over the poor status of cod and spurdog stocks and the effect that the

recommendation for a zero TAC for these species would have on the other species in the fishery.

A cod recovery plan was introduced by the EU in 2004 but because of the unreliability of the landings data ICES has not been able to evaluate the effectiveness of the plan. Given the uncertainties ICES recommended a zero catch for west of Scotland cod in 2006. They also proposed that the fleet should fish without discards of cod and spurdog. The EU decided to adopt a quota for cod of 613 t for 2006 of which the UK was allocated 60 %. ICES considers that the west coast haddock stocks are being harvested at a sustainable level. However, in the mixed fishery they recommend that there should be no catch or discards of cod and spurdog. The agreed TAC for 2006 was 8407 t of which the UK was allocated just over 80%. The status of the west of Scotland whiting is uncertain but stocks are thought to be at a low level. ICES recommends reducing catches to the lowest possible levels and to introduce measures to reduce discarding. The TAC for the west of Scotland in 2006 is 1360 t of which the UK has been allocated 57%.

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

4.2.2 Mixed Nephrops fishery

In 2004 it was estimated that there were about 200 Scottish trawlers targeting *Nephrops*, mainly on inshore grounds (Figure 4.3). Irish vessels are also targeting Nephrops on offshore grounds. The shellfish fisheries of SEA7 are described in a separate report by Chapmen (2006). However, the roundfish bycatch comprising mostly haddock, cod, whiting and saithe are relevant to this report. The level of discarding of fish, especially of haddock and whiting, is high in the *Nephrops* trawl fisheries.

4.2.3 Anglerfish, megrim and hake fishery

In recent years there have been considerable changes in the strategy of the Scottish fleet as a consequence restrictive measures on traditional fisheries. There has been a move to deeper waters on the outer shelf and upper slope and to the targeting of anglerfish. It is probably that this deeper fishery is exploiting the mature adult anglerfish thus putting additional pressure on the stocks. Many vessels have changed to fishing with large twin-rig trawls with mesh sizes >100mm.

A smaller Irish fleet targets anglerfish, megrim and hake on the Stanton Banks but this fleet has declined in recent years.

ICES now treat the northern stocks of anglerfish as a single unit. They consider that the state of the stock is unknown because of the poor quality of the catch and effort data and limited knowledge of the population dynamics. Because of their body shape a high proportion of immature fish are retained by trawls. If the expansion of the fishery into deeper water is exploiting the refuge of the mature fish then there is additional cause for concern. ICES recommended that effort in the fishery should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and bycatch fish species. The TAC for the northern shelf in 2006 was set at 15000 t of which the UK was allocated 65%.

The state of the megrim stocks are unknown and because the fishery has been linked to that for anglerfish area misreporting has been prevalent as megrim catches were misreported from Subarea VI into Subarea IV, due to restrictive quotas for anglerfish. ICES recommends that there should be a combined TAC for both areas. Recent changes in fishing patterns of some fleets may have broken the link with the fishery for anglerfish.

4.2.4 Saithe fishery

The fishery for saithe takes place along the edge of the continental shelf and is mainly by French trawlers. Beginning in the late 1980s some of these trawlers began exploiting deep-water species. The saithe of the west of Scotland, the North Sea and the Skagerrak are treated as a single stock by ICES. The stock is considered to be harvested sustainably. In 2004 the EU and Norway agreed to implement a long-term management plan for saithe. The TAC for 2006 was set at 136037 (t) of which the UK was allocated 10%. The change in the fishing patterns of the Scottish fleet and the move to deeper water has resulted in significant discarding of over quota saithe.

4.2.5 Deep-water trawl fishery of the Rockall Trough

General descriptions of the development of these fisheries have been given by Gordon (2001a, 2003), Gordon et al. (2003). The problems of how to assess the status of these deep-water stocks in the absence of long time-series and age structure has been described by Large et al. (2003).

The potential new resources identified by the deep-water surveys of the 1970s (see Section 2.4) were initially of little interest to the fishing industry and only Germany developed a seasonal targeted fishery on aggregations of blue ling in the northern Rockall Trough, especially around the northern banks. This only lasted for a few years in the mid 1970s. In the following years the French fishery exploited this resource and it was the development of markets for previously discarded deep-water species that led to the present deep-water fishery. The seasonal targeted blue ling fishery continued and new targeted fisheries for roundnose grenadier and black scabbardfish with significant bycatch of deep-water sharks were developed. These fisheries are mostly along the continental margin of the Rockall Trough at depths between about 600 and 1200 m. Figure 4.4 shows the distribution of French trawlers observed by by spotter plane in the Scottish sector of ICES statistical area VIa for the years 1989 to 1993 (Gordon and Hunter, 1994). Although these are mixed fisheries the catch composition changes significantly with depth. Initially, there was little interest by other countries in these fisheries until France began landing significant quantities of high value orange roughy in the early 1990s. While some orange roughy are taken in the deeper mixed trawl fisheries, most of the catch was from targeted fisheries around aggregations on the seamounts within the Rockall Trough. As in other areas of the world the stocks of orange roughy in the Rockall Trough were rapidly depleted and given the longevity and other life history characteristics are likely to take a long time to recover. Scottish vessels showed some interest in deep-water species during the 1990s, but the fishery for the ‘new’ deep-water species never really developed. The main interest was in the discovery of anglerfish in deep-water but the quota for the west of Scotland was restrictive.

The introduction of TACs for deep-water species in 2003 based on previous track records has meant that the fishery for deep-water species in the Rockall Trough is dominated by France.

Unfortunately in the lead time up until the introduction of quotas an element of unreliability has become apparent in the reported landings of deep-water species.

4.2.6 Rockall Bank fishery

Blacker (1982) gives an interesting historical account of the Rockall bank fishery that can be traced back to hand liners in the early years of the 19th Century. Trawling by English vessels began in the early 20th Century but was sporadic and died out in the 1930s. Scottish vessels trawled on the Bank in the 1960s. In the early 1970s Russian trawlers began a major fishery on the Bank landing in excess of 50000 t (mostly haddock) in some years. This fishery ceased when the UK fishing limits were extended in 1977. In recent years Scottish and Irish trawlers have fished the Bank mostly for haddock but the landings have fluctuated depending on year class strength. When most of the Rockall Bank reverted back to international waters the Russian fishery resumed and their fleet has targeted haddock, with a bycatch of other demersal species, including gurnards. Russia has also reported catches of argentine, blue ling, roundnose grenadier, tusk and rabbit fish from the slopes of the Rockall Bank (ICES 2006)

Up until 2005 the EU TAC for haddock was for the whole of Sub-area VI with a limit on how much of the quota could be taken in Division VIa. In later years specific EU TACs were set for Division VIb. However, vessels of non-EU countries fishing in international waters are unregulated. ICES recommends that an international TAC should be agreed. However, ICES also recognises the difficulty in agreeing such a plan and, given the remoteness of the area, enforcing it. In 2003 NEAFC adopted a resolution to close an area of the Rockall Bank to all fishing except longlining to conserve haddock stocks. ICES has commented that it is too early to assess the compliance with the closed area and whether any stock improvements have resulted from the closure. In 2005 the EC enlarged this area into the fishery zones of UK and Ireland. Only longlining is to be allowed in this area

At the NEAFC annual meeting in 2005 the EC introduced a proposal to close areas on the Hatton Bank, North West Rockall, Logachev Mounds, South Rockall, West Rockall Mounds and South West Rockall where these fell in the NEAFC Regulatory Area. A decision was deferred until criteria and guidelines could be established.

4.2.7 Hatton Bank Trawl Fishery

Soviet trawlers were the first to explore the fishery potential of the Hatton Bank and a commercial fishery developed in the 1970s and lasted until the UK claimed the fishery rights. Now that the Bank has reverted to international waters a Russian fishery has resumed.

It has been reported that one Faroese trawler fished continuously on the Hatton Bank for 5 or 6 years. It targeted blue ling in the first quarter of the year. In the second quarter black scabbardfish was prominent in the catches while roundnose grenadier was important during the remainder of the year. That vessel then reverted to fishing on the Faroese shelf (ICES 2002b). The Faroese also carried out wide ranging exploratory and commercial fishing for orange roughy in the North Atlantic during the 1990s (Thomsen, 1998). From 1992 to 1994 they fished on Hatton Bank and then concentrated on the Mid-Atlantic Ridge. If it is assumed that the reported landings from ICES Sub-Area VI are from Hatton Bank then the landings of orange roughy were as follows.

Year	1993	1994	1995	1996	1997	1998 (I-VII)
Reported landings (t).	34	179	34	20	11	12

Following the exploratory trawl survey in 1998 (see 2.6.2) Norway showed little interest in commercial trawling on the Hatton Bank.

A Spanish deep-water trawl fishery began on the Hatton Bank (Sub-area XII) in the second half of 1996 (Pineiro et al 2001). This fishery by freezer trawlers extended into Division VIb fishing at depths between 800 and 1600 m. The presence of vessels is discontinuous varying between one week to three months. The most important species are roundnose grenadier and Baird's smoothhead. In 2000 the Spanish fleet spent 1363 days fishing on Hatton Bank and this increased to 1627 days in 2001 which corresponds to an estimated hours of trawling of 22202 and 26123 respectively (ICES 2002). Since then there has been a decline in fishing effort.

4.3 Pelagic Fisheries

The main pelagic fisheries of the west of Scotland are for herring, mackerel and horse mackerel. Figure 4.5 shows the distribution of pelagic fishing effort.

Historically the drift net herring fishery was the major fishery on the west coast of Scotland but with marked fluctuations in landings (Bailey et al., 1979). Landings increased rapidly in 1969 mainly due to a new pair-trawl fishery. In the following years the landings began to decline and the fishery was closed between 1977 and 1981. Now most of the catch is by Scottish vessels but foreign vessels, especially Dutch and German, make a significant contribution. ICES considers that the west of Scotland stock of herring is being exploited at a sustainable rate and recommends that the fishing mortality be maintained at the present level. The TAC for 2006 was 34,800 t with a UK share of 60% t.

The mackerel fishery takes place mostly in the fourth and first quarter of the year and exploits mackerel returning from the summer feeding grounds of the northern North Sea to the spawning grounds off south west England and Ireland. In ICES Division VIa the Scottish and and Irish pelagic trawl fleet take the bulk of the catch. ICES considers that the mackerel stock is being harvested unsustainably. The closure of the fishery in the central/southern North Sea and the seasonal closure of the northern North Sea are believed to have resulted in large-scale misreporting of catches to ICES Division VIa. Reported landings have consistently overshot the TAC in recent years. The whole northeastern Atlantic stock of mackerel is treated by ICES as a single unit and management advice is given on this basis. The agreed TAC for 2006 is 415,824 t of which the UK has almost 38%.

Horse mackerel is generally taken in the fourth and first quarter of the year mainly by Irish vessels. ICES is concerned about the continuing decline in the spawning stock biomass and the high exploitation of juvenile fish at a time when recruitment is low.

The rapid expansion of the blue whiting fishery in recent years has been a cause of major concern to ICES and the species is considered to be being harvested at an unsustainable level. Blue whiting is a straddling stock with major components of the fishery in both national and international waters. Parts of both these components lie within the SEA7 area. In 2003 the catch reached 2.3 million tonnes despite ICES advice for a maximum catch of 600,000 t. It is believed that the stock was saved from collapse by several recent strong year classes.

Although a long-term management plan was agreed between coastal states in 2002 it was never implemented. The combined catch quotas of the individual countries exceeded those of the proposed management plan.

The fishery for argentine (greater silver smelt) has been described in Section 3.5.1.

4.4 Industrial fisheries

The Norway pout fishery is mainly by Danish vessels and there are considerable fluctations in annual catches. This stock is not assessed but since is a small mesh trawl fishery. ICES suggests that the bycatch should be documented

The sandeel fishery is almost entirely by Scottish vesels. The fishing grounds are close inshore and often adjacent to bird colonies where sandeels are an important food source, especially in the breeding season. Current management consists of a TAC of 12000 t, a closure from 31 July and access restricted to vessels with a track record of fishing for sandeels. The reported landings have been considerably less than the TAC in recent years.

4.5 Static gear fisheries

Most of the static gear fisheries in the SEA7 area are by creel for shellfish and are described in a separate report by Chapman (2006).

4.5.1 Norwegian longline fishery

Longline fishing is now mainly confined to the edge of the continental shelf and deeper waters. The Norwegian fishery that targets ling and tusk is well documented (Bergstad and Hareide, 1996; Magnusson et al., 1997). Figure 4.6 shows the distribution of Norwegian longliners observed by spotter plane in the Scottish sector of ICES statistical area VIa for the years 1989 to 1993 (Gordon and Hunter, 1994).

In 2000 a new Norwegian longline fishery for Greenland halibut developed in deeper water along the southwestern slopes of the Hatton Bank but effort has declined in recent years.

4.5.2 Spanish longline fishery

There is a Spanish (including vessels on UK register) longline fishery for hake that also sometimes targets deep-water sharks. Figure 4.7 shows the distribution of Spanish longliners observed by spotter plane in the Scottish sector of ICES statistical area VIa for the years 1989 to 1993 (Gordon and Hunter, 1994).

4.5.3 Gill netting

A recent report (Hareide et al., 2005) has drawn attention to a fleet of about 50 gillnetters operating from Spain but registered in UK, Germany and other countries. This fleet targets anglerfish and deep-water sharks around Rockall and Hatton Banks. The report highlighted problems with ghost fishing by lost nets, discarding of nets and wastage caused by long soak times. In 2006 the EC introduced a regulation prohibiting the use of gillnets by Community vessels where the charted depth is greater than 200 m.

4.6 Area closures

The Darwin Mounds are noted for the cold water coral living on top of sandy mounds. They are located in the north east corner of the Rockall Trough at a depth of about 1000m (approx 59 40 N and 7 W). In 2004 the EC took action to protect these unique features and prohibited all fishing with gear that makes contact with the seabed in a defined area around the mounds.

It was generally assumed that the deep-water fish populations of the Hatton Bank and its surrounding waters would have strong affinities with those of the Rockall Trough. However, knowledge gained from the developing fisheries indicates a more complex situation. Fisheries for roundnose grenadier, black scabbardfish etc. exist over a large part of the bank but in some areas fisheries for Greenland halibut also occur. Greenland halibut is associated with the colder waters of Nordic Seas and are probably associated with the coldwater overflow across the Faroe/Iceland Ridge being channeled past the bank.

A proposal was made by Norway to NEAFC in 2004 to create a closed area for trawling on the Hatton Bank with the objective of protecting areas known to have cold-water corals (Agenda item 16 for NEAFC Annual Meeting 2004 (www.neafc.org)). This proposal was not adopted by the contracting parties. Action on another proposal by the EU in 2005 was deferred (see 4.2.4)

The Rockall bank closed areas are described in Section 4.2.4.

5. FISHERIES: OIL AND GAS INDUSTRY INTERACTIONS

Rogers and Stocks (2001) dealt very comprehensively with the interactions between fishing activity and the oil and gas industry in their technical report for SEA2. Almost all of what has been written is equally relevant to the shelf part of SEA7 and therefore the following section simply highlights any special features of the SEA7 area.

5.1 Seismic Activity

Seismic surveys can disrupt the behaviour of fish populations and are considered to be a special concern during spawning activity when fish tend to be aggregated. It follows that a precautionary approach should be taken to the licensing of seismic surveys to minimise possible detrimental effects on spawning fish.

Coull et al. (1998) provide monthly seismic sensitivity maps that are useful for the SEA7 continental shelf and the Rockall Bank. They specifically excluded blue whiting on the grounds that it has a very wide ranging spawning distribution. Given the concerns expressed by ICES about the sustainability of the stock at current levels of exploitation and also the ecosystem effects of the removal of such a large biomass it would be prudent to minimise seismic activity when the fish aggregate for spawning along the shelf edge and around the Rockall Bank.

A special problem that exists in SEA7 is the unreliability of the location of officially reported landings for a number of species. (see Section 3). This is most likely to be a problem with species where the quota is restrictive and surplus catches are reported to a different ICES Sub-area. In the SEA7 area this occurs mainly between ICES Sub-areas VI and IV, but can also occur between VI and VII or VI and XII. When new fisheries are developing there can be a certain amount of secrecy as to the exact location of the catches, eg the orange roughy fishery of the Rockall Trough.

Vessel monitoring systems (VMS) are now mandatory but are subject to confidentially for individual vessels. However overviews of the data collected are beginning to appear. A recent example for vessels of >24 m overall length can be found in An Integrated Assessment of the State of UK Seas published by DEFRA in 2005 (their Figure 4.2) (available for downloading on www.defra.gov.uk). VMS will give much more reliable information on the location of fishing activity than logbooks or spotter plane sightings.

5.2 Cuttings disposal

The potential impacts of cuttings piles has been comprehensively dealt with in the SEA2 report. Of particular concern are the possible smothering effects on areas of seabed utilised by fish that have demersal eggs. The most important are herring and sandeel both of which have spawning areas in the SEA7 area.

5.3 Hydrocarbon spill

The implications and the legislation relating to hydrocarbon spill have been described in the SEA2 report.

5.4 Surface installations, subsea structures, well heads and pipelines

The interaction between oil installations and the fishing industry has been comprehensively described in the SEA2 report. When towing a bottom trawl in deep water several thousands of metres of wire can be paid such that the net is some considerable distance from the vessel As a safety precaution consideration should be given to increasing the dimensions of safety zones around installations situated in deep-water areas.

5.5 Fisheries management

Many of the fisheries of the west coast of Scotland are considered to be outside safe biological limits and ICES has recommended various measures including reductions in TACs and fishing effort. In some cases, following the precautionary approach, ICES has recommended a zero TAC. The translation of these recommendations into management regulations is the responsibility of the European Union and this inevitably results in compromises to satisfy the differing requirements of the member states and other non-EU countries with an interest in the stock. In addition to the imposition of TACs, various technical and effort control measures, such as gear modification, mesh sizes and days at sea, are applied.

Problems arise with straddling stocks (stocks that occur in both national and international waters). In setting its TACs the EC usually includes catches in international waters. NEAFC have had some success in regulating some fisheries, such as an effort reduction on deep-water species. For other species, notably blue whiting, no regulation has been implemented. Any regulatory measures apply only to contracting parties to NEAFC.

Management measures that close areas or restrict access either seasonally or to different sectors of the fleet or the gears that they use can have implications for the oil and gas industry.

There is a need for fisheries independent data for the SEA7 area. Such data exist for the North Sea in the Atlas of North Sea Fishes (Knijn et al., 1993). It is based on research bottom trawl surveys carried out between 1985 and 1987 and presents distribution maps and basic biological data for 98 North Sea fish species or species groups. Recently ICES has produced ICES-FishMap, an electronic atlas for the North Sea (http://www.ices.dk/marine world/ices-fish.asp) . The initial pilot project concentrated on 15 species regularly caught in research surveys of the North Sea using data collected from 1983-2004. In addition to mapping distribution and abundance a detailed species account is given often with information on inter-annual changes in abundance. The second phase is to provide similar information for all 150 North Sea species. Ultimately it is hoped to extend coverage to a large part of the west-European shelf. Time-series of research survey data exist for the West Coast of Scotland and every encouragement should be given to the incorporation of these data into the ICES FishMap.

6. REFERENCES

Afonso-Dias, I. P. and Hislop, J. R. G. (1996). The reproduction of anglerfish *Lophius piscatorius* Linnaeus from the north-west coast of Scotland. *Journal of Fish Biology* **49 Supplement A**, 18-39.

Allain, V. (1999). Fecundity of the deep-sea fish in the north-east Atlantic *Alepocephalus bairdii* (Pisces: Alepocephalidae). *Journal of the Marine Biological Association of the United Kingdom* **79**, 765-767.

Allain, V. (2001). Reproductive strategies of three deep-water benthopelagic fishes from the northeast Atlantic Ocean. *Fisheries Research* **51**, 165-176.

Allain, V., and Lorance, P. (2000). Age estimation and growth of some deep-sea fish from the Northeast Atlantic Ocean. *Cybium* **24 Supplement**, 7-16.

Anon. (2001) Scottish Fisheries Statistics 2000. Scottish Executive

Anon. (2002a). Scottish Fisheries Statistics 2001. Scottish Executive

Anon. (2003) Scottish Fisheries Statistics 2002. Scottish Executive

Anon. (2004) Scottish Fisheries Statistics 2003. Scottish Executive

Anon. (2005) Scottish Fisheries Statistics 2004. Scottish Executive

Bailey, R. S. (1975). Observations on diel behaviour patterns of North Sea gadoids in the pelagic phase. *Journal of the Marine Biological Association of the United Kingdom* **55**, 133-142.

Bailey, R. S. (1982). The population biology of blue whiting in the North Atlantic. *Advances in Marine Biology* **19**, 257-355.

Bailey, R. S., Hislop, J. R. G. and Mason, J. (1979). The fish and shellfish resources in seas adjacent to the Outer Hebrides. *Proceedings of the Royal Society of Edinburgh* **77B**, 479-494.

Basson, M., Gordon, J. D. M., Large, P., Lorance, P., Pope, J. and Rackham, B. (2002). The effects of fishing on deep-water fish species to the west of Britain. *Joint Nature Conservation Committee* **Report No. 32**. 150 pp.

Bergstad, O. A. (1990). Distribution, population structure, growth and reproduction of the roundnose grenadier *Coryphaenoides rupestris* (Pisces: Macrouridae) in the deep waters of the Skagerrak. *Marine Biology* **107,** 25-39.

Bergstad, O. A. and Hareide, N. R. (1996). Ling, blue ling and tusk of the north-east Atlantic. *Fisken og havet* **No.15**. 126pp.

Blacker, R. W. (1982). Rockall and its fishery. *Laboratory Leaflet, MAFF Directorate of Fisheries Research,Lowestoft* **55.** 23 pp.

Bullough, L. W., Turrell, W. R., Buchan, P. and Priede, I.G. (1998). Commercial deep water trawling at sub-zero temperatures - observations from the Faroe-Shetland Channel. *Fisheries Research* **39,**33-41.

Bridger, J. P. (1978) New deep-water trawling grounds to the west of Britain. *Laboratory Leaflet, MAFF Directorate of Fisheries Research, Lowestoft* **No.41**. 40pp

Burrows, M. T., Gibson, R. N., Robb, L. and Comely. C. A. (1994). Temporal patterns of movement in juvenile flatfishes and their predators: underwater television observations. *Journal of Experimental Marine Biology and Ecology* **177**, 251-268.

Burrows, M. T., Gontarek, S. J., Nash R. D. M. and Gibson, R. N. (2001). Shrimp predation on 0-group plaice: contrasts between field data and predictions of an individual-based model. *Journal of Sea Research* **45**, 243-254.

Burrows, M. T., Kawai, K. and Hughes, R. N. (1999). Foraging by mobile predators on a rocky shore: underwater TV observations of blennies *Lipophrys pholis* and crabs *Carcinus maenas*. *Marine Ecology Progress Series* **187,** 237-250.

Casey, J. and Pereiro, J. (1995). European hake (*M. merluccius*) in the North-east Atlantic. In *Hake: Biology, fisheries and markets*, eds. J. Alheit and T. Pitcher), pp. 123-147. London: Chapman & Hall.

Chapman, C. J. (2006). Coastal shellfish resources and fisheries in SEA7. Strategic Environmental Assessment – SEA7, Technical Report for Department of Trade and Industry, 75 pp.

Clarke, M. W. (2000). Records of deep water chondrichthyan fish caught on long-line in the Rockall Trough. *Journal of the Marine Biological Association of the United Kingdom* **80,** 337-378.

Clarke, M. W., Connolly, P. L. and Bracken, J. J. (2001). Aspects of reproduction of the deep water sharks *Centroscymnus coelolepis* and *Centroscymnus squamosus* from west of Ireland and Scotland. *Journal of the Marine Biological Association of the United Kingdom* **81**, 1019-1029.

Clarke, M. W., Connolly, P. L. and Bracken, J. J. (2002). Age estimation of the exploited deepwater shark *Centrophorus squamosus* from the continental slopes of the Rockall Trough and Porcupine Bank. *Journal of Fish Biology,* **60**, 501-514.

Coggan, R. A., Gordon, J. D. M. and Merrett, N. R. (1999). Aspects of the biology of *Nezumia aequalis* from the continental slope west of the British Isles. *Journal of Fish Biology* **54**, 152-170

Cooper, A. (1979). Aspects of the ecology of gadoid fish of the west coast of Scotland. PhD thesis, University of Stirling. 162pp.

Cooper, A. (1980). Gadoid populations of western Scottish sea lochs and their exchanges with west coast stocks. In: *Fjord Oceanography*, eds. H. Freeland D. Farmer and C. Leving, Plenum Press.

Cooper, A (1983) The reproductive biology of poor-cod, *Trisopterus minutus* L., whiting, *Merlangius merlangus* L., and Norway pout, *Trisopterus esmarkii* Nilsson, off the west coast of Scotland. *Journal of Fish Biology* **22**, 317-334.

Coull, K. A., Johnstone, R. and Rogers, S. I. (1998). Fisheries sensitivity maps in British waters. Published and distributed by UKOOA Ltd., 58 pp.

Currie, R. I. (1972). The potential productivity of waters on the west coast of Scotland. *Symposium of the Zoological Society of London*. **No. 29**:285-296.

Daan, N., Bromley, P. J., Hislop, J. R. G. and Nielsen, N. A. (1990). Ecology of North Sea fish. *Netherlands Journal of Sea Research* **26**, 343-386.

De Silva, S. S. (1973a). Clupeid populations of inshore waters of the west coast of Scotland. PhD thesis, University of Stirling. 121 pp + appendices.

De Silva, S. S. (1973b). Abundance, structure, growth and origin of inshore clupeid populations of the west coast of Scotland. *Journal of Experimental Marine Biology and Ecology* **12,** 119-144.

De Silva, S. S. (1973c). Food and feeding habits of the herring *Clupea harengus* and the sprat *S. sprattus* in inshore waters of the west coast of Scotland. *Marine Biology* **20**, 282-290.

De Silva, S. S. (1973d). Aspects of the reproductive biology of the sprat *Sprattus sprattus* (L.) in inshore waters of the west coast of Scotland. *Journal of Fish Biology* **5**, 689-705.

Du Buit, M. H. (1982). Essai sur la predation de la morhue (*Gadus morhua*, L.) L'eglefin (*Melanogrammus aeglefinus* (L) et du lieu noir Pollachius virens (L) aux Faeroe *Cybium*, **6**, 3-19

Du Buit, M. H. (1995). Notes préliminaires sur la ponte de l'hoplostèthe (*Hoplostethus atlanticus*, Trachichthyidae) a l'ouest des Iles Britanniques. *Cybium*. **19**, 199-200.

Duncan, J. A. R. (1993). Seasonal spawning and distribution of larval and juvenile stages of fish of the west coast of Scotland. MSc thesis, University of Stirling 50 pp + appendices.

Durán Muñoz, P., Román, E. and González, F. (2000). Results of a deep-water experimental fishing in the North Atlantic: an example of cooperative research with the fishing industry. *ICES CM*. CM 2000/W:04, 1-15.

Durán Muñoz, P., and Román Marcote, E. (2001). The Spanish multi-species deep-sea fishery on Hatton Bank (North East Atlantic): 1996-2000. *NAFO SCR Doc.* 01/120. 20pp.

Edwards, R. R. C., Finlayson, D. M. and Steele, J. H. (1969). The ecology of 0-group plaice and common dabs in Loch Ewe. II Experimental studies of metabolism. *Journal of Experimental Marine Biology and Ecology* **3,** 1-17.

Edwards, R., and Steele, J. H. (1968). The ecology of O-group plaice and common dabs at Loch Ewe. I. Population and food. *Journal of Experimental Marine Biology and Ecology* **2,** 215-238.

Edwards, R. R. C., Steele, J. H. and Trevallion, A. (1970). The ecology of 0-group plaice and common dabs in Lochewe. III Prey-predator experiments with plaice. *Journal of Experimental Marine Biology and Ecology* **4**, 156-173.

Ehrich, S. (1983). On the occurrence of some fish species at the slopes of the Rockall Trough. Archiv für Fischereiwissenschaft **33**, 105-150.

Freytag, G. (1979). Bemerkenswerte Anlandung einer Tiefseefischart. *Informationen fur die Fischwirtschaft,* **26**, 72.

Gauld, J. A. (1989). Records of porbeagles landed in Scotland, with observations on the biology, distribution and exploitation of the species. *Scottish Fisheries Research Report* **45**. 14pp.

Gibson, R. N. (1973). The intertidal movements and distribution of young fish on a sandy beach with special reference to the plaice (*Pleuronectes platessa* L.). *Journal of Experimental Marine Biology and Ecology* **12**, 79-102.

Gibson, R. N., Ansell A. D. and Robb, L.. (1993). Seasonal and annual variations in abundance and species composition of fish and macrocrustacean communities on a Scottish sandy beach. *Marine Ecology Progress Series* **98,** 89-105.

Gibson, R. N. & Ezzi, I. A. (1978). The biology of a Scottish population of Fries' goby, *Lesueurigobius friesii*. *Journal of Fish Biology* **12**, 371-389.

Gibson, R. N. & Ezzi, I. A. (1979). Aspects of the biology of the spotted dragonet *Callionymus maculatus* Rafinesque?Schmaltz from the west coast of Scotland. *Journal of Fish Biology* **15**, 555-569.

Gibson, R. N. & Ezzi, I. A. (1980). The biology of the scaldfish, *Arnoglossus laterna* (Walbaum) on the west coast of Scotland. *Journal of Fish Biology,* **17**, 565-575.

Gibson, R. N. & Ezzi, I. A, (1981). The biology of the Norway goby *Pomatoschistus norvegicus* (Collett) on the west coast of Scotland. *Journal of Fish Biology,* **19**, 697-714.

Gibson, R. N. & Ezzi, I. A., (1987). Feeding relationships of a demersal fish assemblage on the west coast of Scotland. *Journal of Fish Biology,* **31**, 55-69.

Gibson, R. N., and Ezzi, I. A. (1990). A comparative study of sea trout (*Salmo trutta*) L.) in west highland sea lochs with special reference to Loch Feochan. *In* The sea trout in Scotland. M.J. Picken and W.M. Shearer, editors. NERC, Swindon.pp 61-70.

Gibson, R. N. and Robb, L. (1996). Piscine predation on juvenile fishes on a Scottish sandy beach. *Journal of Fish Biology* **49**, 120-138.

Gibson, R. N. and Robb, L. (1997). Occurrence of juvenile red mullet (*Mullus surmuletus*) on the west coast of Scotland. *Journal of the Marine Biological Association of the United Kingdom*, **77**, 911-912.

Gibson, R. N., Robb. L., Burrows, M. T. & Ansell, A. D. (1996). Tidal, diel and longer term changes in the distribution of fishes on a Scottish sandy beach. *Marine Ecology Progress Series* **130** 1-17.

Girard, M., and Du Buit, M. -H. (1999). Reproductive biology of two deep-water sharks from the British Isles, *Centroscymnus coelolepis* and *Centrophorus squamosus* (Chondrichthyes: Squalidae). *Journal of the Marine Biological Association of the United Kingdom* **79**, 923-931.

Gordon, J. D. M. (1977a) The fish populations in inshore waters of the west coast of Scotland. The distribution,abundance and growth of the whiting (*Merlangius merlangus* L.). *Journal of Fish Biology* **10,** 587-596.

Gordon, J. D. M. (1977b) The fish populations in inshore waters of the west coast of Scotland. The food and feeding of the whiting (*Merlangius merlangus* L.). *Journal of Fish Biology* **11**, 513-529.

Gordon, J. D. M. (1977c). The fish populations of inshore waters of the west coast of Scotland. The unusual occurrence of the blue whiting (*Micromesistius poutassou*) and notes on its biology. *Journal of Fish Biology*. **11,** 121-124.

Gordon, J. D. M. (1977d). The fish populations in inshore waters of the west of Scotland. The biology of the Norway pout (*Trisopterus esmarkii*). *Journal of Fish Biology,* **10**, 417-430.

Gordon, J. D. M. (1978). Some notes on the biology of the roundnose grenadier *Coryphaenoides rupestris* to the west of Scotland. *ICES C.M.1978/G:40.*

Gordon, J. D. M. (1979a). Life style and phenology in deep sea anacanthine teleosts. *Symposium of the Zoological Society of London* **44**, 327-356.

Gordon, J.D.M. (1979b). Seasonal reproduction in deep sea fish. In: Naylor,E. and Hartnoll, R.G. (eds.): Cyclic Phenomenon in Marine Plants and Animals. Proceedings of the 13th Eurupean Symposium on Marine Biology, Oxford; Pergamon Press, pp. 223-229.

Gordon, J. D. M. (1979c). The depth distribution of the roundnose grenadier (*Coryphaenoides rupestris* Gunnerus) on the west of Scotland slope. *Annales biologique,Copenhagen* **34**, 225-226.

Gordon, J. D. M.. (1981). The fish populations of the west of Scotland shelf. Part II. *Oceanography and Marine Biology: an Annual Review* **19**, 405-441.

Gordon, J. D. M. (1990) The fish populations of Scottish sea lochs with particular reference to those of the Firth of Lorne area. *Glasgow Naturalist* **21 (5)**, 561-575.

Gordon, J. D. M. (Ed.) (1999a) EC FAIR 95/655 Developing deep-water fisheries: data for their assessment and for understanding their interaction with and impact on a fragile environment. Consolidated Final Report 1086 pp + Appendices. (Available on www.sams.ac.uk)

Gordon, J. D. M. (1999b). Management considerations of deep-water shark fisheries. In: Shotton, R. (ed.) *Case studies of the management of elasmobranch fisheries.* FAO Fisheries Technical Paper, No.378, 77-818.

Gordon, J. D. M. (2001a). Deep-water fisheries at the Atlantic Frontier. *Continental Shelf Research* **21,** 987-1003.

Gordon, J. D. M. (Ed.) (2001b). Final Report. Distribution and biology of anglerfish and megrim in waters to the west of Scotland: European Commission Directorate General Fisheries Study Contract (98/096).

Gordon, J. D. M. (2003). The Rockall Trough, North East Atlantic: the cradle of deep-sea biological oceanography that is now being subjected to unsustainable fishing activity. *Journal of Northwest Atlantic Fishery Science* **31,** 57-83.

Gordon, J. D. M. and Bergstad, O. A. (1992). Species composition of demersal fish in the Rockall Trough, North-eastern Atlantic, as determined by different trawls. *Journal of the Marine Biological Association of the United Kingdom* **72**, 213-230.

Gordon, J. D. M., Bergstad, O. A., Figueiredo, I and Menezes, G. (2003). The deep-water fisheries of the Northeast Atlantic: I Description and current trends. *Journal of Northwest Atlantic Fishery Science* **31,** 137-150.

Gordon, J. D. M. and de Silva, S. S. (1980). The fish populations of the west of Scotland shelf. Part I. *Oceanography and Marine Biology: an Annual Review* **18**, 317-366.

Gordon, J D M & Duncan, J. A. R. (1979) Some notes on the biology of the snake blenny, *Lumpenus lampretaeformis* on the west coast of Scotland. *Journal of the Marine Biological Association of the United Kingdom* **59**, 413-419.

Gordon, J. D. M., and Duncan, J .A. R. (1985). The biology of fish of the family Moridae in the deep-water of the Rockall Trough. *Journal of the Marine Biological Association of the United Kingdom* **65,** 475-485.

Gordon, J. D. M. and Duncan, J. A. R. (1987a). Deep-sea bottom living fishes at two repeat stations at 2200 and 2900 m in the Rockall Trough, northeastern Atlantic Ocean. *Marine Biology* **96**, 309-325.

Gordon, J. D. M. and Duncan, J. A. R. (1987b). Aspects of the biology of *Hoplostethus atlanticus* and *H. mediterraneus* (Pisces; Berycomorphi) from the slopes of the Rockall Trough and the Porcupine Sea Bight (northeastern Atlantic). *Journal of the Marine Biological Association of the United Kingdom* **67**, 119 -133.

Gordon, J. D. M. and Duncan, J. A. R. (1989). A note on the distribution and diet of deep-water rays (Rajidae) in an area of the Rockall Trough. *Journal of the Marine Biological Association of the United Kingdom* **69**, 655-658.

Gordon, J. D. M. and Hunter, J. E. (1994) Study of the deep-water fish stocks to the west of Scotland. Volume 1. Final report April 1994. Report presented to Highlands and Islands Enterprise and other sponsors, 182 pp

Gordon, J. D. M. and Swan, S. C.. (1993). Biological parameters of deep-water fish species. Report to the Commission of the European Communities, DG XIV/C/1, 1992/10, 122 pp + appendices.

Gordon, J. D. M and Swan, S. C. (1996) Age validation of juvenile roundnose grenadier, *Coryphaenoides rupestris*, a deep-water macrourid fish. *Journal of Fish Biology* **49 (Supplement A**), 289-297.

Gordon, J. D. M. and Swan, S.C. (1997a). Final Report of EC DGXIV/C1 Contract 94/017 Deep-water demersal fishes: data for assessment and biological analysis.

Gordon, J. D. M. and Swan, S. C. (1997b). The distribution and abundance of deep-water sharks on the continental slope to the west of the British Isles. *ICES CM 1997/BB* **11.** 23pp.

Haedrich, R. L., and Merrett, N. R. (1988). Summary atlas of deep-living demersal fishes in the North Atlantic Basin. *Journal of Natural History* **22,** 1325-1362.

Haggan, N. and Pitcher, T. J. (Eds.) (2005) Ecosystem simulation models of Scotland's west coast and sea lochs. Fisheries Research Centre Reports 13 (4), Fisheries Centre, University of British Columbia, Canada, 67 pp

Hall, S. J.,. Raffaelli, D., Basford, D. J., Robertson, M. R. and Fryer, R. (1990). The feeding relationships of the larger fish species in a Scottish sea loch. *Journal of Fish Biology* **37**, 775-791.

Hareide, N.-R., Garnes, G., Rihan, D., Mulligan, M., Tyndall, P., Clark, M., Connolly, P., Misund, R., McMullen, P., Furevik, D.. Humborstad, O.-B., Hoydal, K. and Blasdale. T. (2005). A preliminary investigation on the shelf edge and deepwater fixed net fisheries to the west and north of Great Britain, Ireland, around Rockall and Hatton Bank. Report available on www.neafc.org

Heessen, H. J. L. (2003). Development of elasmobranch assessments (DELASS) Final Report of DG Fish Study Contract 99/055, pp. 603 pp.

Heessen, H. J. L., and Rink G. J. (2001). The fishery for greater argentine (*Argentina silus)* by the Netherlands. Poster presented at NAFO Deep-sea Fisheries Symposium, held in Cuba 2001.

Hickling, C. F. (1935). The Hake and the Hake Fishery. Buckland Lectures for 1934. Edward Arnold & Co., London. 142pp.

Hislop, J. R. G., Gallego, A., Heath, M. R., Kennedy, F. M., Reeves, S. A.

and Wright, P. J. (2001). A synthesis of the early life history of the anglerfish, *Lophius piscatorius* (Linnaeus, 1758) in northern British waters. *ICES Journal of Marine Science* **58**, 70-86.

Hislop, J. R. G., Holst, J. C. and Skagen, D. (2000). Near-surface captures of post-juvenile anglerfish in the North-east Atlantic - an unsolved mystery. *Journal of Fish Biology* **57**, 1083-1087.

Hislop, J. R. G., and Mackenzie, K. (1976). Population studies of the whiting *Merlangius merlangus* (L.) of the northern North Sea. *Journal du Conseil* **37**, 98-111.

Holden, M. J. (1965). The stocks of spurdogs *Squalus acanthias* L.) in British waters and their migrations. *Fishery Investigations*, 24, 20pp.

Howson, C. M., Connor, D. W. and Holt, R. H. F (1994). The Scottish sealochs. An account of surveys undertaken for the Marine Nature Conservation Review. (Contractor:University Marine Biological Station, Millport) Joint Nature Conservation Committee Report **No. 164**. (Marine Nature Conservation Review Report, No. MNCR/SR/27).

ICES (2000). Report of the study group on the biology and assessment of deep-sea fisheries resources. ICES CM 2000/ACFM:8, 206 pp.

ICES (2002a) Report of the study group on elasmobranch fishes. *ICES CM 2002/G:08*

ICES (2002b) Report of the Working Group on Biology and Assessment of Deep-sea Fisheries Resources ICES CM 2000/ACFM:8, 206 pp

ICES (2003a) Report of the Working Group on Biology and Assessment of Deep-sea Fisheries Resources ICES CM 2003/ACFM:25

ICES (2003b) Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks for 2002 ICES CM 2003/ACFM:04

ICES (2004) Report of the ICES Advisory Committee on Fishery Management and Advisory Committee on Ecosystems, 2004. *ICES Advice* Volume 1, Number 2. 1544 pp.

ICES 2006a Report of the Working Group on Mackerel, Horse Mackerel, Sardine and Anchovy ICES C.M. 2006/ACFM:08

ICES (2005) Report of the ICES Advisory Committee on Fishery Management Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2005. *ICES Advice* Volumes 1 – 11, 1418 pp

Kabata, Z. (1967). Whiting stocks and their gall-bladder parasites in British waters. *Marine Research 1967* **No 2**. 11 pp.

Kelly, C. J., Connolly, P. L. and Bracken J. J. (1996). Maturity,oocyte dynamics and fecundity of the roundnose grenadier from the Rockall Trough. *Journal of Fish Biology* **49 Supplement A**, 5-17.

Kelly, C. J., Connolly, P. L. and Bracken J. J. (1997). Age estimation, growth, maturity and distribution of the roundnose grenadier from the Rockall trough. *Journal of Fish Biology* **50**. 1-17.

Kislalioglu, M. and Gibson, R. N. (1977). The feeding relationships of shallow water fishes in a Scottish sea loch. *Journal of Fish Biology* **11**, 257-266.

Knijn, R. J., Boon, T. W., Heessen, H. J. L. and Hislop, J. R. G. (1993). Atlas of North Sea fishes. *ICES Cooperative Research Report* **No.194.** 268pp.

Kunzlik, P. A. (1988). The Basking shark. *Scottish Fisheries Information Pamphlet* **No.14**. 20pp.

Large, P. A., Hammer, C., Bergstad, O. A., Gordon, J. D. M. and Lorance, P. (2003) Deep-water fisheries of the Northeast Atlantic: II Assessment and management approaches. *Journal of Northwest Atlantic Fishery Science* **31,** 151-163.

Lorance, P., Garren, F.and Vigneau, J.. (2003). Age estimation of the roundnose grenadier (*Coryphaenoides rupestris*), effects of uncertainties on ages. *Journal of Northwest Atlantic Fishery Science* **31**, 387-399.

Lorance, P., Latrouite, D. and Séret B. (2000). Observations of chondrichthyan fishes (sharks, rays and chimaeras) in the Bay of Biscay (North-Eastern Atlantic) from submersibles. *In* Proceedings of 3rd European Elasmobranch Association Meeting, Boulogne-sur -Mer,1999. B. Séret and J.Y. Sire, editors. Paris: Soc. Fr. Icthyol. + IRD, 2000. 29-45.

Lundy, C., Moran, P., Rico, C., Milner, R. S. and Hewitt, G. M. (1999). Macrogeographical population differentiation in oceanic environments: a case study of European hake (*Merluccius merluccius*), a commercially important fish. *Molecular Ecology* **8**, 1889-1898.

Macer, C.T. (1977) Some aspects of the biology of the horse mackerel (*Trachurus trachurus* L.) in waters around Britain. Journal of Fish Biology **10,** 51-62

Magill, S. H., and Sayer, M. D. J. (2002). Seasonal and interannual variation in fish assemblages of northern temperate rocky subtidal habitats. *Journal of Fish Biology* **61**, 1198-1216.

Magill, S. H., and Sayer, M. D. J. (2004). Abundance of juvenile Atlantic cod (*Gadus morhua*) in the shallow rocky subtidal and the relationship to winter seawater temperature. *Journal of the Marine Biological Association of the United Kingdom* **84**, 439-442.

Magnusson, J. V., Bergstad, O. A., Hareide, N.-R., Magnusson, J. and Reinert, J. (1997). Ling, blue ling and tusk of the northeast Atlantic. *TemaNord* **535.** 61pp.

Mauchline, J. and Gordon, J. D. M. (1980). The food and feeding of the deep-sea morid fish *Lepidion eques* (Gunther 1887) in the Rockall Trough. *Journal of the Marine Biological Association of the United Kingdom* **60,** 1053-1059.

Mauchline, J. and Gordon, J. D. M. (1983a). Diets of the sharks and chimaeroids of the Rockall Trough, northeastern Atlantic Ocean. *Marine Biology* **75,** 269-278.

Mauchline, J. and Gordon, J. D. M. (1983b). Diets of clupeoid, stomiatoid and salmonoid fish of the Rockall Trough, northeastern Atlantic Ocean. *Marine Biology* **77,** 67-78.

Mauchline, J. and Gordon, J. D. M. (1984a). Feeding and bathymetric distribution of the gadoid and morid fish of the Rockall Trough. *Journal of the Marine Biological Association of the United Kingdom* **64,** 657-665.

Mauchline, J. and Gordon, J. D. M. (1984b). Diets and bathymetric distributions of the macrourid fish of the Rockall Trough, northeastern Atlantic Ocean. *Marine Biology* **81**, 107-121.

Mauchline, J. and Gordon, J. D. M. (1984c). Occurrence and feeding of the berycomorphid and percomorphid teleost fish in the Rockall Trough. *Journal de Conseil* **41**, 239-247.

Morales-Nin, B., Canha, Â, Casas, M., Figuereido, I., Gordo, L. S., Gordon, J. D. M., Gouveia, E., Piñeiro, C. G., Reis, S., Reis, A., Swan, S. C. (2002) Intercalibration of age readings of deepwater black scabbardfish *Aphanopus carbo* (Lowe, 1839). *ICES Journal of Marine Science* **59**, 352-364.

Nash, R. D. M. and Gibson, R. N. (1982). Seasonal fluctuations in the populations of small demersal fishes on the west coast of Scotland. *Estuarine Coastal. Shelf Science* **15**, 485-495.

Nizovtsev G. P. (1989) New information on the distribution of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northeast Atlantic. *Journal of Ichthyology*, **8,** 113-117

Nolan, C. P. E. (2004) (editor). A technical and scientific record of experimental fishing for deepwater species in the Northeast Atlantic, by Irish fishing vessels in 2001. *Fisheries Resources Series, Bord Iascaigh Mhara (Irish Sea Fisheries Board), Dun Laoghaire, Ireland*. 1 (1 & 2):172 & 309 pp

Picken, M. J., and Shearer, W. M. (1990). The sea trout in Scotland. NERC, Swindon. 102pp.

Pemberton, R. (1976a). Sea trout in North Argyll sea lochs: II.diet. *Journal of Fish Biology* **9,** 195-208.

Pemberton, R. (1976b). Sea trout in North Argyll Sea lochs, population, distribution and movements. *Journal of Fish Biology* **9,** 157-179.

Piñeiro, C. G., Casas, M.and Bañón, R. (2001). The deep-water fisheries exploited by Spanish fleets in the Northeast Atlantic: a review of the current status. *Fisheries Research* **51,** 311-320.

Rogers, S. and Stocks, R. (2001). North Sea Fish & Fisheries, Technical Report 003, Strategic Environmental Assessment SEA2, CD-ROM.

Russell, F. S. (1976). The eggs and planktonic stages of British marine fishes. Academic Press, London. 524 pp.

Sarno, B., Glass, C.W. and Smith, G. W. (1994a). Differences in diet and behaviour of sympatric Saithe and Pollack in a Scottish sea loch. *Journal of Fish Biology* **45 (Supplement A),** 1-11.

Sarno, B., Glass, C.W. and Smith, G. W., Johnstone, A. D. F. and Mojsiewicz, W. R. (1994b). A comparison of the movements of two species of gadoid in the vicinity of an underwater reef. *Journal of Fish Biology* **45,** 811-817.

Sayer, M. D. J. (1996). Wrasse use in aquaculture: implications for the sea loch environment. In *Aquaculture and Sea Lochs* (Black, K. D., ed.), pp. 82–88. Oban: Scottish Association for Marine Science.

Sayer, M. D. J., Magill, S. M., Thurston, S. R., Wilding, T. A., Nickell, L. A. and Gibson, R. N. (2001). MF0133: The factors affecting distribution and abundance of juvenile gadoids in rocky subtidal habitats; Final report of GSG MAFF. *Dunstaffnage Marine Laboratory Internal Report* **233**. 202pp.

Sayer, M. D. J., Treasurer, J. W. and Costello, M. J. (1996). *Wrasse: Biology and use in aquaculture*. Oxford: Blackwell Scientific, 284pp

Sims, D. W., Southall, E. J., Richardson, A. J., Reid, P. C. and Metcalfe, J. D. (2003). Seasonal movements and behaviour of basking sharks from archival tagging; no evidence of winter hibernation. *Marine Ecology Progress Series* **248,** 187-196.

Southall, E. J., Sims, D. W., Metcalfe, J. D., Doyle, J. I., Fanshawe, S., Lacey, C., Shrimpton, J,. Solandt, J.-L. and Speedie, C. (2005). Spatial distribution patterns on the European shelf: preliminary comparison of satellite-tag geolocation, survey and public sightings data. *Journal of the Marine Biological Association of the United Kingdom* **85,** 1083-1088.

Steele, J. H. and Edwards, R. R. C. (1970). The ecology of O-group plaice and common dabs in Loch Ewe. IV. Dynamics of the plaice and dab populations. *Journal of Experimental Marine Biology and Ecology* **4,** 174-187.

Steele, J. H., McIntyre, A. D., Edwards, R. R. C. and Trevallion, A. (1970). Interrelations of a young plaice population with its invertebrate food supply. *In Animal populations in relation to their food resources.* Vol. 10. A. Watson, editor. Blackwell, Oxford and Edinburgh. 375-388.

Stene, A. and Buner, A., (1991). Forsøksfiske med liner vest for Shetland, Færøyene og Hebridene, samt på Reykjanesryggen. *MS, Møreforsking Ålesund (Unpublished Report),* 60pp.

Swan, S. C. and Gordon, J. D. M. (2001) A review of age estimation in macrourid fishes with new data on age validation of juveniles. *Fisheries Research* **51**, 177-196

Thomsen, B. (1998) Faroese quest of orange roughy in the North Atlantic. *ICES CM 1998/O:31*, 8pp.

Vinnichenko, V. I. (2000). Historical review of the Soviet deepwater investigations and fishery in the open northeast Atlantic (the Outer-Bailey Bank, Hatton Plateau, Rockall Rising). *Working Document presented to the ICES Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources,*14pp.

Walsh, M., Reid, D. G. and Turrell,W. R. (1995). Understanding mackerel migration off Scotland: tracking with echosounders and commercial data, and including environmental correlates and behaviour. *ICES Journal of Marine Science*
52, 925-939.

Walsh, M., Skogen, M., Reia, D. G., Svendsen, E. and McMillan, J. A. (1996). The relationship between the location of western mackerel spawning, larval drift and recruit distributions: A modelling study. *ICES CM 1996/S:33*, 12p.

Wheeler, A. (1969). The Fishes of the British Isles and North-West Europe. Macmillan: London.

Wheeler, A. (1992) A list of the common and scientific names of fishes of the British Isles. *Journal of Fish Biology* **41, (Supplement A)**, 26 pp.

Wheeler, A. C., Merrett, N. R. and Quigley, D. T. G. (2004) Additional records and notes for Wheeler's (1992) list of the common and scientific names of fishes of the British Isles. *Journal of Fish Biology* **65, (Supplement B),** 40pp**.**

Whitehead, P. J. P., Bauchot, M. L., Hureau, J. C., Nielsen, J. and Tortonese, E. (1984). Fishes of the North-eastern Atlantic and the Mediterranean. Vol 1, UNESCO, Paris.

Whitehead, P. J. P., Bauchot, M. L., Hureau, J. C., Nielsen, J. and Tortonese, E. (1986). Fishes of the North-eastern Atlantic and the Mediterranean. Vol 1 & 2, UNESCO, Paris.

Woodroffe, D.A., Wright, P. J. and Gordon, J. D. M. (2003) Verification of annual increment formation in the white anglerfish, *Lophius piscatorius* using the illicia and sagitta otoliths. *Fisheries Research* 60, 345-356

Wright, P. J., Woodroffe, D. A., Gibb, F. M. and Gordon, J. D. M. (2002).
Verification of first annulus formation in the illicia and otoliths of white anglerfish, *Lophius piscatorius* using otolith microstructure. *ICES Journal of Marine Science* **59**, 587-593.

APPENDIX 1

The distribution of fish caught by the bottom trawl in sea lochs and other areas during the period 1969-1973 (Modified from Gordon and de Silva, 1980)

	Loch Etive (upper)	Loch Etive (lower)	Loch Spelve	Firth of Lorne	Loch Linnhe	Loch Sunart	Upper Sound of Mull
Approximate depth (m)	102	45	25	47	90	80	50
Number of trawls	13	39	19	60	30	13	17
Scyliorhinus canicula	+	+	+	+	+	+	+
Galeus melastomus	+	+	+	+	+	+	+
Squalus acanthias	+	+	+	+	+	+	+
Raja (Raja) clavata					+	+	
Raja (Leucoraja) naevus	+	+	+	+	+	+	+
Raja (Dipturus) batis	+	+	+	+	+	+	+
Clupea harengus							+
Clupea sprattus							+
Argentina sphyraena	+	+	+	+	+	+	+
Gasterosteus aculeatus	+	+	+	+	+	+	+
Merluccius merluccius				+	+		+
Gadus morhua		+					
Melanogrammus aeglefinus		+			+	+	+
Merlangius merlangus	+	+	+	+	+	+	+
Micromesistius poutassou	+		+	+	+	+	+
Pollachius pollachius	+	+	+	+	+	+	+
Pollachius virens					+	+	
Trisopterus minutus			+				
Trisopterus esmarki		+	+	+	+	+	+
Phycis blennoides	+	+	+	+	+	+	+
Rhinonemus cimbrius	+	+	+	+	+	+	+
Zeus faber					+		
Cepola macrophthalma					+		+
Trachurus trachurus				+	+	+	+
Ctenolabrus rupestris			+	+			+
Symphodus (Crenilabrus) melops		+		+	+	+	+
Scomber scombrus						+	
Gobiidae			+				
Callionymus maculatus		+	+	+	+		+
Lumpenus lampretaeformis		+	+	+		+	+
Eutrigla gurnardus		+		+	+	+	+
Myoxocephalus scorpius				+	+		
Taurulus bubalis	+	+	+	+	+	+	+

	Loch Etive (upper)	Loch Etive (lower)	Loch Spelve	Firth of Lorne	Loch Linnhe	Loch Sunart	Upper Sound of Mull
Agonus cataphractus		+	+		+		
Lepidorhombus whiffiagonis			+				
Phrynorhombus norvegicus		+					
Arnoglossus laterna					+		
Pleuronectes platessa				+			
Glyptocephalus cynoglossus			+	+			
Hippoglossoides platessoides	+	+	+	+	+	+	+
Limanda limanda	+	+	+	+	+	+	+
Microstomus kitt	+	+	+	+	+	+	+
Platichthys flesus		+	+	+	+	+	+
Solea vulgaris						+	+
Lophius piscatorius		+		+	+		+
Number of species	15	24	24	28	31	26	30

APPENDIX 2

The distribution of fish caught by beach seine, beam trawl and push net on beaches in the Firth of Lorne area (Modified from Gordon and de Silva, 1980).

	Loch Etive[a]	Dunstaffnage Bay[a]	Ardmucknish Bay[b]	Ganavan Beach	Loch Feochan	Loch Creran
Clupeidae	+	+			+	+
Clupea harengus		+	+			+
Clupea sprattus		+				
Salmo trutta	+	+			+	+
Argentina sphyraena		+				
Anguilla anguilla	+	+				
Syngnathus acus	+		+	+	+	+
Nerophis lumbriciformis	+	+	+			
Gasterosteus aculeatus	+	+				+
Spinachia spinachia	+	+	+	+	+	+
Gadidae	+	+				
Gadus morhua	+	+	+	+	+	+
Merlangius merlangus			+			+
Pollachius pollachius		+				
Pollachius virens	+	+	+		+	+
Ciliata mustela			+			+
Symphodus (Crenilabrus) melops	+	+				
Ammodytidae	+	+	+		+	+
Ammodytes tobianus			+	+		
Hyperoplus lanceolatus	+	+				
Echiichthys vipera			+			
Gobiidae	+	+	+	+	+	+
Pomatoschistus minutus	+	+	+			
Pomatoschistus microps	+	+				
Gobiusculus flavescens	+	+				
Callionymidae	+		+			+
Chirolophis ascanii		+				
Pholis gunnellus	+	+	+	+	+	+
Zoarces viviparus	+	+	+			+
Chelon labrosus		+				
Atherina (Hepsetia) presbyter		+			+	
Eutrigla gurnardus			+			
Myoxocephalus scorpius	+	+	+	+		+
Taurulus bubalis	+	+	+	+		+
Agonus cataphractus	+	+	+			+
Cyclopterus lumpus		+	+	+		
Liparidae			+			

	Loch Etive[a]	Dunstaffnage Bay[a]	Ardmucknish Bay[b]	Ganavan Beach	Loch Feochan	Loch Creran
Scophthalmus rhombus			+			
Phrynorhombus regius					+	+
Psetta maxima			+	+	+	
Zeugopterus punctatus				+		
Pleuronectes platessa	+	+	+	+	+	+
Limanda limanda	+	+	+	+	+	
Platichthys flesus	+	+	+	+	+	+
Solea vulgaris			+		+	+
Apletodon dentatus				+		

[a]Includes data from Kislalioglu (1975)
[b]Includes data from Gibson (1973)

APPENDIX 3

Presence or absence of deep-water demersal fishes in the Rockall Trough by bathymetric zone for all sampling methods combined.

	Bathymetric Zone										
Family and species	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**	**2250**	**2500**	**3000**
Myxinidae											
Myxine ios						+					
Scyliorhinidae											
Apristurus sp				+	+	+	+				
Galeus melastomus	+	+	+								
Galeus murinus				+	+						
Squalidae											
Centrophorus squamosus			+	+							
Centroscyllium fabricii				+	+	+					
Centroscymnus crepidater		+	+	+	+						
Centroscymnus coelolepis			+	+	+	+					
Dalatias licha		+	+								
Deania calceus		+	+	+							
Etmopterus spinax		+	+								
Etmopterus princeps			+	+	+	+	+				
Scymnodon ringens		+	+								

	Bathymetric Zone										
Family and species	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**	**2250**	**2500**	**3000**
Rajidae											
Bathyraja richardsoni										+	
Breviraja caerulea					+						
Raja (Dipturus) nidarosiensis			+	+							
Raja (Leucoraja) circularis			+								
Raja (Rajella) bathyphila					+	+					
Raja (Rajella) bigelowi							+	+	+		
Raja (Rajella) fyllae				+	+	+					
Chimaeridae											
Chimaera monstrosa	+	+	+	+	+	+					
Hydrolagus pallidus							+				
Hydrolagus affinis						+	+		+		
Hydrolagus mirabilis			+	+	+	+					
Rhinochimaeridae											
Hariotta raleighana					+	+	+				
Rhinochimaera atlantica					+						

	Bathymetric Zone										
Family and species	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**	**2250**	**2500**	**3000**
Alepocephalidae											
Alepocephalus agassizii						+	+	+	+	+	
Alepocephalus australis						+				+	
Alepocephalus bairdii		+	+	+	+	+	+		+		
Alepocephalus rostratus			+	+	+	+					
Conocara macroptera						+			+		
Conocara murrayi								+		+	
Narcetes stomias									+		
Rouleina attrita						+	+				
Xenodermichthys copei		+	+	+	+		+		+		
Searsiidae											
Normichthys operosus						+					
Argentinidae											
Argentina silus	+	+	+								
Argentina sphyraena	+										
Synodontidae											
Bathysaurus ferox										+	
Chlorophthalmidae											
Bathypterois dubius					+	+	+				
Notosudidae											
Scopelosaurus lepidus				+	+						

	Bathymetric zone										
Family and species	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**	**2250**	**2500**	**3000**
Paralepididae											
Notolepis rissoi			+								
Synaphobranchidae											
Histiobranchus bathybius										+	+
Ilyophis blachei					+						
Synaphobranchus kaupi		+	+	+	+	+	+	+	+	+	
Halosauridae											
Aldrovandia sp				+							
Halosauropsis macrochir							+	+	+	+	
Notacanthidae											
Notacanthus chemnitzii			+	+	+				+		
Notacanthus bonapartei		+	+	+	+	+	+				
Polyacanthonotus challengeri									+	+	
Polyacanthonotus rissoanus		+	+	+	+	+	+	+	+	+	
Macrouridae											
Coryphaenoides (Chalinura) brevibarbis							+	+	+	+	+
Coryphaenoides (Chalinura) leptolepis											+
Coryphaenoides (Chalinura) mediterranea				+	+	+	+	+	+	+	
Coelorinchus coelorhincus	+	+	+								
Coelorinchus labiatus		+	+	+	+	+	+	+			
Coryphaenoides rupestris		+	+	+	+	+	+				
Coryphaenoides guentheri				+	+	+	+	+	+	+	

	Bathymetric zone										
Family and species	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**	**2250**	**2500**	**3000**
Macrouridae (cont.)											
Coryphaenoides (Lionurus) carapinus									+	+	+
Malacocephalus laevis	+	+									
Coryphaenoides (Nematonurus) armatus									+	+	+
Nezumia aequalis		+	+	+	+	+					
Trachyrincus murrayi			+	+	+	+	+				
Merluccidae											
Merluccius merluccius	+	+	+								
Gadidae											
Gadiculus argenteus thori	+	+	+								
Gadus morhua morhua	+										
Micromesistius poutassou	+	+	+	+		+					
Pollachius virens	+										
Trisopterus minutus	+										
Trisopterus esmarki	+	+									
Brosme brosme		+	+	+							
Gaidropsarus macrophthalmus		+	+	+	+						
Molva molva	+	+									
Molva dypterygia dypterygia		+	+	+	+						
Phycis blennoides	+	+	+	+							

	Bathymetric zone										
Family and species	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**	**2250**	**2500**	**3000**
Moridae											
Antimora rostrata				+	+	+	+	+	+	+	
Halargyreus johnsonii		+	+	+	+						
Lepidion eques		+	+	+	+	+					
Mora moro		+	+	+							
Trachichthyidae											
Hoplostethus atlanticus				+	+		+				
Melamphaidae											
Scopelogadus beanii						+		+		+	
Apogonidae											
Epigonus telescopus		+	+	+							
Carangidae											
Trachurus trachurus	+										
Gempylidae											
Nesiarchus nasutus			+								
Trichiuridae											
Aphanopus carbo		+	+	+	+						
Scombridae											
Scomber scombrus		+									
Zoarcidae											
Lycodes sp							+	+	+		
Melanostigma atlanticum				+	+						

	Bathymetric zone										
Family and species	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**	**2250**	**2500**	**3000**
Bythidae											
Cataetyx laticeps					+	+	+	+	+		
Ophidiidae											
Spectrunculus grandis							+	+	+	+	
Scorpaenidae											
Helicolenus dactylopterus dactylopterus	+	+	+	+							
Sebastes mentella			+								
Sebastes viviparus		+									
Cottunculidae											
Cottunculus thomsoni				+	+	+					
Liparidae											
Paraliparis hystrix			+	+							
Paraliparis bathybius									+		
Scophthalmidae											
Lepidorhombus boscii	+	+	+	+							
Lepidorhombus whiffiagonis	+	+	+	+							
Pleuronectidae											
Glyptocephalus cynoglossus		+	+	+	+						
Microstomus kitt	+										
Lophiidae											
Lophius piscatorius		+	+	+							

APPENDIX 4

The abundance (No/1000 m^2) and biomass (kg/1000 m^2)of deep-water fishes by gear type for the 500, 750, 1000, 1250, 1500, 1750 and 2000 m bathymetric zones. For a description of the trawls see Gordon and Bergstad (1992).

ROCKALL 500 m Zone

Gear: GT(S) Granton trawl short bridles paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	kg (%)
Micromesistius poutassou	14.5811	87.0	Micromesistius poutassou	2.5853	83.8
Helicolenus d. dactylopterus	0.4298	2.6	Argentina silus	0.1219	4.0
Argentina silus	0.3893	2.3	Chimaera monstrosa	0.1071	3.5
Chimaera monstrosa	0.3550	2.1	Phycis blennoides	0.0668	2.2
Etmopterus spinax	0.2211	1.3	Helicolenus d. dactylopterus	0.0338	1.1
Epigonus telescopus	0.1931	1.2	Lophius piscatorius	0.0278	0.9
Phycis blennoides	0.1370	0.8	Molva d. dypterygia	0.0277	0.9
Lepidorhombus boscii	0.1121	0.7	Merluccius merluccius	0.0237	0.8
Lepidion eques	0.0903	0.5	Epigonus telescopus	0.0208	0.7
Gadiculus argenteus thori	0.0529	0.3	Etmopterus spinax	0.0199	0.6
Coelorinchus coelorhincus	0.0529	0.3	Molva molva	0.0149	0.5
Lepidorhombus whiffiagonis	0.0467	0.3	Lepidorhombus whiffiagonis	0.0101	0.3
Merluccius merluccius	0.0280	0.2	Coelorinchus coelorhincus	0.0062	0.2
Malacocephalus laevis	0.0156	0.1	Lepidorhombus boscii	0.0056	0.2
Molva d. dypterygia	0.0156	0.1	Malacocephalus laevis	0.0046	0.1
Galeus melastomus	0.0093	0.1	Lepidion eques	0.0036	0.1
Lophius piscatorius	0.0062	0.0	Galeus melastomus	0.0034	0.1
Molva molva	0.0062	0.0	Beryx decadactylus	0.0012	0.0
Sebastes viviparus	0.0031	0.0	Gadiculus argenteus thori	0.0008	0.0
Sagamichthys schnakenbecki	0.0031	0.0	Sebastes viviparus	0.0004	0.0
Beryx decadactylus	0.0031	0.0	Sagamichthys schnakenbecki	0.0000	0.0
Total	16.7518		Total	3.0857	

Gear: GT(L) Granton trawl with long bridles paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Chimaera monstrosa	1.5032	28.1	Chimaera monstrosa	0.9882	38.6
Lepidion eques	0.7272	13.6	Deania calceus	0.3371	13.2
Phycis blennoides	0.5271	9.8	Phycis blennoides	0.2319	9.1
Argentina silus	0.4441	8.3	Argentina silus	0.1821	7.1
Gadiculus argenteus thori	0.3270	6.1	Merluccius merluccius	0.1337	5.2
Etmopterus spinax	0.2928	5.5	Centrophorus squamosus	0.0976	3.8
Helicolenus d. dactylopterus	0.2440	4.6	Molva molva	0.0848	3.3
Micromesistius poutassou	0.2391	4.5	Aphanopus carbo	0.0743	2.9
Coelorinchus coelorhincus	0.1708	3.2	Coryphaenoides rupestris	0.0662	2.6
Merluccius merluccius	0.0927	1.7	Etmopterus spinax	0.0573	2.2
Lepidorhombus whiffiagonis	0.0927	1.7	Brosme brosme	0.0432	1.7
Deania calceus	0.0830	1.5	Lepidion eques	0.0382	1.5
Lepidorhombus boscii	0.0683	1.3	Centroscymnus crepidater	0.0353	1.4

Coryphaenoides rupestris	0.0634	1.2	Micromesistius poutassou	0.0340	1.3
Aphanopus carbo	0.0586	1.1	Molva d. dypterygia	0.0201	0.8
Halargyreus johnsonii	0.0586	1.1	Coelorinchus coelorhincus	0.0194	0.8
Notacanthus bonapartei	0.0488	0.9	Helicolenus d. dactylopterus	0.0187	0.7
Trisopterus esmarki	0.0390	0.7	Galeus melastomus	0.0166	0.6
Sebastes viviparus	0.0342	0.6	Lepidorhombus whiffiagonis	0.0155	0.6
Galeus melastomus	0.0293	0.5	Raja clavata	0.0098	0.4
Coelorinchus labiatus	0.0244	0.5	Sebastes mentella	0.0078	0.3
Molva molva	0.0244	0.5	Pagellus bogareveo	0.0071	0.3
Epigonus telescopus	0.0195	0.4	Squalis acanthias	0.0064	0.3
Synaphobranchus kaupi	0.0195	0.4	Sebastes viviparus	0.0053	0.2
Gaidropsarus macrophthalmus	0.0146	0.3	Conger conger	0.0049	0.2
Glyptocephalus cynoglossus	0.0146	0.3	Gadiculus argenteus thori	0.0048	0.2
Centroscymnus crepidater	0.0146	0.3	Lepidorhombus boscii	0.0041	0.2
Brosme brosme	0.0146	0.3	Notacanthus bonapartei	0.0037	0.1
Molva d. dypterygia	0.0098	0.2	Malacocephalus laevis	0.0029	0.1
Malacocephalus laevis	0.0098	0.2	Hoplostethus atlanticus	0.0026	0.1
Raja (Raja) clavata	0.0049	0.1	Epigonus telescopus	0.0020	0.1
Squalus acanthias	0.0049	0.1	Coelorinchus labiatus	0.0019	0.1
Sebastes mentella	0.0049	0.1	Glyptocephalus cynoglossus	0.0014	0.1
Hoplostethus atlanticus	0.0049	0.1	Alepocephalus bairdii	0.0013	0.1
Conger conger	0.0049	0.1	Halargyreus johnsonii	0.0007	0.0
Centrophorus squamosus	0.0049	0.1	Gaidropsarus macrophthalmus	0.0007	0.0
Polyacanthonotus rissoanus	0.0049	0.1	Polyacanthonotus rissoanus	0.0001	0.0
Pagellus bogaraveo	0.0049	0.1	Trisopterus esmarki	0.0001	0.0
Alepocephalus bairdii	0.0049	0.1	Synaphobranchus kaupi	0.0001	0.0
Total	5.3538		Total	2.5621	

Gear: OTSB(P) OTSB paired warps

species	No/1000m2	No (%)	species	kg/1000m2	kg (%)
Chimaera monstrosa	1.7207	19.9	Chimaera monstrosa	1.3451	28.2
Lepidion eques	1.4501	16.8	Aphanopus carbo	1.0226	21.5
Coelorinchus coelorhincus	0.9307	10.8	Coryphaenoides rupestris	0.6563	13.8
Aphanopus carbo	0.8116	9.4	Deania calceus	0.4068	8.5
Coryphaenoides rupestris	0.7251	8.4	Phycis blennoides	0.3445	7.2
Phycis blennoides	0.6168	7.1	Molva d. dypterygia	0.1515	3.2
Epigonus telescopus	0.4870	5.6	Lepidion eques	0.1509	3.2
Helicolenus d. dactylopterus	0.4112	4.8	Galeus melastomus	0.1082	2.3
Lepidorhombus whiffiagonis	0.2814	3.3	Coelorinchus coelorhincus	0.1032	2.2
Nezumia aequalis	0.2597	3.0	Lophius piscatorius	0.0974	2.0
Halargyreus johnsonii	0.2381	2.8	Lepidorhombus whiffiagonis	0.0668	1.4
Glyptocephalus cynoglossus	0.1623	1.9	Glyptocephalus cynoglossus	0.0540	1.1
Deania calceus	0.1082	1.3	Brosme brosme	0.0514	1.1
Galeus melastomus	0.1082	1.3	Merluccius merluccius	0.0451	0.9
Xenordermichthys copei	0.0758	0.9	Epigonus telescopus	0.0450	0.9
Molva d. dypterygia	0.0541	0.6	Helicolenus d. dactylopterus	0.0441	0.9
Argentina silus	0.0325	0.4	Argentina silus	0.0189	0.4
Malacocephalus laevis	0.0216	0.3	Nezumia aequalis	0.0117	0.2
Merluccius merluccius	0.0216	0.3	Scymnodon ringens	0.0110	0.2
Lophius piscatorius	0.0216	0.3	Etmopterus spinax	0.0090	0.2

Brosme brosme	0.0216	0.3	Malacocephalus laevis	0.0079	0.2
Scymnodon ringens	0.0108	0.1	Dalatias licha	0.0065	0.1
Synaphobranchus kaupi	0.0108	0.1	Halargyreus johnsonii	0.0026	0.1
Etmopterus spinax	0.0108	0.1	Halosauropsis macrochir	0.0021	0.0
Sebastes viviparus	0.0108	0.1	Sebastes viviparus	0.0018	0.0
Halosauropsis macrochir	0.0108	0.1	Xenordermichthys copei	0.0006	0.0
Dalatias licha	0.0108	0.1	Polyacanthonotus rissoanus	0.0005	0.0
Polyacanthonotus rissoanus	0.0108	0.1	Alepocephalus bairdii	0.0001	0.0
Alepocephalus bairdii	0.0108	0.1	Synaphobranchus kaupi	0.0001	0.0
Total	8.6467		Total	4.7658	

Gear: OTSB(S) OTSB single warp

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Halargyreus johnsonii	2.5717	22.9	Aphanopus carbo	0.0981	3.3
Lepidion eques	2.4235	21.6	Argentina silus	0.0195	0.7
Chimaera monstrosa	1.4558	13.0	Brosme brosme	0.1369	4.6
Coelorinchus coelorhincus	0.7497	6.7	Conger conger	0.0022	0.1
Phycis blennoides	0.6538	5.8	Chimaera monstrosa	1.0238	34.4
Coryphaenoides rupestris	0.6277	5.6	Coelorinchus coelorhincus	0.0856	2.9
Helicolenus d.dactylopterus	0.4882	4.3	Coryphaenoides rupestris	0.6377	21.4
Synaphobranchus kaupi	0.4359	3.9	Deania calceus	0.1481	5.0
Lepidorhombus whiffiagonis	0.4097	3.6	Dalatias licha	0.0044	0.1
Gadiculus argenteus thori	0.4010	3.6	Etmopterus spinax	0.0032	0.1
Epigonus telescopus	0.2441	2.2	Epigonus telescopus	0.0270	0.9
Notacanthus bonapartei	0.1046	0.9	Gadiculus argenteus thori	0.0059	0.2
Glyptocephalus cynoglossus	0.1046	0.9	Glyptocephalus cynoglossus	0.0274	0.9
Galeus melastomus	0.0785	0.7	Gaidropsarus macrophthalmus	0.0005	0.0
Aphanopus carbo	0.0697	0.6	Galeus melastomus	0.0643	2.2
Lepidorhombus boscii	0.0610	0.5	Helicolenus d. dactylopterus	0.0379	1.3
Brosme brosme	0.0436	0.4	Halargyreus johnsonii	0.0146	0.5
Malacocephalus laevis	0.0436	0.4	Lepidorhombus boscii	0.0034	0.1
Micromesistius poutassou	0.0349	0.3	Lepidion eques	0.1118	3.8
Deania calceus	0.0349	0.3	Lepidorhombus whiffiagonis	0.0693	2.3
Argentina silus	0.0349	0.3	Molva d. dypterygia	0.0300	1.0
Scymnodon ringens	0.0262	0.2	Malacocephalus laevis	0.0150	0.5
Mora moro	0.0174	0.2	Merluccius merluccius	0.0305	1.0
Sebastes viviparus	0.0174	0.2	Molva molva	0.0341	1.1
Gaidropsarus macrophthalmus	0.0174	0.2	Mora moro	0.0010	0.0
Molva d. dypterygia	0.0174	0.2	Micromesistius poutassou	0.0044	0.1
Dalatias licha	0.0087	0.1	Nezumia aequalis	0.0003	0.0
Xenordermichthys copei	0.0087	0.1	Notacanthus bonapartei	0.0059	0.2
Etmopterus spinax	0.0087	0.1	Notacanthus chemnitzii	0.0002	0.0
Merluccius merluccius	0.0087	0.1	Phycis blennoides	0.2287	7.7
Molva molva	0.0087	0.1	Synaphobranchus kaupi	0.0019	0.1
Nezumia aequalis	0.0087	0.1	Scymnodon ringens	0.1020	3.4
Notacanthus chemnitzii	0.0087	0.1	Sebastes viviparus	0.0027	0.1
Conger conger	0.0087	0.1	Xenordermichthys copei	0.0000	0.0
Total	11.2369		Total	2.9782	

ROCKALL 750 m Zone

Gear: GT(S) Granton trawl short bridles paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Coryphaenoides rupestris	0.9004	28.4	Coryphaenoides rupestris	0.6369	22.9
Lepidion eques	0.5059	15.9	Deania calceus	0.5110	18.4
Nezumia aequalis	0.3242	10.2	Centrophorus squamosus	0.3562	12.8
Chimaera monstrosa	0.1951	6.1	Centroscymnus coelolepis	0.2895	10.4
Alepocephalus bairdii	0.1807	5.7	Aphanopus carbo	0.2142	7.7
Deania calceus	0.1590	5.0	Chimaera monstrosa	0.2027	7.3
Aphanopus carbo	0.1528	4.8	Molva d. dypterygia	0.1732	6.2
Epigonus telescopus	0.0991	3.1	Hydrolagus mirabilis	0.0470	1.7
Halargyreus johnsonii	0.0981	3.1	Lepidion eques	0.0419	1.5
Gadiculus argenteus thori	0.0774	2.4	Alepocephalus bairdii	0.0355	1.3
Hydrolagus mirabilis	0.0723	2.3	Dalatias licha	0.0344	1.2
Molva d. dypterygia	0.0485	1.5	Phycis blennoides	0.0333	1.2
Micromesistius poutassou	0.0361	1.1	Centroscymnus crepidater	0.0263	0.9
Coelorinchus coelorhincus	0.0351	1.1	Raja (Dipturus) nidarosiensis	0.0258	0.9
Glyptocephalus cynoglossus	0.0330	1.0	Nezumia aequalis	0.0229	0.8
Helicolenus d. dactylopterus	0.0310	1.0	Mora moro	0.0223	0.8
Centroscymnus coelolepis	0.0299	0.9	Lophius piscatorius	0.0207	0.7
Phycis blennoides	0.0289	0.9	Epigonus telescopus	0.0163	0.6
Synaphobranchus kaupi	0.0248	0.8	Chimaera spp	0.0161	0.6
Centrophorus squamosus	0.0217	0.7	Glyptocephalus cynoglossus	0.0115	0.4
Etmopterus spinax	0.0186	0.6	Merluccius merluccius	0.0110	0.4
Centroscymnus crepidater	0.0186	0.6	Coelorinchus coelorhincus	0.0094	0.3
Chimaera spp	0.0145	0.5	Micromesistius poutassou	0.0061	0.2
Mora moro	0.0145	0.5	Etmopterus spinax	0.0058	0.2
Xenordermichthys copei	0.0072	0.2	Helicolenus d. dactylopterus	0.0056	0.2
Galeus melastomus	0.0052	0.2	Galeus melastomus	0.0039	0.1
Notacanthus bonapartei	0.0052	0.2	Halargyreus johnsonii	0.0035	0.1
Merluccius merluccius	0.0041	0.1	Sebastes mentella	0.0034	0.1
Dalatias licha	0.0041	0.1	Lepidorhombus whiffiagonis	0.0017	0.1
Lepidorhombus whiffiagonis	0.0041	0.1	Gadiculus argenteus thori	0.0010	0.0
Notolepis rissoi	0.0031	0.1	Argentina silus	0.0009	0.0
Argentina silus	0.0031	0.1	Etmopterus princeps	0.0008	0.0
Lophius piscatorius	0.0031	0.1	Notacanthus bonapartei	0.0006	0.0
Etmopterus princeps	0.0031	0.1	Nesiarchus nasutus	0.0005	0.0
Sebastes mentella	0.0021	0.1	Conger conger	0.0004	0.0
Gaidropsarus macrophthalmus	0.0021	0.1	Gaidropsarus macrophthalmus	0.0001	0.0
Lepidorhombus boscii	0.0021	0.1	Synaphobranchus kaupi	0.0001	0.0
Nesiarchus nasutus	0.0021	0.1	Lepidorhombus boscii	0.0001	0.0
Conger conger	0.0010	0.0	Xenordermichthys copei	0.0001	0.0
Notacanthus chemnitzii	0.0010	0.0	Notolepis rissoi	0.0000	0.0
Paraliparis hystrix	0.0010	0.0	Notacanthus chemnitzii	0.0000	0.0
Raja (Dipturus) nidarosiensis	0.0010	0.0	Paraliparis hystrix	0.0000	0.0
Total	3.1750		Total	2.7924	

Gear: GT(L) Granton trawl with long bridles paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Coryphaenoides rupestris	2.3404	23.9	Coryphaenoides rupestris	2.3029	29.0
Lepidion eques	1.0841	11.1	Deania calceus	1.9209	24.2
Epigonus telescopus	0.8797	9.0	Aphanopus carbo	0.7876	9.9
Halargyreus johnsonii	0.8528	8.7	Chimaera monstrosa	0.5499	6.9
Nezumia aequalis	0.7532	7.7	Centroscymnus crepidater	0.4604	5.8
Alepocephalus bairdii	0.5569	5.7	Molva d. dypterygia	0.2585	3.3
Chimaera monstrosa	0.5434	5.5	Centrophorus squamosus	0.2260	2.8
Deania calceus	0.5326	5.4	Brosme brosme	0.1655	2.1
Aphanopus carbo	0.5084	5.2	Centroscymnus coelolepis	0.1586	2.0
Helicolenus d. dactylopterus	0.2475	2.5	Raja (Dipturus) nidarosiensis	0.1345	1.7
Hydrolagus mirabilis	0.1856	1.9	Lepidion eques	0.1320	1.7
Glyptocephalus cynoglossus	0.1802	1.8	Epigonus telescopus	0.1312	1.6
Centroscymnus crepidater	0.1802	1.8	Phycis blennoides	0.1251	1.6
Micromesistius poutassou	0.1318	1.3	Hydrolagus mirabilis	0.1008	1.3
Phycis blennoides	0.1049	1.1	Helicolenus d. dactylopterus	0.0916	1.2
Coelorinchus coelorhincus	0.1049	1.1	Dalatias licha	0.0646	0.8
Molva d. dypterygia	0.0915	0.9	Glyptocephalus cynoglossus	0.0498	0.6
Xenordermichthys copei	0.0834	0.9	Nezumia aequalis	0.0417	0.5
Gadiculus argenteus thori	0.0646	0.7	Halargyreus johnsonii	0.0343	0.4
Synaphobranchus kaupi	0.0619	0.6	Merluccius merluccius	0.0304	0.4
Brosme brosme	0.0457	0.5	Lophius piscatorius	0.0296	0.4
Etmopterus spinax	0.0430	0.4	Alepocephalus bairdii	0.0288	0.4
Notacanthus bonapartei	0.0404	0.4	Coelorinchus coelorhincus	0.0263	0.3
Notacanthus chemnitzii	0.0242	0.2	Mora moro	0.0257	0.3
Lepidorhombus whiffiagonis	0.0215	0.2	Micromesistius poutassou	0.0205	0.3
Argentina silus	0.0215	0.2	Etmopterus spinax	0.0170	0.2
Mora moro	0.0215	0.2	Lepidorhombus whiffiagonis	0.0108	0.1
Dalatias licha	0.0161	0.2	Raja (Leucoraja) circularis	0.0067	0.1
Centroscymnus coelolepis	0.0161	0.2	Argentina silus	0.0062	0.1
Centrophorus squamosus	0.0108	0.1	Scymnodon ringens	0.0056	0.1
Merluccius merluccius	0.0081	0.1	Notacanthus bonapartei	0.0031	0.0
Alepocephalus rostratus	0.0081	0.1	Gaidropsarus macrophthalmus	0.0010	0.0
Scymnodon ringens	0.0054	0.1	Lepidorhombus boscii	0.0009	0.0
Raja (Dipturus) nidarosiensis	0.0054	0.1	Gadiculus argenteus thori	0.0009	0.0
Lophius piscatorius	0.0054	0.1	Nesiarchus nasutus	0.0007	0.0
Lepidorhombus boscii	0.0054	0.1	Xenordermichthys copei	0.0006	0.0
Gaidropsarus macrophthalmus	0.0027	0.0	Notacanthus chemnitzii	0.0005	0.0
Trachyrincus murrayi	0.0027	0.0	Alepocephalus rostratus	0.0003	0.0
Antimora rostrata	0.0027	0.0	Synaphobranchus kaupi	0.0002	0.0
Raja (Leucoraja) circularis	0.0027	0.0	Paraliparis hystrix	0.0000	0.0
Paraliparis hystrix	0.0027	0.0	Trachyrincus murrayi	0.0000	0.0
Nesiarchus nasutus	0.0027	0.0	Antimora rostrata	0.0000	0.0
Total	9.8028		Total	7.9520	

Gear: OTSB(P) OTSB paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Coryphaenoides rupestris	3.3800	35.6	Coryphaenoides rupestris	2.5075	55.9
Nezumia aequalis	2.3441	24.7	Molva d. dypterygia	0.4013	8.9
Lepidion eques	1.3006	13.7	Aphanopus carbo	0.3692	8.2
Synaphobranchus kaupi	0.5974	6.3	Chimaera monstrosa	0.2525	5.6
Hydrolagus mirabilis	0.3025	3.2	Deania calceus	0.1875	4.2
Aphanopus carbo	0.2647	2.8	Hydrolagus mirabilis	0.1733	3.9
Chimaera monstrosa	0.2571	2.7	Lepidion eques	0.1528	3.4
Halargyreus johnsonii	0.1361	1.4	Nezumia aequalis	0.1109	2.5
Alepocephalus bairdii	0.1285	1.4	Phycis blennoides	0.0894	2.0
Mora moro	0.1059	1.1	Mora moro	0.0745	1.7
Molva d. dypterygia	0.0983	1.0	Alepocephalus bairdii	0.0467	1.0
Coelorinchus labiatus	0.0907	1.0	Raja (Leucoraja) circularis	0.0378	0.8
Phycis blennoides	0.0832	0.9	Lophius piscatorius	0.0378	0.8
Notacanthus chemnitzii	0.0756	0.8	Glyptocephalus cynoglossus	0.0152	0.3
Deania calceus	0.0605	0.6	Coelorinchus coelorhincus	0.0073	0.2
Glyptocephalus cynoglossus	0.0529	0.6	Helicolenus d. dactylopterus	0.0042	0.1
Epigonus telescopus	0.0529	0.6	Halargyreus johnsonii	0.0039	0.1
Coelorinchus coelorhincus	0.0454	0.5	Micromesistius poutassou	0.0038	0.1
Helicolenus d. dactylopterus	0.0302	0.3	Raja (Rajella) fyllae	0.0035	0.1
Notacanthus bonapartei	0.0151	0.2	Synaphobranchus kaupi	0.0029	0.1
Trachyrincus murrayi	0.0076	0.1	Epigonus telescopus	0.0028	0.1
Xenordermichthys copei	0.0076	0.1	Notacanthus chemnitzii	0.0010	0.0
Raja (Leucoraja) circularis	0.0076	0.1	Lepidorhombus whiffiagonis	0.0008	0.0
Raja (Rajella) fyllae	0.0076	0.1	Hoplostethus mediterraneus	0.0002	0.0
Paraliparis hystrix	0.0076	0.1	Xenordermichthys copei	0.0002	0.0
Hoplostethus mediterraneus	0.0076	0.1	Notacanthus bonapartei	0.0002	0.0
Gaidropsarus macrophthalmus	0.0076	0.1	Coelorinchus labiatus	0.0001	0.0
Lophius piscatorius	0.0076	0.1	Gaidropsarus macrophthalmus	0.0001	0.0
Micromesistius poutassou	0.0076	0.1	Paraliparis ystrix	0.0001	0.0
Lepidorhombus whiffiagonis	0.0076	0.1	Trachyrincus Murrayi	0.0000	0.0
Total	9.4973		Total	4.4875	

Gear: OTSB(S) OTSB single warp

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Synaphobranchus kaupi	10.6756	49.0	Coryphaenoides rupestris	1.6006	42.4
Nezumia aequalis	3.2281	14.8	Lophius piscatorius	0.4373	11.6
Coryphaenoides rupestris	2.5796	11.8	Molva d. dypterygia	0.3070	8.1
Lepidion eques	2.2977	10.5	Chimaera monstrosa	0.3035	8.0
Epigonus telescopus	0.5498	2.5	Centrophorus squamosus	0.2067	5.5
Notacanthus bonapartei	0.4887	2.2	Lepidion eques	0.2009	5.3
Chimaera monstrosa	0.3947	1.8	Mora moro	0.1320	3.5
Mora moro	0.2725	1.3	Nezumia aequalis	0.1291	3.4
Halargyreus johnsonii	0.2631	1.2	Phycis blennoides	0.0933	2.5
Hydrolagus mirabilis	0.1880	0.9	Synaphobranchus kaupi	0.0764	2.0
Coelorinchus coelorhincus	0.1222	0.6	Hydrolagus mirabilis	0.0760	2.0
Phycis blennoides	0.1128	0.5	Aphanopus carbo	0.0689	1.8

Molva d. dypterygia	0.1034	0.5	Alepocephalus bairdii	0.0421	1.1
Gaidropsarus macrophthalmus	0.0893	0.4	Glyptocephalus cynoglossus	0.0249	0.7
Coelorinchus labiatus	0.0705	0.3	Coelorinchus coelorhincus	0.0203	0.5
Lophius piscatorius	0.0705	0.3	Epigonus telescopus	0.0192	0.5
Glyptocephalus cynoglossus	0.0658	0.3	Deania calceus	0.0087	0.2
Alepocephalus bairdii	0.0611	0.3	Notacanthus bonapartei	0.0085	0.2
Aphanopus carbo	0.0517	0.2	Lepidorhombus boscii	0.0066	0.2
Lepidorhombus boscii	0.0188	0.1	Scymnodon ringens	0.0047	0.1
Polyacanthonotus rissoanus	0.0188	0.1	Dalatias licha	0.0042	0.1
Helicolenus d. dactylopterus	0.0188	0.1	Halargyreus johnsonii	0.0030	0.1
Centrophorus squamosus	0.0141	0.1	Helicolenus d. dactylopterus	0.0020	0.1
Scymnodon ringens	0.0094	0.0	Gaidropsarus macrophthalmus	0.0010	0.0
Gadiculus argenteus thori	0.0094	0.0	Coelorinchus labiatus	0.0006	0.0
Xenordermichthys copei	0.0047	0.0	Polyacanthonotus rissoanus	0.0002	0.0
Deania calceus	0.0047	0.0	Gadiculus argenteus thori	0.0001	0.0
Dalatias licha	0.0047	0.0	Xenordermichthys copei	0.0000	0.0
Paraliparis hystrix	0.0047	0.0	Paraliparis hystrix	0.0000	0.0
Total	21.7929		Total	3.7779	

ROCKALL 1000 m Zone

Gear: GT(S) Granton trawl short bridles paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Coryphaenoides rupestris	1.8878	54.3	Coryphaenoides rupestris	1.0568	54.6
Lepidion eques	0.3505	10.1	Centroscymnus coelolepis	0.1560	8.1
Nezumia aequalis	0.2210	6.4	Alepocephalus bairdii	0.1379	7.1
Halargyreus johnsonii	0.1733	5.0	Centroscymnus crepidater	0.1103	5.7
Trachyrincus murrayi	0.1703	4.9	Chimaera monstrosa	0.1066	5.5
Alepocephalus bairdii	0.1423	4.1	Centrophorus squamosus	0.0931	4.8
Hydrolagus mirabilis	0.0878	2.5	Lepidion eques	0.0501	2.6
Chimaera monstrosa	0.0810	2.3	Deania calceus	0.0349	1.8
Xenordermichthys copei	0.0765	2.2	Aphanopus carbo	0.0302	1.6
Centroscymnus crepidater	0.0469	1.4	Hydrolagus mirabilis	0.0220	1.1
Notacanthus bonapartei	0.0333	1.0	Molva d. dypterygia	0.0218	1.1
Aphanopus carbo	0.0250	0.7	Mora moro	0.0188	1.0
Synaphobranchus kaupi	0.0227	0.7	Trachyrincus murrayi	0.0175	0.9
Centroscymnus coelolepis	0.0212	0.6	Apristurus sp	0.0130	0.7
Apristurus sp	0.0204	0.6	Halargyreus johnsonii	0.0124	0.6
Coelorinchus labiatus	0.0159	0.5	Nezumia aequalis	0.0124	0.6
Deania calceus	0.0144	0.4	Brosme brosme	0.0098	0.5
Mora moro	0.0121	0.3	Lophius piscatorius	0.0058	0.3
Hoplostethus atlanticus	0.0068	0.2	Notacanthus bonapartei	0.0054	0.3
Coryphaenoides guentheri	0.0068	0.2	Chimaera spp	0.0031	0.2
Centrophorus squamosus	0.0053	0.2	Hoplostethus atlanticus	0.0030	0.2
Molva d. dypterygia	0.0053	0.2	Raja (Dipturus) nidarosiensis	0.0025	0.1
Melanonus zugmayeri	0.0038	0.1	Phycis blennoides	0.0025	0.1
Chimaera spp	0.0038	0.1	Alepocephalus rostratus	0.0019	0.1
Paraliparis hystrix	0.0038	0.1	Xenordermichthys copei	0.0013	0.1
Polyacanthonotus rissoanus	0.0038	0.1	Etmopterus princeps	0.0011	0.1
Alepocephalus rostratus	0.0030	0.1	Coelorinchus labiatus	0.0010	0.1
Cottunculus thomsoni	0.0030	0.1	Epigonus telescopus	0.0009	0.0
Brosme brosme	0.0030	0.1	Lepidorhombus whiffiagonis	0.0008	0.0
Raja (Rajella) fyllae	0.0030	0.1	Raja (Rajella) fyllae	0.0003	0.0
Antimora rostrata	0.0023	0.1	Synaphobranchus kaupi	0.0003	0.0
Micromesistius poutassou	0.0023	0.1	Lycodes atlanticus	0.0002	0.0
Etmopterus princeps	0.0023	0.1	Cottunculus thomsoni	0.0002	0.0
Lepidorhombus whiffiagonis	0.0023	0.1	Coryphaenoides guentheri	0.0002	0.0
Phycis blennoides	0.0015	0.0	Micromesistius poutassou	0.0001	0.0
Glyptocephalus cynoglossus	0.0015	0.0	Glyptocephalus cynoglossus	0.0001	0.0
Lophius piscatorius	0.0015	0.0	Polyacanthonotus rissoanus	0.0001	0.0
Epigonus telescopus	0.0015	0.0	Lepidorhombus boscii	0.0001	0.0
Scopelosaurus lepidus	0.0008	0.0	Paraliparis hystrix	0.0000	0.0
Raja (Dipturus) nidarosiensis	0.0008	0.0	Antimora rostrata	0.0000	0.0
Galeus murinus	0.0008	0.0	Gaidropsarus macrophthalmus	0.0000	0.0
Gaidropsarus acrophthalmus	0.0008	0.0	Galeus murinus	0.0000	0.0
Lycodes atlanticus	0.0008	0.0	Scopelosaurus lepidus	0.0000	0.0
Melanostigma atlanticum	0.0008	0.0	Melanonus zugmayeri	0.0000	0.0
Total	3.4744		Total	1.9344	

Gear: GT(L) Granton trawl with long bridles paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Coryphaenoides rupestris	4.4172	39.7	Alepocephalus bairdii	7.4923	56.5
Alepocephalus bairdii	3.7416	33.6	Coryphaenoides rupestris	2.9895	22.5
Lepidion eques	0.7424	6.7	Centroscymnus coelolepis	1.2945	9.8
Nezumia aequalis	0.6347	5.7	Chimaera monstrosa	0.4587	3.5
Halargyreus johnsonii	0.3267	2.9	Deania calceus	0.2401	1.8
Centroscymnus coelolepis	0.1967	1.8	Mora moro	0.1408	1.1
Chimaera monstrosa	0.1930	1.7	Lepidion eques	0.1322	1.0
Hydrolagus mirabilis	0.1670	1.5	Centrophorus squamosus	0.0839	0.6
Trachyrincus murrayi	0.1188	1.1	Molva d. dypterygia	0.0723	0.5
Deania calceus	0.1002	0.9	Centroscymnus crepidater	0.0604	0.5
Mora moro	0.0742	0.7	Hydrolagus mirabilis	0.0509	0.4
Centroscymnus crepidater	0.0483	0.4	Lophius piscatorius	0.0445	0.3
Synaphobranchus kaupi	0.0483	0.4	Aphanopus carbo	0.0440	0.3
Hoplostethus atlanticus	0.0408	0.4	Nezumia aequalis	0.0401	0.3
Helicolenus d. dactylopterus	0.0408	0.4	Halargyreus johnsonii	0.0307	0.2
Coelorinchus labiatus	0.0408	0.4	Etmopterus princeps	0.0247	0.2
Aphanopus carbo	0.0371	0.3	Hoplostethus atlanticus	0.0188	0.1
Apristurus sp	0.0297	0.3	Helicolenus d. dactylopterus	0.0123	0.1
Etmopterus princeps	0.0223	0.2	Brosme brosme	0.0077	0.1
Molva d. dypterygia	0.0186	0.2	Apristurus sp	0.0069	0.1
Notacanthus chemnitzii	0.0148	0.1	Trachyrincus murrayi	0.0058	0.0
Notacanthus bonapartei	0.0148	0.1	Raja (Dipturus) nidarosiensis	0.0049	0.0
Micromesistius poutassou	0.0111	0.1	Micromesistius poutassou	0.0026	0.0
Antimora rostrata	0.0074	0.1	Coelorinchus labiatus	0.0017	0.0
Centrophorus squamosus	0.0074	0.1	Notacanthus bonapartei	0.0014	0.0
Lophius piscatorius	0.0074	0.1	Synaphobranchus kaupi	0.0003	0.0
Gaidropsarus macrophthalmus	0.0037	0.0	Notacanthus chemnitzii	0.0003	0.0
Raja (Dipturus) nidarosiensis	0.0037	0.0	Galeus murinus	0.0002	0.0
Xenordermichthys copei	0.0037	0.0	Polyacanthonotus rissoanus	0.0001	0.0
Galeus murinus	0.0037	0.0	Gaidropsarus macrophthalmus	0.0001	0.0
Epigonus telescopus	0.0037	0.0	Epigonus telescopus	0.0001	0.0
Brosme brosme	0.0037	0.0	Xenordermichthys copei	0.0000	0.0
Raja (Rajella) fyllae	0.0037	0.0	Antimora ostrata	0.0000	0.0
Polyacanthonotus rissoanus	0.0037	0.0	Raja (Rajella) fyllae	0.0000	0.0
Total	11.1321		Total	13.2632	

Gear: OTSB(P) OTSB paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Coryphaenoides rupestris	4.0499	57.0	Coryphaenoides rupestris	2.3126	48.5
Lepidion eques	0.5905	8.3	Alepocephalus bairdii	0.6344	13.3
Nezumia aequalis	0.4920	6.9	Aphanopus carbo	0.5788	12.1
Aphanopus carbo	0.4315	6.1	Chimaera monstrosa	0.2709	5.7
Hydrolagus mirabilis	0.3104	4.4	Molva d. dypterygia	0.2531	5.3
Alepocephalus bairdii	0.3028	4.3	Centroscymnus coelolepis	0.2372	5.0
Chimaera monstrosa	0.2347	3.3	Raja (Dipturus) nidarosiensis	0.1211	2.5
Synaphobranchus kaupi	0.1287	1.8	Lepidion eques	0.0929	1.9
Trachyrincus murrayi	0.1211	1.7	Hydrolagus mirabilis	0.0897	1.9

Halargyreus johnsonii	0.0908	1.3	Deania calceus	0.0597	1.3
Notacanthus bonapartei	0.0908	1.3	Mora moro	0.0339	0.7
Molva d. dypterygia	0.0454	0.6	Nezumia aequalis	0.0315	0.7
Apristurus sp	0.0454	0.6	Apristurus sp	0.0205	0.4
Centroscymnus coelolepis	0.0378	0.5	Notacanthus bonapartei	0.0120	0.3
Deania calceus	0.0227	0.3	Trachyrincus murrayi	0.0119	0.2
Mora moro	0.0151	0.2	Halargyreus johnsonii	0.0068	0.1
Raja (Rajella) fyllae	0.0151	0.2	Helicolenus d. dactylopterus	0.0023	0.0
Raja (Dipturus) nidarosiensis	0.0076	0.1	Synaphobranchus kaupi	0.0010	0.0
Cottunculus thomsoni	0.0076	0.1	Raja (Rajella) fyllae	0.0003	0.0
Gaidropsarus macrophthalmus	0.0076	0.1	Xenordermichthys copei	0.0002	0.0
Xenordermichthys copei	0.0076	0.1	Lepidorhombus boscii	0.0002	0.0
Anoplogaster cornuta	0.0076	0.1	Coryphaenoides guentheri	0.0001	0.0
Helicolenus d. dactylopterus	0.0076	0.1	Gaidropsarus macrophthalmus	0.0001	0.0
Melanostigma atlanticum	0.0076	0.1	Cottunculus thomsoni	0.0000	0.0
Chimaera spp	0.0076	0.1	Melanostigma atlanticum	0.0000	0.0
Lepidorhombus boscii	0.0076	0.1	Anoplogaster cornuta	0.0000	0.0
Coryphaenoides guentheri	0.0076	0.1	Chimaera spp	0.0000	0.0
Total	7.1006		Total	4.7712	

Gear: OTSB(S) OTSB single warp

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Synaphobranchus kaupi	9.3583	40.6	Coryphaenoides rupestris	0.8245	29.9
Coryphaenoides rupestris	4.9648	21.5	Alepocephalus bairdii	0.4906	17.8
Nezumia aequalis	2.9853	12.9	Molva d. dypterygia	0.4386	15.9
Lepidion eques	1.9714	8.5	Lepidion eques	0.3426	12.4
Chimaera monstrosa	1.1587	5.0	Nezumia aequalis	0.1461	5.3
Alepocephalus bairdii	0.7564	3.3	Mora moro	0.1293	4.7
Coelorinchus labiatus	0.5391	2.3	Aphanopus carbo	0.0809	2.9
Notacanthus bonapartei	0.3138	1.4	Synaphobranchus kaupi	0.0712	2.6
Macrourid spp	0.2092	0.9	Chimaera monstrosa	0.0686	2.5
Epigonus telescopus	0.1127	0.5	Raja (Dipturus) nidarosiensis	0.0563	2.0
Halargyreus johnsonii	0.0805	0.3	Notacanthus bonapartei	0.0293	1.1
Molva d. dypterygia	0.0805	0.3	Brosme brosme	0.0241	0.9
Mora moro	0.0724	0.3	Hydrolagus hirabilis	0.0240	0.9
Hydrolagus mirabilis	0.0644	0.3	Apristurus sp	0.0057	0.2
Aphanopus carbo	0.0644	0.3	Epigonus telescopus	0.0050	0.2
Paraliparis hystrix	0.0483	0.2	Centroscymnus crepidater	0.0049	0.2
Raja (Rajella) fyllae	0.0402	0.2	Halargyreus johnsonii	0.0045	0.2
Melanostigma atlanticum	0.0402	0.2	Coelorinchus labiatus	0.0042	0.2
Polyacanthonotus rissoanus	0.0322	0.1	Micromesistius poutassou	0.0015	0.1
Apristurus sp	0.0322	0.1	Raja (Rajella) fyllae	0.0013	0.0
Xenordermichthys copei	0.0241	0.1	Polyacanthonotus rissoanus	0.0008	0.0
Galeus murinus	0.0161	0.1	Helicolenus d. dactylopterus	0.0007	0.0
Centroscymnus crepidater	0.0161	0.1	Macrourid spp	0.0006	0.0
Gaidropsarus macrophthalmus	0.0161	0.1	Coryphaenoides guentheri	0.0003	0.0
Zoarcidae	0.0080	0.0	Xenordermichthys copei	0.0002	0.0
Raja (Dipturus) nidarosiensis	0.0080	0.0	Gaidropsarus macrophthalmus	0.0002	0.0
Coryphaenoides guentheri	0.0080	0.0	Paraliparis hystrix	0.0002	0.0
Cottunculus thomsoni	0.0080	0.0	Melanostigma atlanticum	0.0002	0.0
Helicolenus d. dactylopterus	0.0080	0.0	Galeus murinus	0.0002	0.0
Alepocephalus sp	0.0080	0.0	Cottunculus thomsoni	0.0001	0.0

Micromesistius poutassou	0.0080	0.0	Alepocephalus sp	0.0000	0.0
Brosme brosme	0.0080	0.0	Zoarcidae	0.0000	0.0
Total	23.0619		Total	2.7568	

ROCKALL 1250 m Zone

Gear: GT(L) Granton trawl with long bridles paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Aphanopus carbo	0.0418	1.0	Aphanopus carbo	0.0598	2.8
Alepocephalus bairdii	0.7936	19.0	Alepocephalus bairdii	0.7521	35.8
Apristurus sp	0.0656	1.6	Apristurus sp	0.0353	1.7
Antimora rostrata	0.0060	0.1	Antimora rostrata	0.0000	0.0
Centroscymnus coelolepis	0.0358	0.9	Centroscymnus coelolepis	0.2064	9.8
Centroscymnus crepidater	0.0060	0.1	Centroscymnus crepidater	0.0041	0.2
Coryphaenoides guentheri	0.0537	1.3	Coryphaenoides guentheri	0.0010	0.0
Coryphaenoides mediterranea	0.0060	0.1	Coryphaenoides mediterranea	0.0003	0.0
Chimaera monstrosa	0.0656	1.6	Chimaera monstrosa	0.0284	1.4
Coelorinchus labiatus	0.1014	2.4	Coelorinchus labiatus	0.0073	0.3
Coryphaenoides rupestris	1.7243	41.2	Coryphaenoides rupestris	0.8794	41.8
Halargyreus johnsonii	0.0298	0.7	Halargyreus johnsonii	0.0049	0.2
Hydrolagus mirabilis	0.0060	0.1	Hydrolagus mirabilis	0.0001	0.0
Lepidion eques	0.0418	1.0	Lepidion eques	0.0089	0.4
Notacanthus bonapartei	0.0776	1.9	Notacanthus bonapartei	0.0049	0.2
Polyacanthonotus rissoanus	0.0239	0.6	Polyacanthonotus rissoanus	0.0013	0.1
Synaphobranchus kaupi	0.1253	3.0	Synaphobranchus kaupi	0.0012	0.1
Scopelosaurus lepidus	0.0179	0.4	Scopelosaurus lepidus	0.0002	0.0
Trachyrincus murrayi	0.9606	23.0	Trachyrincus murrayi	0.1068	5.1
Total	4.1826	100.0	Total	2.1024	

Gear: GT(L) Granton trawl with long bridles paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Coryphaenoides rupestris	4.2502	41.9	Alepocephalus bairdii	3.4681	54.5
Alepocephalus bairdii	2.7316	26.9	Coryphaenoides rupestris	1.7718	27.9
Trachyrincus murrayi	1.3754	13.5	Centroscymnus coelolepis	0.3923	6.2
Coelorinchus labiatus	0.3677	3.6	Trachyrincus murrayi	0.1602	2.5
Chimaera monstrosa	0.1671	1.6	Chimaera monstrosa	0.1142	1.8
Hoplostethus atlanticus	0.1576	1.6	Aphanopus carbo	0.0980	1.5
Coryphaenoides guentheri	0.1480	1.5	Hoplostethus atlanticus	0.0663	1.0
Synaphobranchus kaupi	0.1289	1.3	Centroscymnus crepidater	0.0575	0.9
Hydrolagus mirabilis	0.1003	1.0	Centroscyllium fabricii	0.0518	0.8
Halargyreus johnsonii	0.0860	0.8	Hariotta raleighana	0.0469	0.7
Apristurus sp	0.0812	0.8	Coelorinchus labiatus	0.0306	0.5
Polyacanthonotus rissoanus	0.0716	0.7	Etmopterus princeps	0.0291	0.5
Coryphaenoides mediterranea	0.0669	0.7	Apristurus sp	0.0245	0.4
Aphanopus carbo	0.0573	0.6	Halargyreus johnsonii	0.0196	0.3
Lepidion eques	0.0573	0.6	Lepidion eques	0.0098	0.2
Centroscymnus coelolepis	0.0525	0.5	Synaphobranchus kaupi	0.0075	0.1
Notacanthus bonapartei	0.0525	0.5	Hydrolagus mirabilis	0.0072	0.1
Centroscyllium fabricii	0.0430	0.4	Notacanthus bonapartei	0.0071	0.1
Hariotta raleighana	0.0382	0.4	Coryphaenoides mediterranea	0.0070	0.1
Centroscymnus crepidater	0.0382	0.4	Coryphaenoides guentheri	0.0029	0.0
Antimora rostrata	0.0191	0.2	Alepocephalus rostratus	0.0028	0.0
Etmopterus princeps	0.0191	0.2	Glyptocephalus cynoglossus	0.0022	0.0
Alepocephalus rostratus	0.0143	0.1	Polyacanthonotus rissoanus	0.0019	0.0
Xenordermichthys copei	0.0096	0.1	Cottunculus thomsoni	0.0004	0.0

Raja (Rajella) fyllae	0.0048	0.0	Xenordermichthys copei	0.0002	0.0
Cottunculus thomsoni	0.0048	0.0	Raja (Rajella) fyllae	0.0002	0.0
Glyptocephalus cynoglossus	0.0048	0.0	Antimora rostrata	0.0001	0.0
Notacanthus chemnitzii	0.0048	0.0	Notacanthus chemnitzii	0.0000	0.0
Total	10.1528		Total	6.3801	

Gear: OTSB(P) OTSB paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Coryphaenoides rupestris	8.2939	34.6	Alepocephalus bairdii	10.0946	57.7
Alepocephalus bairdii	6.7095	28.0	Coryphaenoides rupestris	3.6520	20.9
Trachyrincus murrayi	3.0226	12.6	Chimaera monstrosa	1.2761	7.3
Coelorinchus labiatus	1.7368	7.3	Centroscymnus coelolepis	0.4698	2.7
Synaphobranchus kaupi	0.9202	3.8	Aphanopus carbo	0.3254	1.9
Chimaera monstrosa	0.7191	3.0	Trachyrincus murrayi	0.3221	1.8
Apristurus sp	0.5180	2.2	Molva d. dypterygia	0.2515	1.4
Coryphaenoides guentheri	0.3352	1.4	Hoplostethus atlanticus	0.2493	1.4
Hoplostethus atlanticus	0.2803	1.2	Apristurus sp	0.1820	1.0
Aphanopus carbo	0.2194	0.9	Rhinochimaera atlantica	0.1463	0.8
Hydrolagus mirabilis	0.1645	0.7	Centroscyllium fabricii	0.1256	0.7
Halargyreus johnsonii	0.1402	0.6	Coelorinchus labiatus	0.0926	0.5
Notacanthus bonapartei	0.1097	0.5	Hariotta raleighana	0.0911	0.5
Lepidion eques	0.1097	0.5	Alepocephalus rostratus	0.0544	0.3
Alepocephalus rostratus	0.0975	0.4	Synaphobranchus kaupi	0.0289	0.2
Polyacanthonotus rissoanus	0.0853	0.4	Halargyreus johnsonii	0.0255	0.1
Centroscyllium fabricii	0.0609	0.3	Lepidion eques	0.0224	0.1
Centroscymnus coelolepis	0.0609	0.3	Notacanthus bonapartei	0.0195	0.1
Hariotta raleighana	0.0548	0.2	Deania calceus	0.0145	0.1
Antimora rostrata	0.0427	0.2	Ilyophis blachei	0.0105	0.1
Molva d. dypterygia	0.0427	0.2	Hydrolagus mirabilis	0.0098	0.1
Etmopterus princeps	0.0366	0.2	Etmopterus princeps	0.0092	0.1
Coryphaenoides mediterranea	0.0366	0.2	Raja (Rajella) bathyphila	0.0092	0.1
Rhinochimaera atlantica	0.0305	0.1	Coryphaenoides guentheri	0.0081	0.0
Raja (Rajella) fyllae	0.0305	0.1	Coryphaenoides mediterranea	0.0035	0.0
Ilyophis blachei	0.0244	0.1	Micromesistius poutassou	0.0025	0.0
Nezumia aequalis	0.0183	0.1	Raja (Rajella) fyllae	0.0015	0.0
Bathypterois dubius	0.0122	0.1	Polyacanthonotus rissoanus	0.0013	0.0
Raja (Rajella) bathyphila	0.0061	0.0	Antimora rostrata	0.0011	0.0
Deania calceus	0.0061	0.0	Nezumia aequalis	0.0008	0.0
Galeus murinus	0.0061	0.0	Bathypterois dubius	0.0004	0.0
Micromesistius poutassou	0.0061	0.0	Galeus murinus	0.0003	0.0
Total	23.9371		Total	17.5019	

Gear: OTSB(S) OTSB single warp

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Synaphobranchus kaupi	23.1237	64.5	Coryphaenoides rupestris	1.8539	43.0
Coryphaenoides rupestris	4.5579	12.7	Alepocephalus bairdii	0.7451	17.3
Trachyrincus murrayi	2.6866	7.5	Synaphobranchus kaupi	0.5880	13.7
Coelorinchus labiatus	1.8419	5.1	Trachyrincus murrayi	0.2763	6.4
Coryphaenoides guentheri	0.8916	2.5	Hoplostethus atlanticus	0.1361	3.2
Alepocephalus bairdii	0.6394	1.8	Centroscymnus coelolepis	0.1337	3.1
Lepidion eques	0.5866	1.6	Lepidion eques	0.1123	2.6

Polyacanthonotus rissoanus	0.4810	1.3		Raja (Dipturus) nidarosiensis	0.1056	2.5
Hoplostethus atlanticus	0.1701	0.5		Molva d. dypterygia	0.0863	2.0
Hydrolagus mirabilis	0.1408	0.4		Coelorinchus labiatus	0.0831	1.9
Coryphaenoides mediterranea	0.1056	0.3		Aphanopus carbo	0.0351	0.8
Nezumia aequalis	0.0821	0.2		Centroscyllium fabricii	0.0193	0.4
Antimora rostrata	0.0587	0.2		Cottunculus thomsoni	0.0183	0.4
Notacanthus bonapartei	0.0469	0.1		Apristurus sp	0.0144	0.3
Halargyreus johnsonii	0.0411	0.1		Etmopterus princeps	0.0130	0.3
Melanostigma atlanticum	0.0352	0.1		Chimaera monstrosa	0.0113	0.3
Cottunculus thomsoni	0.0352	0.1		Halargyreus johnsonii	0.0090	0.2
Apristurus sp	0.0352	0.1		Hydrolagus mirabilis	0.0088	0.2
Chimaera monstrosa	0.0352	0.1		Coryphaenoides guentheri	0.0083	0.2
Alepocephalus rostratus	0.0293	0.1		Polyacanthonotus rissoanus	0.0073	0.2
Xenordermichthys copei	0.0235	0.1		Notacanthus chemnitzii	0.0065	0.2
Chimaera spp	0.0235	0.1		Coryphaenoides mediterranea	0.0063	0.1
Raja (Rajella) fyllae	0.0235	0.1		Notacanthus bonapartei	0.0055	0.1
Breviraja caerulea	0.0176	0.0		Nezumia aequalis	0.0050	0.1
Aphanopus carbo	0.0176	0.0		Alepocephalus rostratus	0.0045	0.1
Centroscymnus coelolepis	0.0176	0.0		Ilyophis blachei	0.0045	0.1
Rhinochimaera atlantica	0.0117	0.0		Raja (Rajella) fyllae	0.0036	0.1
Centroscyllium fabricii	0.0117	0.0		Breviraja caerulea	0.0024	0.1
Molva d. dypterygia	0.0117	0.0		Glyptocephalus cynoglossus	0.0008	0.0
Ilyophis blachei	0.0117	0.0		Centroscymnus crepidater	0.0006	0.0
Bathypterois dubius	0.0117	0.0		Xenordermichthys copei	0.0004	0.0
Paraliparis hystrix	0.0059	0.0		Bathypterois dubius	0.0004	0.0
Raja (Dipturus) nidarosiensis	0.0059	0.0		Galeus murinus	0.0003	0.0
Glyptocephalus cynoglossus	0.0059	0.0		Antimora rostrata	0.0003	0.0
Gaidropsarus macrophthalmus	0.0059	0.0		Halosaurus johnsonianus	0.0002	0.0
Centroscymnus crepidater	0.0059	0.0		Gaidropsarus macrophthalmus	0.0001	0.0
Etmopterus princeps	0.0059	0.0		Chimaera spp	0.0001	0.0
Notacanthus chemnitzii	0.0059	0.0		Melanostigma atlanticum	0.0001	0.0
Paraliparis sp	0.0059	0.0		Paraliparis hystrix	0.0000	0.0
Galeus murinus	0.0059	0.0		Rhinochimaera atlantica	0.0000	0.0
Halosaurus johnsonianus	0.0059	0.0		Paraliparis sp	0.0000	0.0
Total	35.8646			Total	4.3068	

ROCKALL 1500 m Zone

Gear: OTSB(P) OTSB paired warps

Species	No/1000	No (%)	Species	Kg/1000	Kg (%)
Coryphaenoides rupestris	7.0621	47.6	Coryphaenoides rupestris	2.9824	45.7
Alepocephalus bairdii	1.8755	12.6	Alepocephalus bairdii	2.4350	37.3
Synaphobranchus kaupi	1.3623	9.2	Trachyrincus murrayi	0.2430	3.7
Trachyrincus murrayi	1.2890	8.7	Centroscymnus coelolepis	0.2260	3.5
Coelorinchus labiatus	1.2829	8.6	Coelorinchus labiatus	0.1106	1.7
Coryphaenoides guentheri	0.7453	5.0	Synaphobranchus kaupi	0.0992	1.5
Polyacanthonotus rissoanus	0.2932	2.0	Hariotta raleighana	0.0864	1.3
Coryphaenoides mediterranea	0.1527	1.0	Coryphaenoides guentheri	0.0627	1.0
Hariotta raleighana	0.1283	0.9	Cataetyx laticeps	0.0579	0.9
Antimora rostrata	0.1100	0.7	Antimora rostrata	0.0271	0.4
Apristurus sp	0.0733	0.5	Apristurus sp	0.0239	0.4
Alepocephalus sp	0.0672	0.5	Coryphaenoides mediterranea	0.0238	0.4
Etmopterus princeps	0.0367	0.2	Alepocephalus sp	0.0214	0.3
Bathypterois dubius	0.0367	0.2	Chimaera monstrosa	0.0211	0.3
Centroscyllium fabricii	0.0367	0.2	Etmopterus princeps	0.0170	0.3
Lepidion eques	0.0367	0.2	Apristurus microps	0.0150	0.2
Chimaera monstrosa	0.0305	0.2	Notacanthus chemnitzii	0.0131	0.2
Centroscymnus coelolepis	0.0305	0.2	Polyacanthonotus rissoanus	0.0126	0.2
Hydrolagus affinis	0.0183	0.1	Centroscyllium fabricii	0.0096	0.1
Cottunculus thomsoni	0.0183	0.1	Hydrolagus mirabilis	0.0081	0.1
Cataetyx laticeps	0.0183	0.1	Alepocephalus agassizii	0.0056	0.1
Hydrolagus mirabilis	0.0183	0.1	Lepidion eques	0.0051	0.1
Nezumia aequalis	0.0122	0.1	Alepocephalus australis	0.0034	0.1
Myxine ios	0.0122	0.1	Alepocephalus rostratus	0.0033	0.1
Alepocephalus rostratus	0.0122	0.1	Alepocephalus productus	0.0029	0.0
Alepocephalus agassizii	0.0122	0.1	Bathypterois dubius	0.0021	0.0
Alepocephalus australis	0.0122	0.1	Cottunculus thomsoni	0.0021	0.0
Nemichthys scolopaceus	0.0061	0.0	Nettastoma melanurum	0.0018	0.0
Nettastoma melanurum	0.0061	0.0	Rouleina attrita	0.0013	0.0
Alepocephalus productus	0.0061	0.0	Cococara macroptera	0.0011	0.0
Rouleina attrita	0.0061	0.0	Nezumia aequalis	0.0010	0.0
Cococara macroptera	0.0061	0.0	Myxine ios	0.0008	0.0
Lycodonus ophidium	0.0061	0.0	Lycodes atlanticus	0.0006	0.0
Lycodes atlanticus	0.0061	0.0	Notacanthus bonapartei	0.0006	0.0
Notacanthus chemnitzii	0.0061	0.0	Nemichthys scolopaceus	0.0003	0.0
Notacanthus bonapartei	0.0061	0.0	Lycodonus ophidium	0.0003	0.0
Apristurus microps	0.0061	0.0	Hydrolagus affinis	0.0000	0.0
Total	14.8450		Total	6.5283	

Gear: OTSB(S) OTSB single warp

Species	No/1000	No (%)	Species	Kg/1000	Kg (%)
Coryphaenoides rupestris	10.9398	41.5	Coryphaenoides rupestris	4.6168	75.7
Synaphobranchus kaupi	9.1428	34.7	Synaphobranchus kaupi	0.5178	8.5
Coryphaenoides guentheri	2.4750	9.4	Trachyrincus murrayi	0.1908	3.1

Coelorinchus labiatus	1.3166	5.0		Alepocephalus bairdii	0.1574	2.6
Trachyrincus murrayi	1.0849	4.1		Coryphaenoides guentheri	0.1369	2.2
Coryphaenoides mediterranea	0.3108	1.2		Cataetyx laticeps	0.1289	2.1
Antimora rostrata	0.2543	1.0		Coelorinchus labiatus	0.1053	1.7
Polyacanthonotus rissoanus	0.2147	0.8		Centroscymnus coelolepis	0.0509	0.8
Alepocephalus bairdii	0.1469	0.6		Etmopterus princeps	0.0403	0.7
Centroscyllium fabricii	0.0735	0.3		Coryphaenoides mediterranea	0.0285	0.5
Etmopterus princeps	0.0678	0.3		Hariotta raleighana	0.0231	0.4
Bathypterois dubius	0.0622	0.2		Antimora rostrata	0.0222	0.4
Cottunculus thomsoni	0.0509	0.2		Molva d. dypterygia	0.0219	0.4
Hariotta raleighana	0.0452	0.2		Centroscyllium fabricii	0.0141	0.2
Cataetyx laticeps	0.0452	0.2		Cottunculus thomsoni	0.0133	0.2
Notacanthus bonapartei	0.0283	0.1		Alepocephalus australis	0.0125	0.2
Alepocephalus australis	0.0283	0.1		Polyacanthonotus rissoanus	0.0090	0.1
Chimaera monstrosa	0.0170	0.1		Chimaera monstrosa	0.0050	0.1
Raja (Rajella) bathyphila	0.0170	0.1		Notacanthus bonapartei	0.0035	0.1
Apristurus sp	0.0113	0.0		Apristurus sp	0.0009	0.0
Normichthys operosus	0.0113	0.0		Cococara macroptera	0.0008	0.0
Xenordermichthys copei	0.0057	0.0		Rouleina attrita	0.0008	0.0
Centroscymnus coelolepis	0.0057	0.0		Bathypterois dubius	0.0007	0.0
Rouleina species	0.0057	0.0		Rouleina species	0.0005	0.0
Molva d. dypterygia	0.0057	0.0		Normichthys operosus	0.0002	0.0
Cococara macroptera	0.0057	0.0		Xenordermichthys copei	0.0001	0.0
Rouleina attrita	0.0057	0.0		Raja (Rajella) bathyphila	0.0000	0.0
Total	26.3775			Total	6.1020	

ROCKALL 1750 m Zone

Gear: OTSB(P) OTSB paired warps

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Synaphobranchus kaupi	1.5823	27.2	Coryphaenoides rupestris	0.7464	47.0
Coryphaenoides rupestris	1.0912	18.8	Alepocephalus bairdii	0.1825	11.5
Coryphaenoides guentheri	0.9548	16.4	Synaphobranchus kaupi	0.1250	7.9
Coryphaenoides mediterranea	0.7093	12.2	Coryphaenoides guentheri	0.1170	7.4
Coelorinchus labiatus	0.5183	8.9	Cataetyx laticeps	0.0922	5.8
Alepocephalus bairdii	0.2455	4.2	Hydrolagus affinis	0.0684	4.3
Antimora rostrata	0.1910	3.3	Coelorinchus labiatus	0.0526	3.3
Polyacanthonotus rissoanus	0.1364	2.3	Coryphaenoides mediterranea	0.0513	3.2
Etmopterus princeps	0.0546	0.9	Cottunculus thomsoni	0.0318	2.0
Bathypterois dubius	0.0546	0.9	Antimora rostrata	0.0284	1.8
Hariotta raleighana	0.0273	0.5	Hariotta raleighana	0.0192	1.2
Notacanthus bonapartei	0.0273	0.5	Spectrunculus grandis	0.0177	1.1
Spectrunculus grandis	0.0273	0.5	Etmopterus princeps	0.0136	0.9
Rouleina attrita	0.0273	0.5	Apristurus sp	0.0123	0.8
Alepocephalus sp	0.0273	0.5	Halosauropsis macrochir	0.0098	0.6
Cataetyx laticeps	0.0273	0.5	Polyacanthonotus rissoanus	0.0088	0.6
Apristurus sp	0.0273	0.5	Bathypterois dubius	0.0033	0.2
Halosauropsis macrochir	0.0273	0.5	Rouleina attrita	0.0029	0.2
Hydrolagus affinis	0.0273	0.5	Alepocephalus sp	0.0027	0.2
Cottunculus thomsoni	0.0273	0.5	Notacanthus bonapartei	0.0023	0.1
Total	5.8108		Total	1.5884	

Gear: OTSB(S) OTSB single warp

Species	No/1000m2	No (%)	Species	kg/1000m2	Kg (%)
Synaphobranchus kaupi	4.5305	45.6	Coryphaenoides rupestris	0.6296	29.9
Coryphaenoides guentheri	1.8956	19.1	Synaphobranchus kaupi	0.3753	17.8
Coryphaenoides rupestris	1.0257	10.3	Antimora rostrata	0.3095	14.7
Coryphaenoides mediterranea	0.6306	6.4	Coryphaenoides guentheri	0.2291	10.9
Antimora rostrata	0.5690	5.7	Hydrolagus pallidus	0.1160	5.5
Coelorinchus labiatus	0.5473	5.5	Coryphaenoides mediterranea	0.0659	3.1
Polyacanthonotus rissoanus	0.2356	2.4	Alepocephalus agassizii	0.0579	2.7
Coryphaenoides brevibarbis	0.1740	1.8	Coelorinchus labiatus	0.0552	2.6
Halosauropsis macrochir	0.0725	0.7	Hydrolagus affinis	0.0549	2.6
Alepocephalus agassizii	0.0362	0.4	Cataetyx laticeps	0.0500	2.4
Etmopterus princeps	0.0217	0.2	Centroscymnus coelolepis	0.0387	1.8
Alepocephalus bairdii	0.0181	0.2	Alepocephalus bairdii	0.0340	1.6
Lycodes sp	0.0145	0.1	Hariotta raleighana	0.0239	1.1
Hariotta raleighana	0.0145	0.1	Halosauropsis macrochir	0.0166	0.8
Hydrolagus pallidus	0.0145	0.1	Polyacanthonotus rissoanus	0.0130	0.6
Spectrunculus grandis	0.0145	0.1	Spectrunculus grandis	0.0098	0.5
Rouleina attrita	0.0145	0.1	Etmopterus princeps	0.0080	0.4
Xenordermichthys copei	0.0145	0.1	Apristurus sp	0.0074	0.3
Hydrolagus affinis	0.0145	0.1	Raja (Rajella) bigelowi	0.0032	0.2
Apristurus sp	0.0145	0.1	Rouleina attrita	0.0021	0.1
Cataetyx laticeps	0.0145	0.1	Raja (Rajella) bathyphila	0.0021	0.1
Notacanthus bonapartei	0.0109	0.1	Bathysaurus ferox	0.0014	0.1
Raja (Rajella) bigelowi	0.0072	0.1	Coryphaenoides brevibarbis	0.0012	0.1

Centroscymnus coelolepis	0.0036	0.0		Notacanthus bonapartei	0.0011	0.1
Anoplogaster cornuta	0.0036	0.0		Lycodes sp	0.0010	0.0
Holtbyrnia anomala	0.0036	0.0		Alepocephalus sp	0.0009	0.0
Alepocephalus sp	0.0036	0.0		Holtbyrnia anomala	0.0002	0.0
Raja (Rajella) bathyphila	0.0036	0.0		Xenordermichthys copei	0.0002	0.0
Bathysaurus ferox	0.0036	0.0		Anoplogaster cornuta	0.0000	0.0
Total	9.9273			Total	2.1082	

ROCKALL 2000 m Zone

Gear: OTSB(S) OTSB single warp

Species	No/1000m2	No (%)		Species	kg/1000m2	Kg (%)
Coryphaenoides guentheri	2.1293	39.7		Antimora rostrata	0.8671	60.9
Synaphobranchus kaupi	1.2635	23.6		Coryphaenoides guentheri	0.2251	15.8
Antimora rostrata	1.0061	18.8		Alepocephalus agassizii	0.1228	8.6
Coryphaenoides mediterranea	0.4212	7.9		Synaphobranchus kaupi	0.0840	5.9
Halosauropsis macrochir	0.1170	2.2		Coryphaenoides mediterranea	0.0465	3.3
Alepocephalus agassizii	0.1170	2.2		Spectrunculus grandis	0.0265	1.9
Coryphaenoides brevibarbis	0.0936	1.7		Halosauropsis macrochir	0.0213	1.5
Polyacanthonotus rissoanus	0.0468	0.9		Conocara murrayi	0.0211	1.5
Spectrunculus grandis	0.0468	0.9		Notacanthus bonapartei	0.0047	0.3
Conocara murrayi	0.0468	0.9		Micromesistius poutassou	0.0021	0.1
Alepocephalus sp	0.0234	0.4		Polyacanthonotus rissoanus	0.0020	0.1
Notacanthus bonapartei	0.0234	0.4		Coryphaenoides brevibarbis	0.0008	0.1
Micromesistius poutassou	0.0234	0.4		Alepocephalus sp	0.0005	0.0
Total	5.3582			Total	1.4247	

APPENDIX 5

Total catch (kg round weight) of all species from Norwegian longline survey of Hatton bank in 1999 (data from Langedal and Hareide working document to ICES SGDEEP 2000).

Species	Total catch	%
Centrophorus squamosus	23079	25.97
Centroscymnus coelolepis	15251	17.16
Centroscymnus crepidater	10878	12.24
Centroscymnus fabricii	7748	8.72
Reinhardtius hippoglossus	6590	7.41
Molva dypterygia	6266	7.05
Deania calceus	5288	5.95
Etmopterus princeps	5924	6.67
Mora moro	2897	3.26
Galeus melastomus	1658	1.87
Brosme brosme	1265	1.42
Hydrolagus affinis	598	0.67
Raja nidrosiensis	285	0.32
Macrourus berglax	254	0.29
Chimaera monstrosa	194	0.22
Raja fullonica	105	0.12
Etmopterus spinax	100	0.11
Hydrolagus mirabilis	77	0.09
Lophius piscatorius	75	0.08
Coelorhynchus occa	63	0.07
Antimora rostrata	63	0.07
Pseudotriakis microdon	60	0.07
Galeus murinus	58	0.07
Lepidion eques	25	0.03
Anarhichas denticulatis	18	0.02
Chalinura sp.	18	0.02
Centrophorus lusitanicus	18	0.02
Bathyraja richardsoni	17	0.02
Raja hyperborea	15	0.02
Raja oxyrhynchus	15	0.02
Raja lintea	15	0.02
Spectrunculus grandis	7	0.0089
Cottunculus microps	3.9	0.0044
Lepidion smithi	2	0.0023
Bathyraja pallida	2	0.0023
Anarhichas lupus	1.5	0.0017
Raja circularis	1	0.0011
Squid sp.	1	0.0011
Raja fyllae	0.7	0.0008
Helicolenus dactylopterus	0.5	0.0006
Synaphobranchus kaupi	0.4	0.0005
Onogadus argentatus	0.1	0.0001

APPENDIX 6

Catch per unit of effort (kg/1000 hooks) by depth zone of all species from Norwegian longline survey of Hatton bank in 1999 (data from Langedal and Hareide working document to ICES SGDEEP 2000).

Depth range (m)	500-600	700-800	800-900	900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1700-1800	1900-2000	Total
Temp. °C	8.0-8.5	7.5-8.0	7.0 -7.5	6.0-7.0	5.5-6.0	5.5 -5.0	4.5-5.0	4.0-4.5	3.9-4.1	3.7-3.9	3.5-3.7		
Number of sets	2	2	3	6	8	9	18	12	3	2	1	1	67
Species													
Centrophorus squamosus		77.9	129	208.7	236.2	113.1	72.9	40	18.4	11.3	5	5	98.26
Centroscymnus coelolepis			9.2	8.8	85.5	98.1	75.1	91.4	114.2	80.8	74.9	11.8	69.94
Centroscymnus crepidater			2.3	0.2	30	74.4	75.7	57.6	56.6	42.1	37.4	1.6	48.74
Centroscymnus fabricii		9.2	37	46.1	134.5	90.7	35.7	3.4	0.3				44.52
Reinhardtius hippoglossus				0.6	0.2	9.3	47.1	54.1	44.2	5.1			25.78
Deania calceus	23.9	166.3	97.1	96.5	45.2	3.8	0.3						24.65
Molva dipterygia	5.5	22.2	25	20.6	28.7	37.4	37.9	10.5	4.1	2.5			24.56
Mora moro	2.1	32.4	67.1	73.7	27.4								13.91
Galeus melastomus	48.8	93.4	31.3	20.1	6.6	0.1	0.03						8.25
Brosme brosme	46.6	22.5	27.9	13.7	11.2	2.1							6.16
Hydrolagus affinis							0.2	13.1	25.5	2	4		3.66
Etmopterus princeps	5.7			0.8	0.5	2.9	1.4	4.7	2.6	2	1.6		2.11
Macrourus berglax						0.1	0.6	1.9	7.8	9.1	10.4	1.3	1.32
Raja nidrosiensis	3.1		2.1	1	2.1	0.7	2	0.7					1.27
Chimaera monstrosa	5.6	2.2	3.4	1.3	1.6	1	0.5						0.97
Etmopterus spinax	0.04	1.9	0.1	0.4	0.01	0.2	1.3			4.4			0.6
Lophius piscatorius			4.2	0.7	0.5	0.7							0.4
Antimora rostrata										1.2	6.8	16.9	0.39
Raja fullonica					0.1	0.7	0.8	0.2					0.35
Galeus murinus		0.3	0.6	0.2	0.5	0.4	0.2	0.2		0.1			0.25

Depth range (m)	500-600	700-800	800-900	900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1700-1800	1900-2000	Total
Temp. °C	8.0-8.5	7.5-8.0	7.0 -7.5	6.0-7.0	5.5-6.0	5.5 -5.0	4.5-5.0	4.0-4.5	3.9-4.1	3.7-3.9	3.5-3.7		
Number of sets	2	2	3	6	8	9	18	12	3	2	1	1	67
Species													
Coelorhynchus occa					0.02	0.1	0.5	0.4	0.1	0.1			0.24
Pseudotriakis microdon							0.7						0.19
Lepidion eques	0.2	0.3	0.5	0.5	0.2	0.02	0.03	0.01					0.12
Chalinura sp.										0.3	7		0.11
Anarhichas denticulatis				0.6		0.3							0.1
Raja hyperborea						0.03	0.02			0.3	2.6	2.6	0.1
Bathyraja richardsoni								0.1	0.2			4.7	0.1
Raja oxyrhynchus		3.1											0.09
Raja lintea							0.4						0.09
Cottunculus microps						0.02	0.02	0.02	0.1	0.1			0.02
Raja circularis	0.2												0.01
Bathyraja pallida								0.07					0.01
Spectrunculus grandis							0.03						0.01
Lepidion smithi								0.07					0.01
Helicolenus dactylopterus	0.1												<0.01
Raja fyllae					0.02								<0.01
Anarhichas lupus							0.02						<0.01
Synaphobranchus kaupi									0.03	0.02	0.04		<0.01
Onogadus argentatus											0.04		<0.01
	143.9	433.9	439.8	500.5	619.3	445.6	372.2	290.7	277.3	163.7	153.4	47.6	444.78

Appendix 7

Species composition by depth stratum from the Spanish trawling surveys on Hatton Bank in spring 2000. (data from ICES 2001)

Depth stratum			
701-800 m	**801-900**	**901-1000**	**1001-1100**
Galeus melastomus	*Galeus melastomus*	*Centroscymnus coelolepis*	*Centroscymnus coelolepis*
Centroscymnus crepidater	*Apristurus spp*	*Alepocephalus bairdii*	*Centroscymnus crepidater*
Deania calcea	*Centroscymnus coelolepis*	*Coryphaenoides rupestris*	*Alepocephalus bairdii*
Hydrolagus mirabilis	*Centroscymnus crepidater*	*Molva dypterygia*	*Coryphaenoides rupestris*
Brosme brosme	*Deania calceus*	*Lepidion eques*	*Trachyrhynchus trachyrhynchus*
Molva dypterygia	*Hydrolagus mirabilis*	*Aphanopus carbo*	*Molva dypterygia*
Micromesistius poutassou	*Argentina silus*		*Lepidion eques*
Lepidion eques	*Coryphaenoides rupestris*		*Aphanopus carbo*
Mora moro	*Brosme brosme*		
Aphanopus carbo	*Molva dypterygia*		
	Micromesistius poutassou		
	Lepidion eques		
	Mora moro		
	Aphanopus carbo		

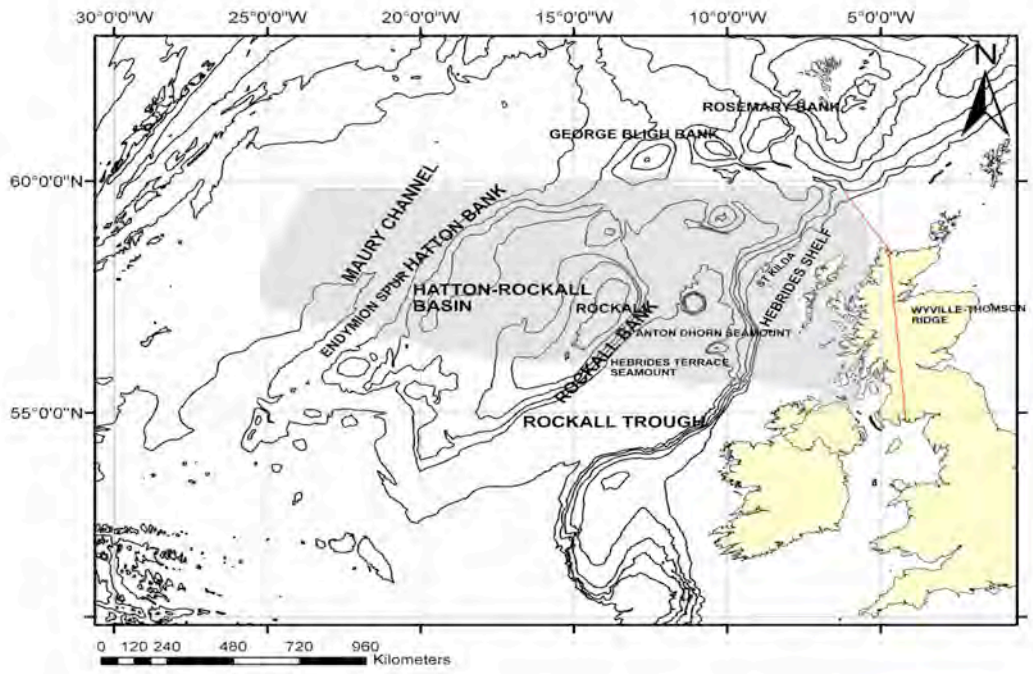

Figure 1.1 Bathymetry of the SEA7 area

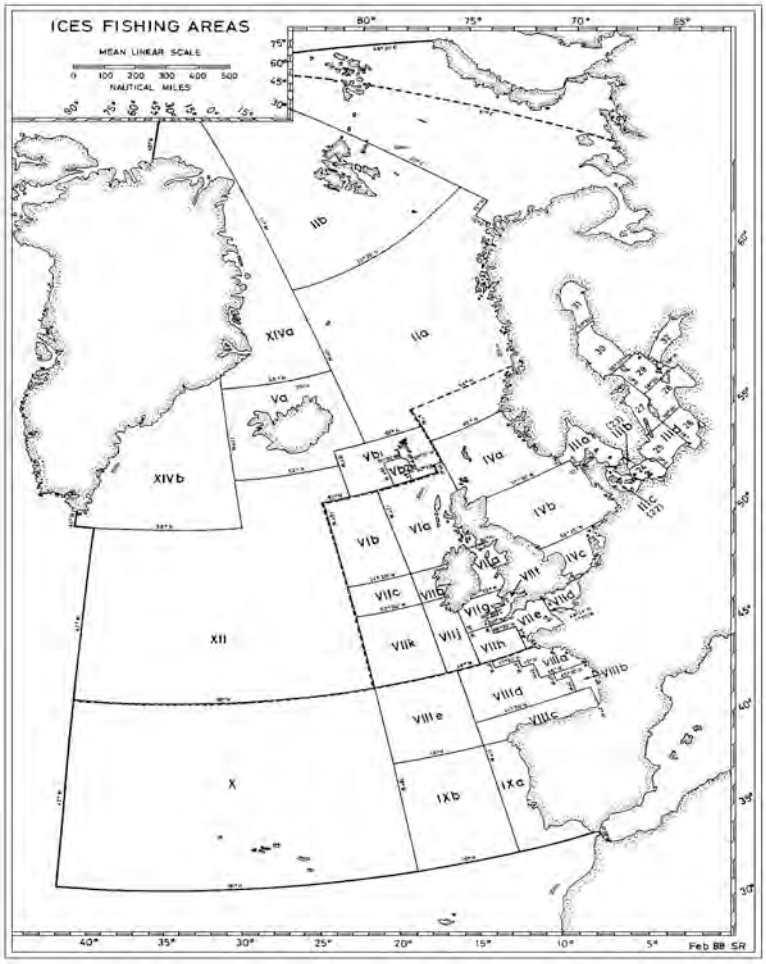

Figure 1.2 ICES Statistical areas and divisions

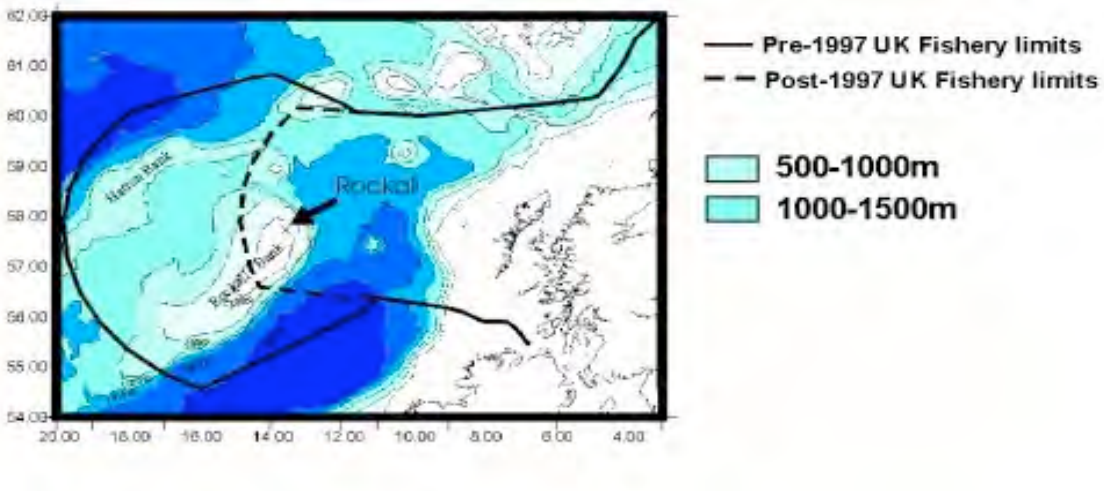

Figure 1.3 Rockall UK fishery limits

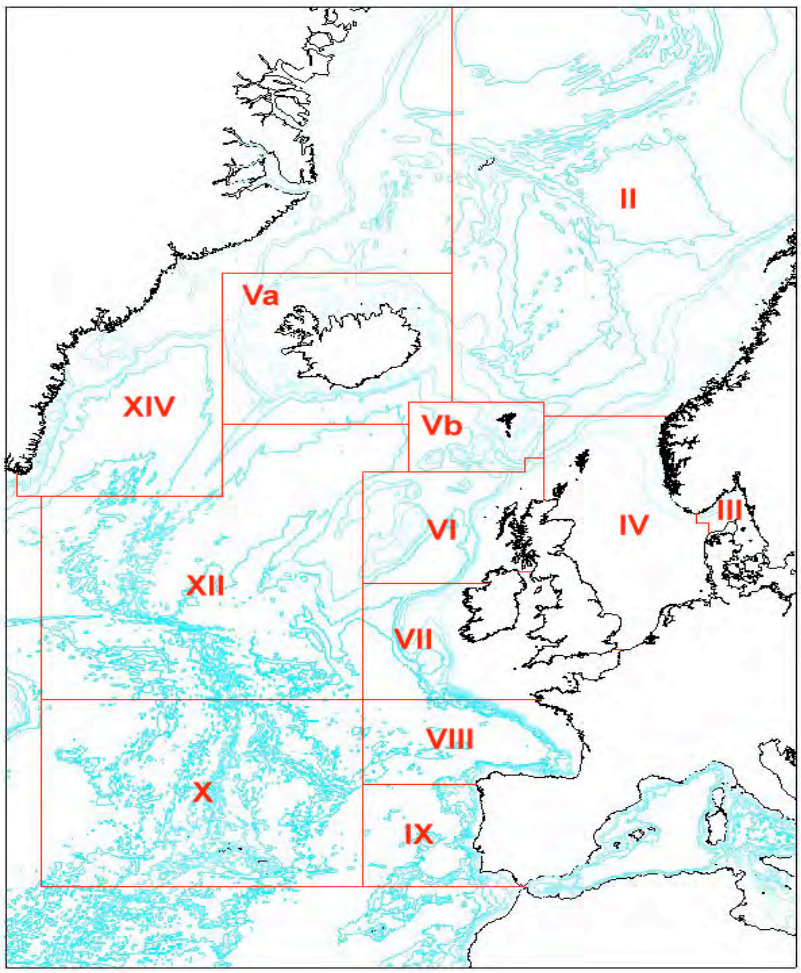

Figure 1.4 The bathymetry of the ICES area.

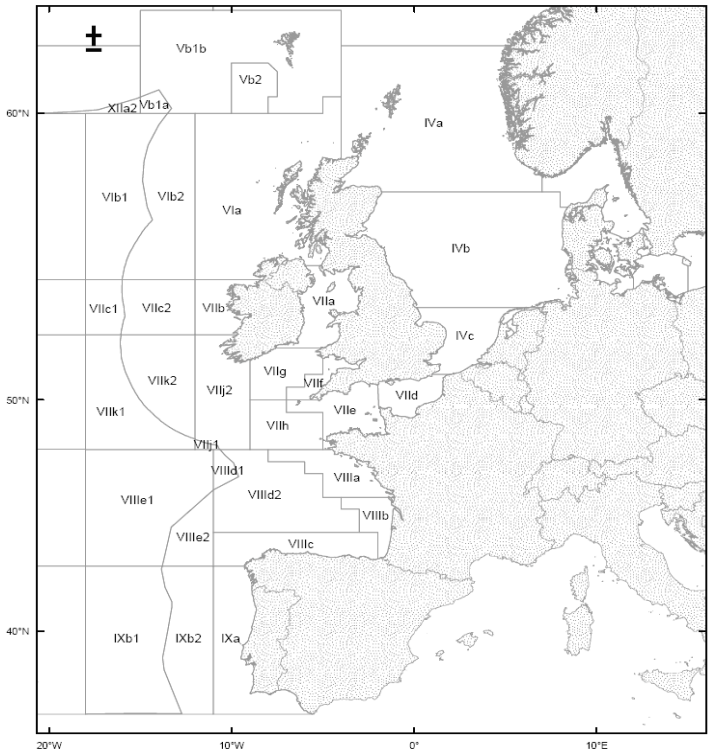

Figure 1.5 New ICES Sub-divisions for Division VIb

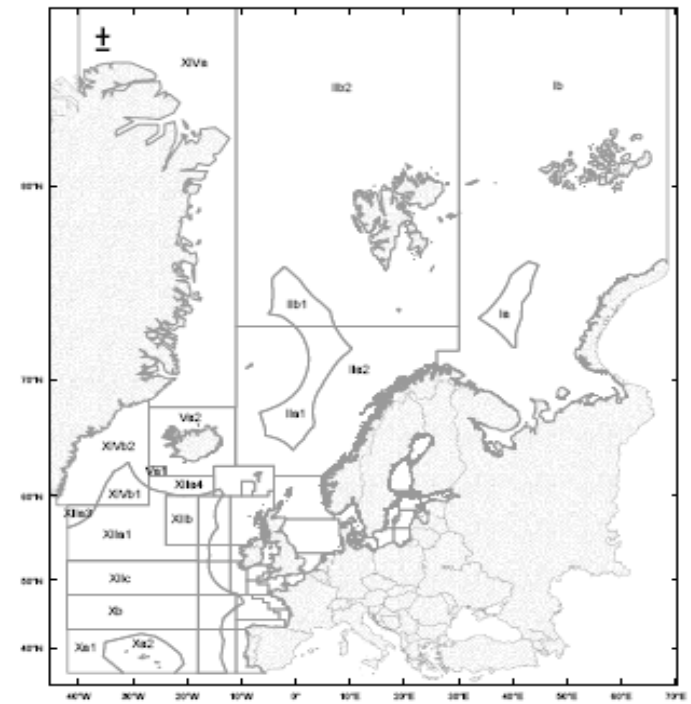

Figure 1.6 New ICES Divisions for Sub -area XII.

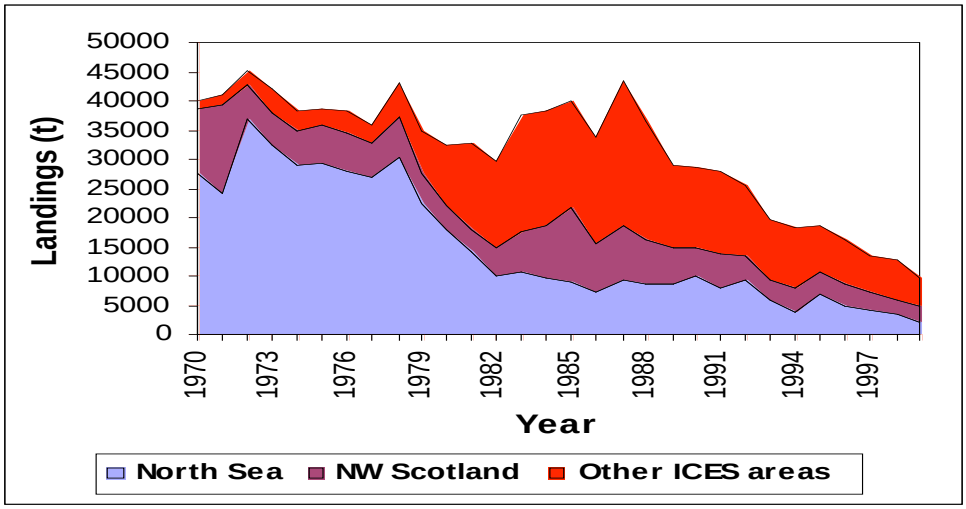

Figure 3.1 Spurdog: The annual reported landings (tonnes) of spurdog for the North Sea, West of Scotland and all other ICES Sub -areas combined for the years 1970 to 1999. Data from final report of DELASS project (Heessen 2003).

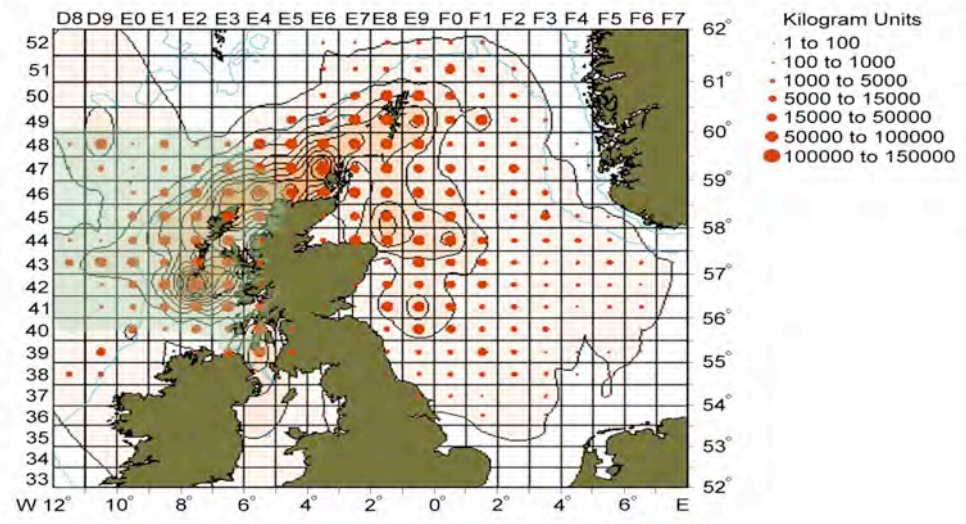

Figure 3.2 Spurdog: Mean annual landings (tonnes) of spurdog for 1997 -2001 by Scottish vessels. The SEA7 area is shaded (modified figure supplied by Fisheries Research Services for the final report of DELASS project (Heessen 2003).

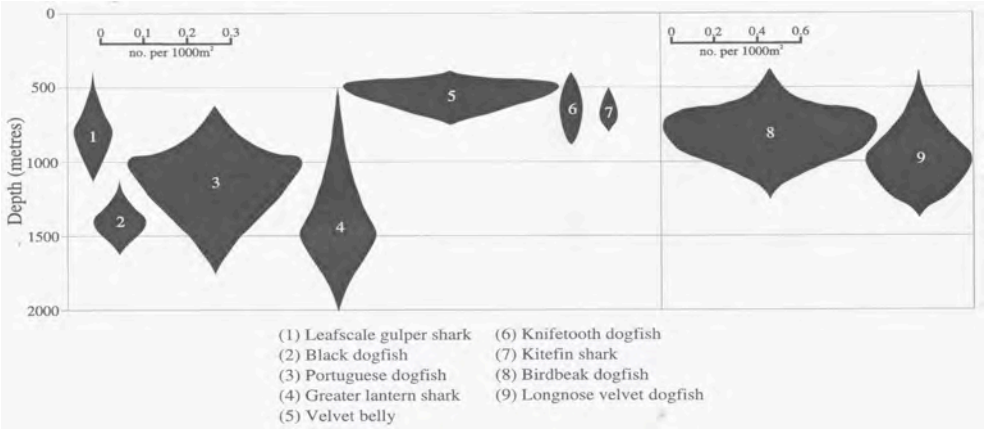

Figure 3.3 Deep-water sharks: Depth distribution and relative abundance of some of the squalid sharks in the Rockall Trough (SAMS data).

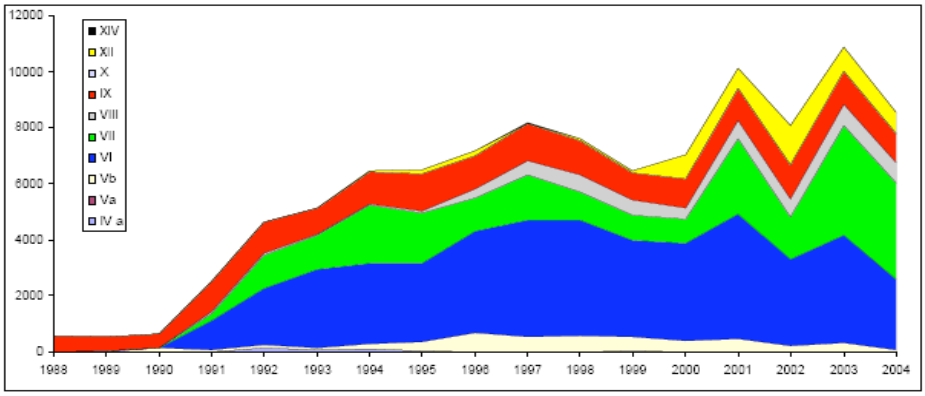

Figure 3.4 Sharks: ICES estimates of total landings of deep -water sharks (mainly Portuguese dogfish and leafscale gulper shark by Sub -area and Division

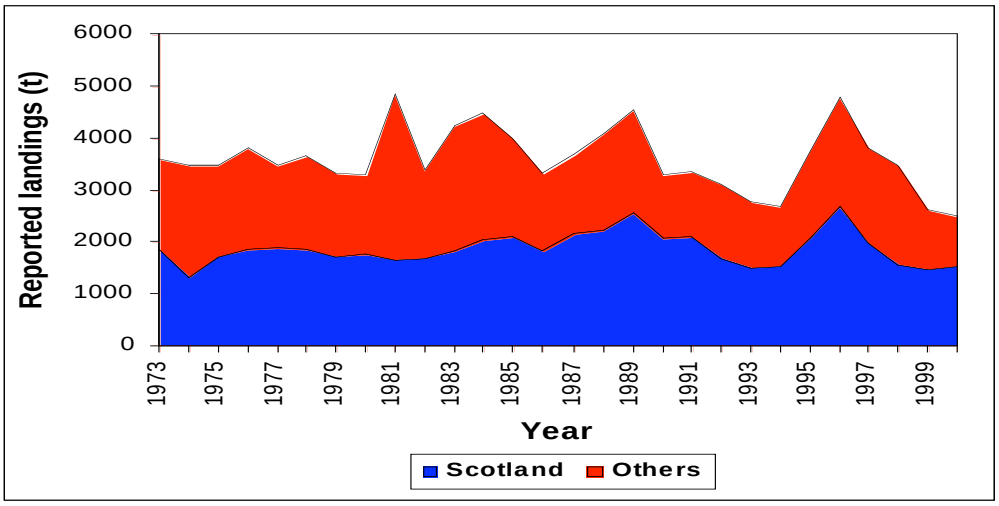

Figure 3.5 Rays: The reported landing of rays (tonnes) in ICES Sub -area VI for the years 1973 to 2000

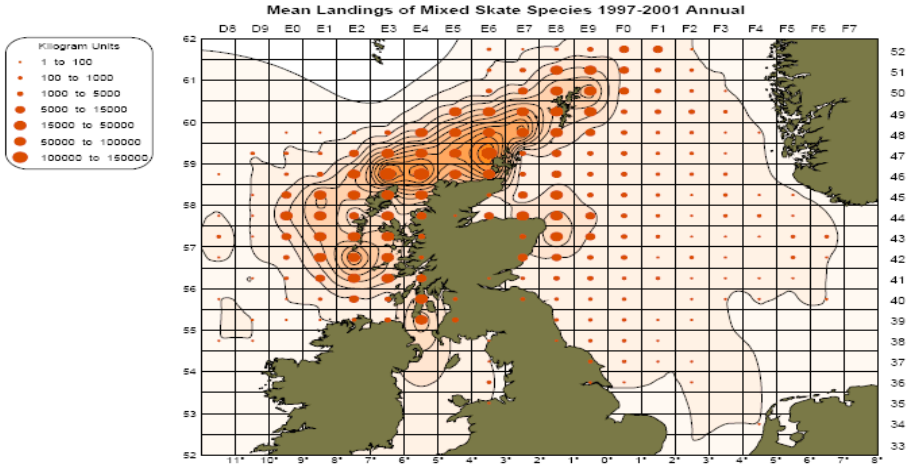

Figure 3.6 Rays: Mean annual landings (tonnes) of mixed ray species for 1997 - 2001 by Scottish vessels. (From a figure supplied by Fisheries Research Services for the final report of DELASS project (Heessen 2003)

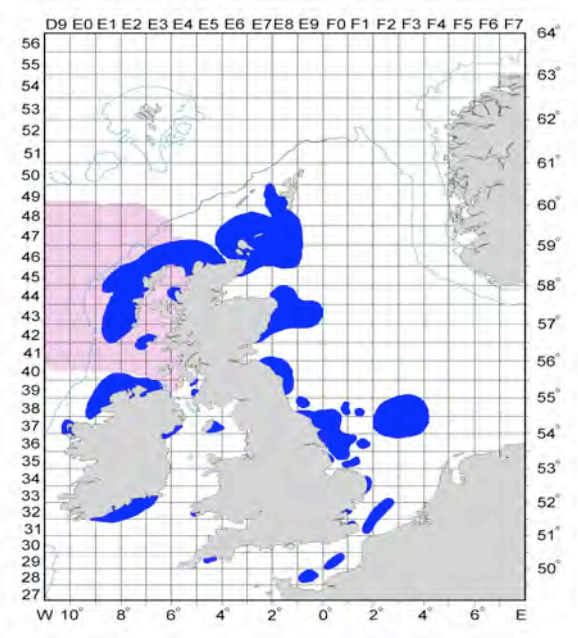

Figure 3.7 Herring spawning grounds around the British Isles with the SEA7 area shaded (modified from Coull et al., 1998)

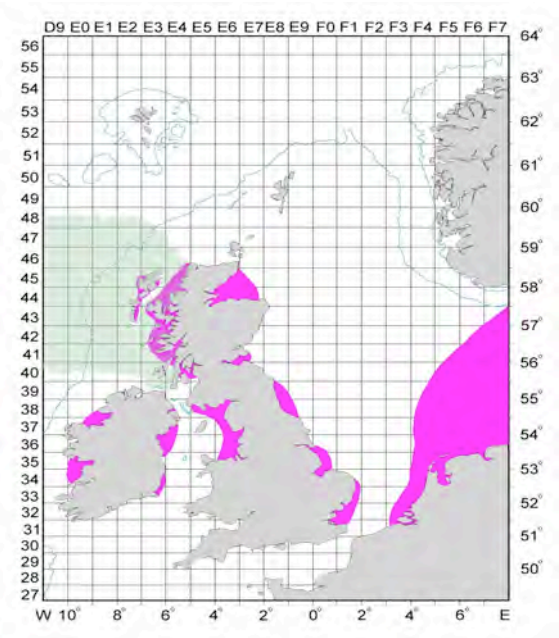

Figure 3.8 Herring nursery grounds around the British Isles with the SEA7 area shaded (modified from Coull et al., 1998)

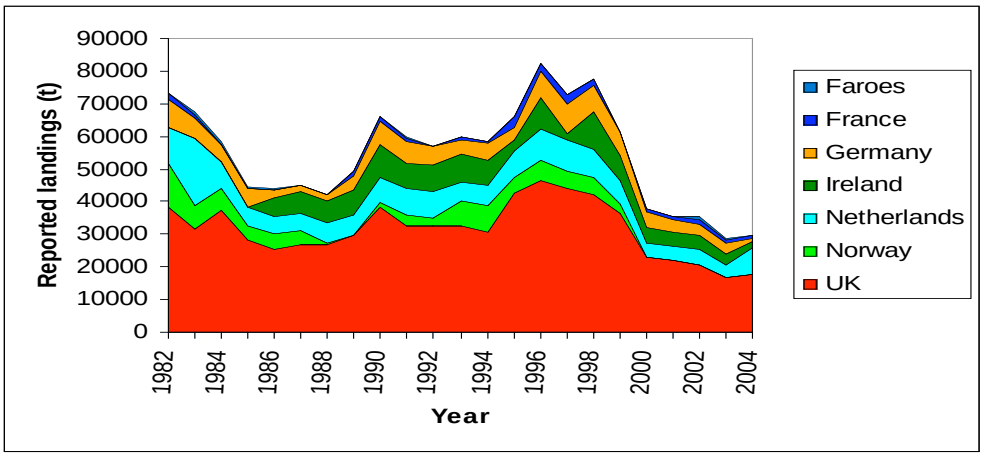

Figure 3.9 Herring: The reported landings of herring (t) by country for ICES Division VIa (north)

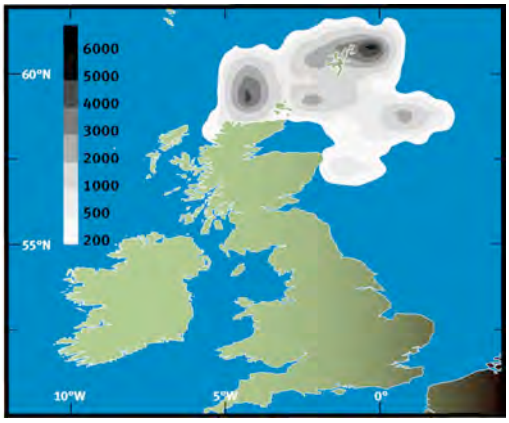

Figure 3.10 Herring; 2004 distribution of catches by Scottish Vessels (t).). Reproduced with permission of Fisheries Research Services.

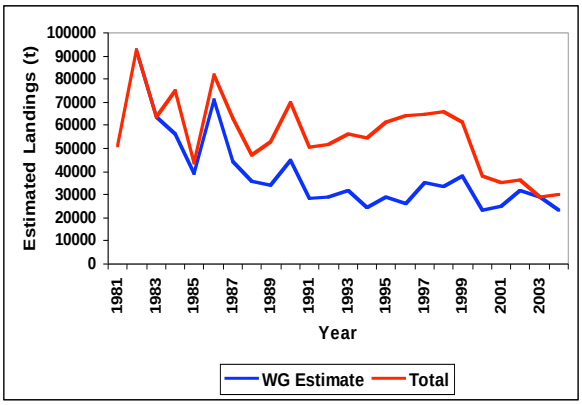

Figure 3.11 Herring:The total landings of herring (reported by country and unallocated to a country) and the estimate of the true landings from ICES Division VIa (north) after deducting probable misreported landings from other areas.

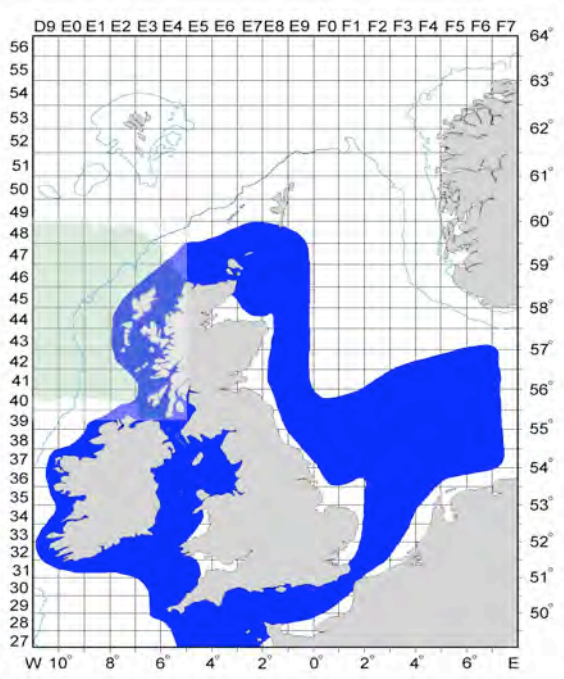

Figure 3.12 Sprat spawning grounds around the British Isles with the SEA7 area shaded (modified from Coull et al. 1998)

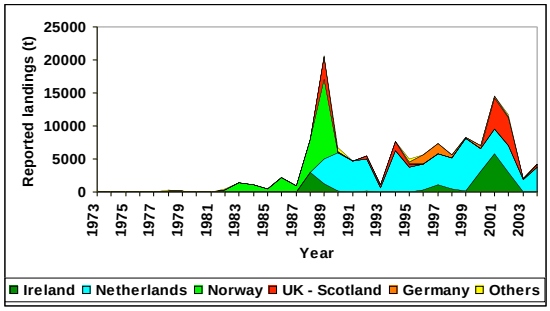

Figure 3.13 Argentine: Reported landings of argentine by country from ICES Division VIa

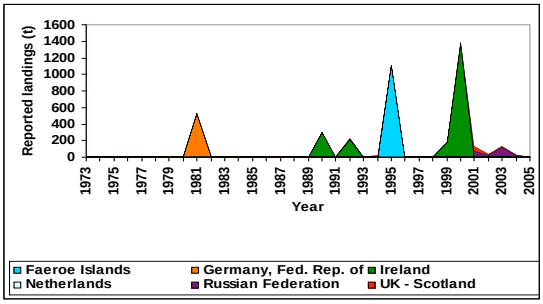

Figure 3.14 Argentine: Reported landings of argentine by country from ICES Division VIb

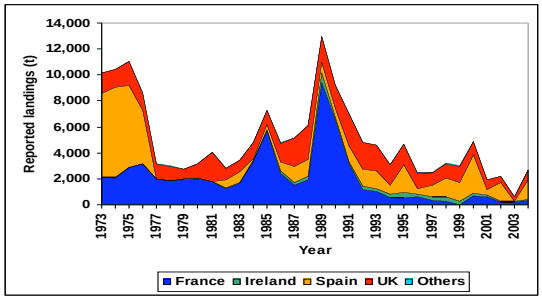

Figure 3.15 Hake: The reported landings by country for ICES Division VIa

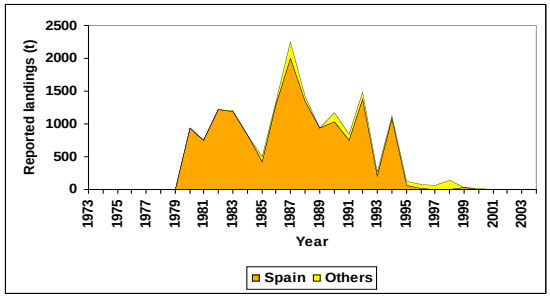

Figure 3.16 Hake: The reported landings by country for ICES Division VIb

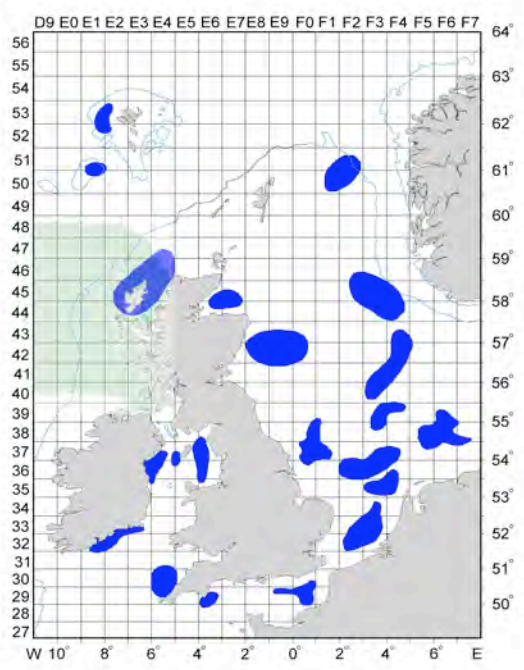

Figure 3.17 Cod spawning grounds around the British Isles with the SEA7 area shaded (modified from Coull et al. 1998)

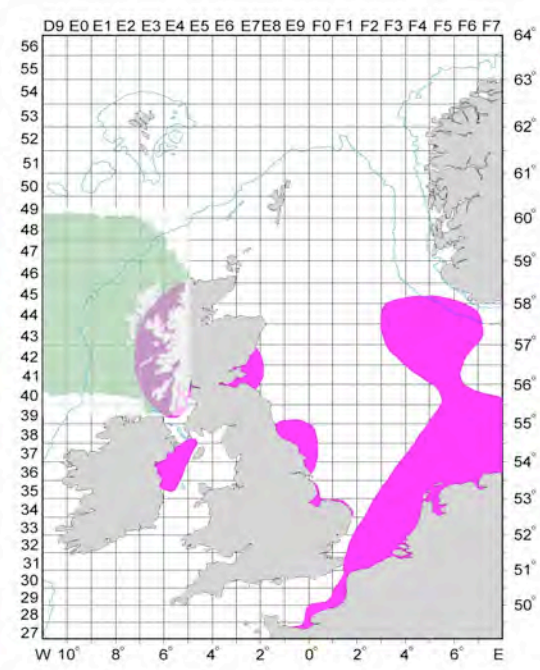

Figure 3.18 Cod nursery areas around the British Isles with the SEA7 area shaded (modified from Coull et al. 1998)

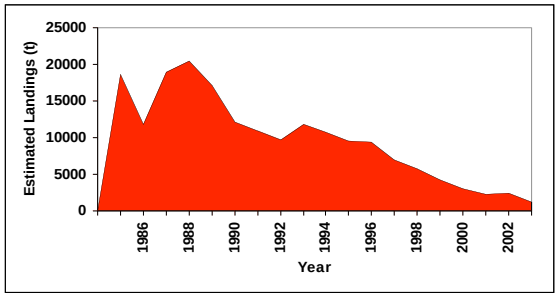

Figure 3.19 Cod: The estimated total landings of cod after corrected for unallocated landings and discards for ICES Division VIa.

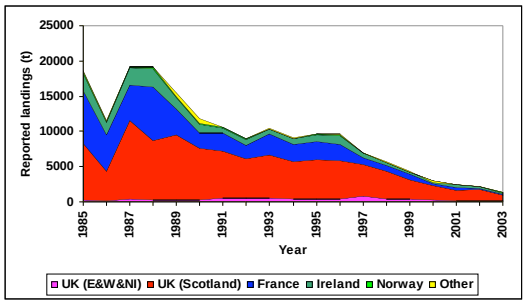

Figure 3.20 Cod: Reported landings by country for ICES Division VIa.

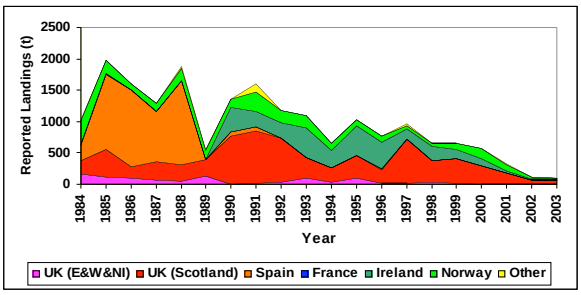

Figure 3.21 Cod: Reported landings by country for ICES Division VIb

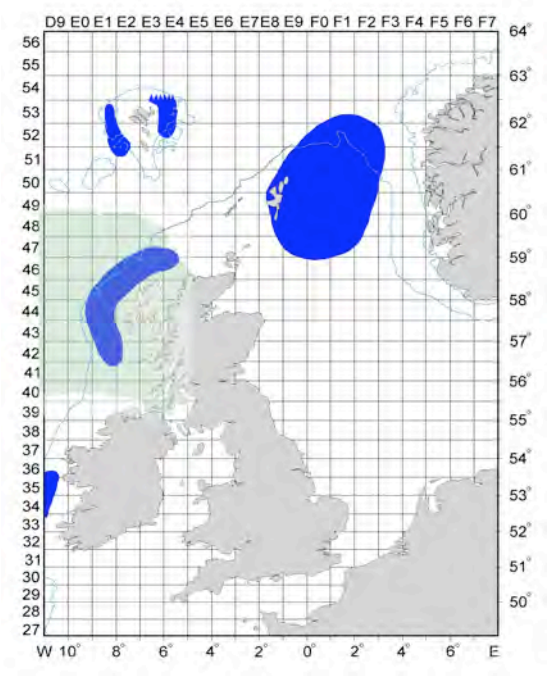

Figure 3.22 Haddock spawning grounds around the British Isles with the SEA7 area shaded (modified from Coull et al. 1998).

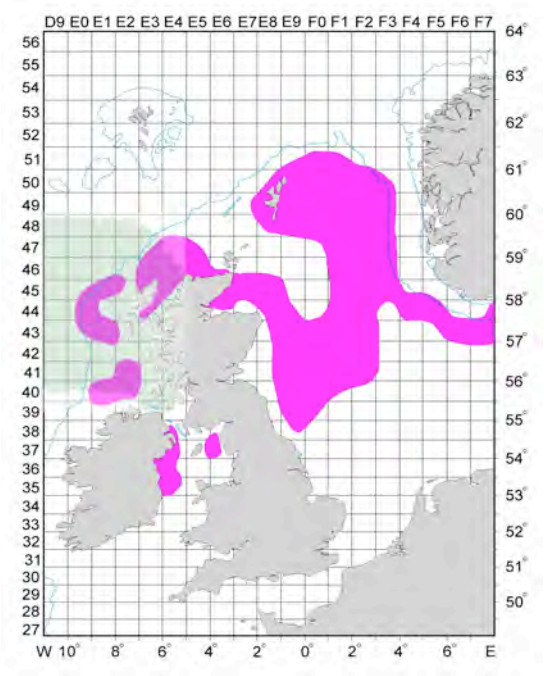

Figure 3.23 Haddock nursery areas around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

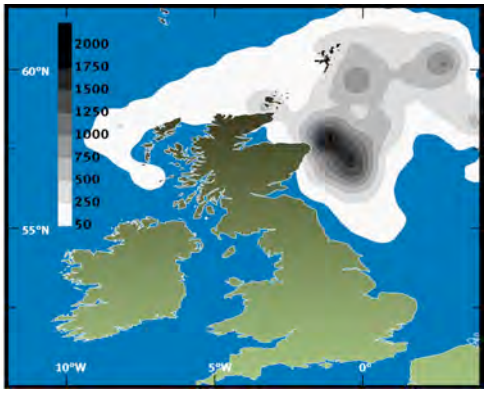

Figure 3.24 Haddock: 2004 distribution of catches by Scottish Vessels (t). Reproduced with permission of Fisheries Research Services.

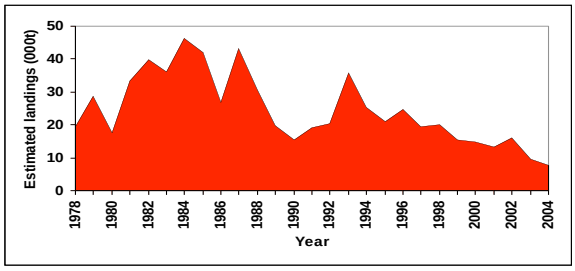

Figure 3.25 Haddock: The estimated annual international catch of haddock from Division VIa (includes reported and unallocated landings and an estimate of discards)

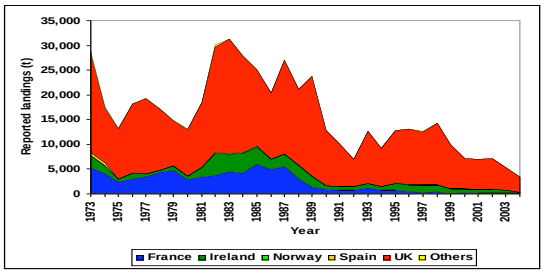

Figure 3.26 Haddock: Reported landings for ICES Division VIa

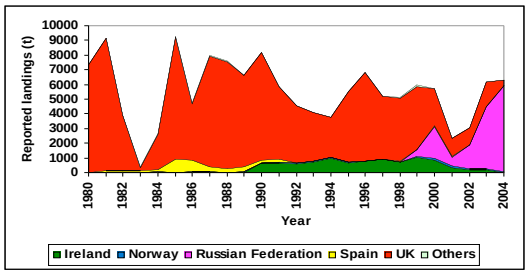

Figure 27 Haddock: Reported landings for ICES Division VIb

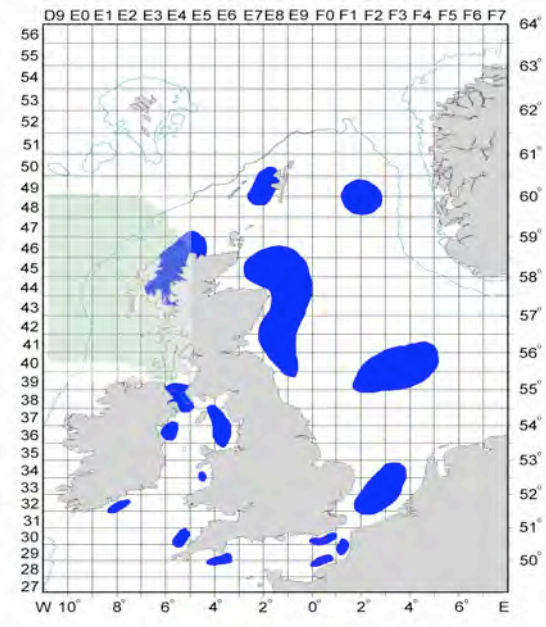

Figure 3.28 Whiting spawning grounds around the British Isles with SEA7 area shaded (modified from Coull et al. 1998).

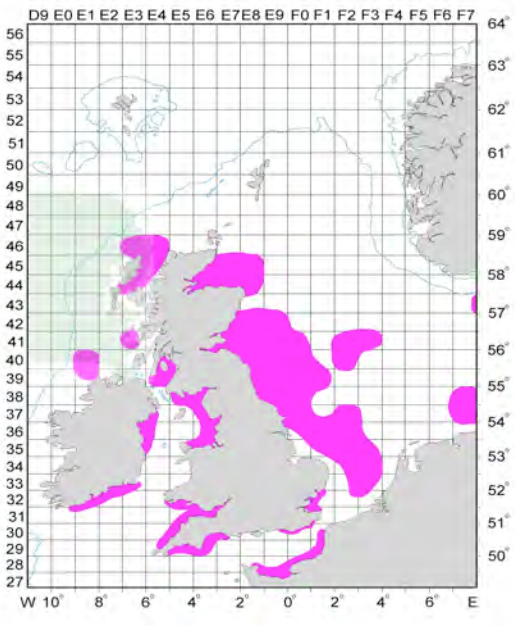

Figure 3.29 Whiting nursery areas around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

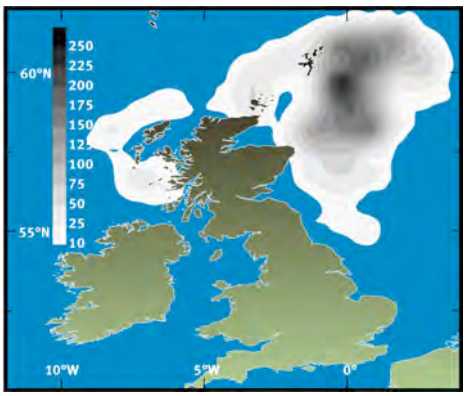

Figure 3.30 Whiting: 2004 distribution of catches by Scottish vessels (t). Reproduced with permission of Fisheries Research Services.

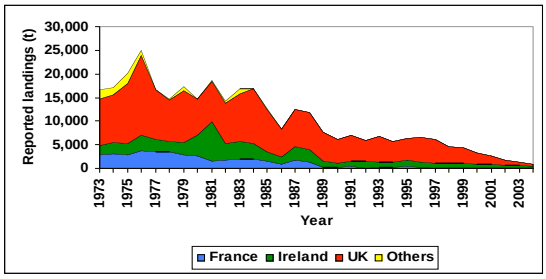

Figure 3.31 Whiting: Reported landings of whiting by country for ICES Division VIa

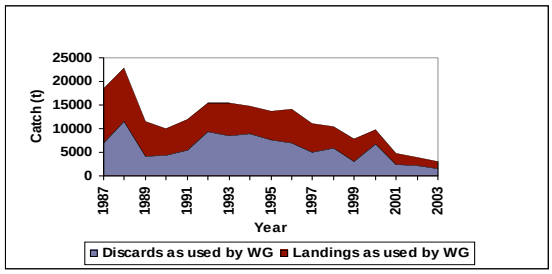

Figure 3.32 Whiting: ICES Working Group estimate of the total catch, comprising the landings and an estimate of the weight of discarded whiting

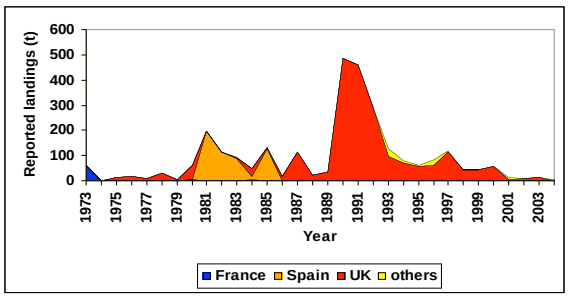

Figure 3.33 Whiting: Reported landings of whiting by country for ICES Division VIb

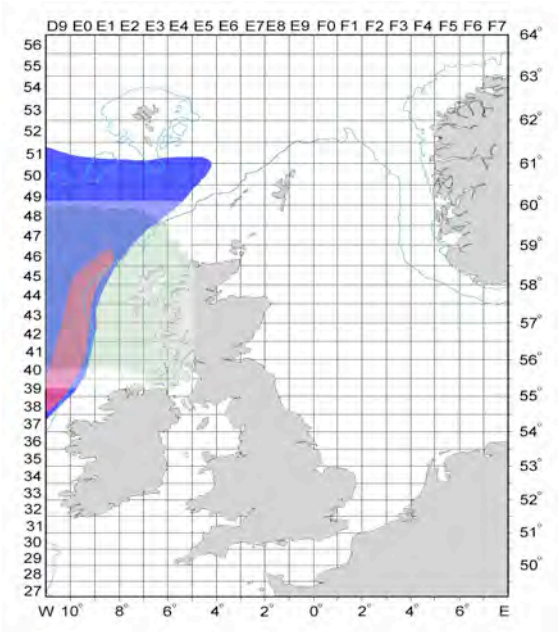

Figure 3.34 Blue whiting spawning grounds around the British Isles with SEA7 area shaded (modified from Coull et al. 1998) .

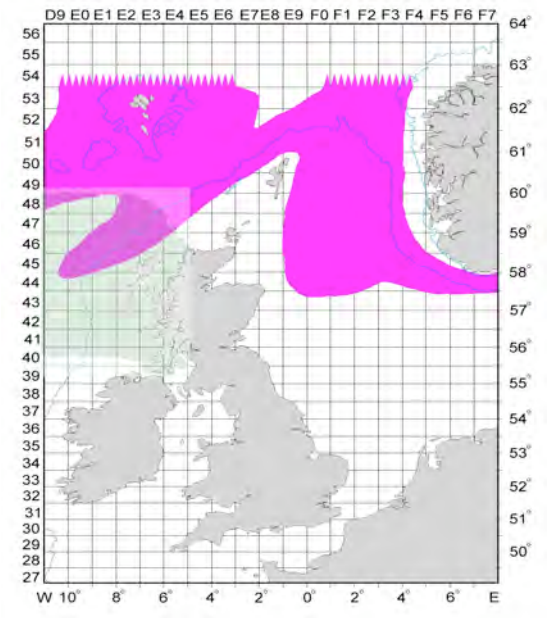

Figure 3.35 Blue whiting nursery areas around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

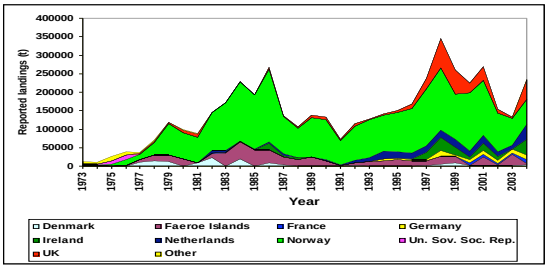

Figure 3.36 Blue whiting: Reported landings of blue whiting by country for ICES Division VIa

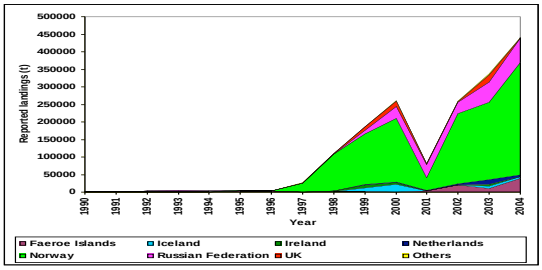

Figure 3.37 Blue whiting: Reported landings of blue whiting by country for ICES Division VIb

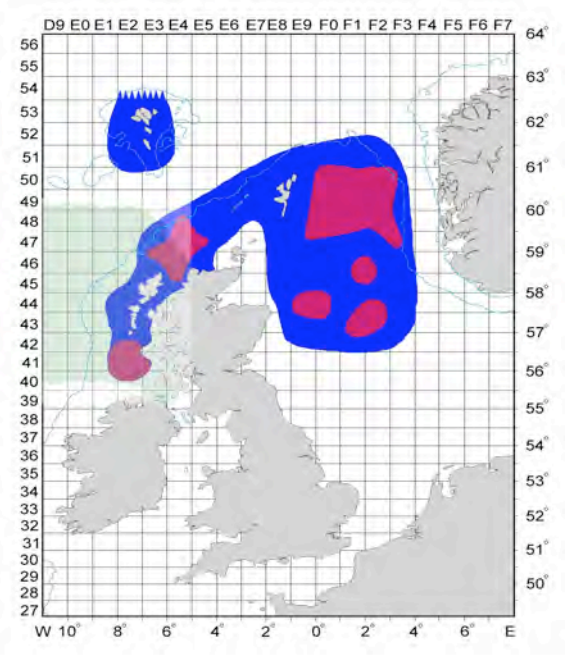

Figure 3.38 Norway pout spawning grounds around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

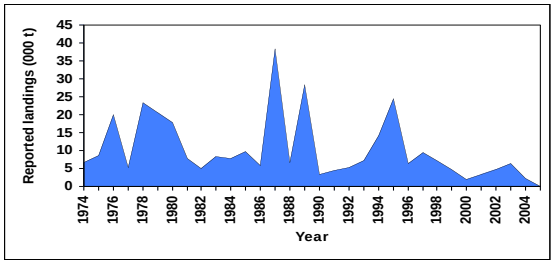

Figure 3.39 Norway pout: Reported landings of Norway pout (almost entirely Danish) from ICES Division VIa

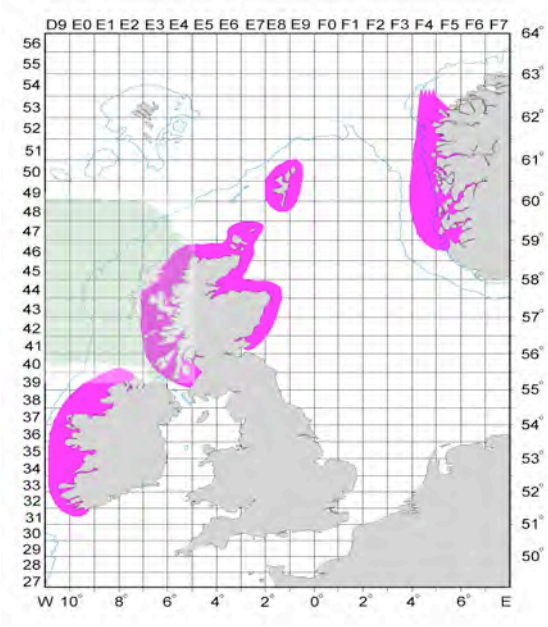

Figure 3.40 Saithe nursery grounds around the British Isles with SEA7 area shaded (modified from Coull et al. 1998).

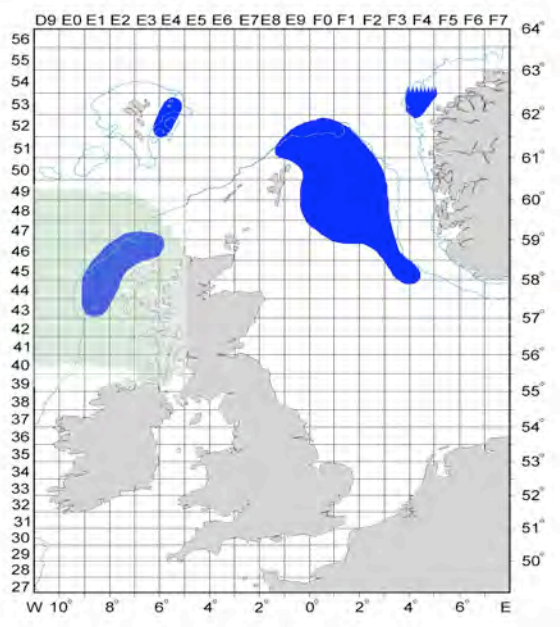

Figure 3.41 Saithe spawning grounds around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

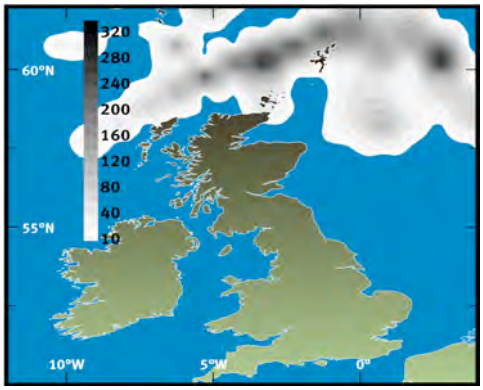

Figure 3.42 Saithe: 2004 distribution of catches by Scottish vessels (t). Reporoduced with permission from Fisheries Research Services

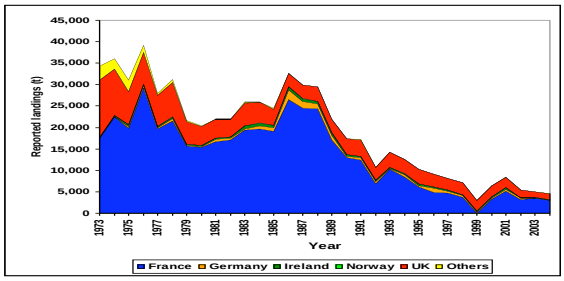

Figure 3.43 Saithe: Reported landings by country for ICES Division VIa

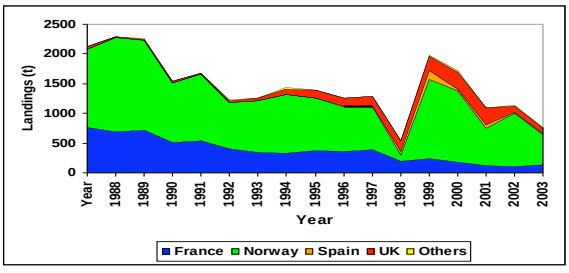

Figure 3.44 Tusk: Reported landings of tusk by country for ICES Division VIa

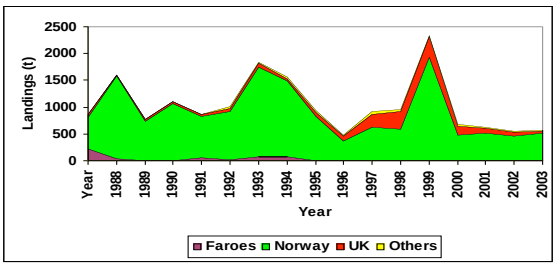

Figure 3.45 Tusk: Reported landings of tusk by country for ICES Division VIb

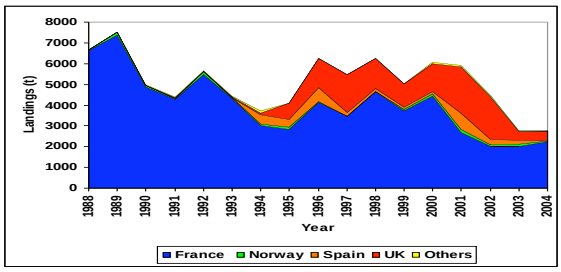

Figure 3.46 Blue ling: The reported landings of blue ling by country for ICES Division VIa

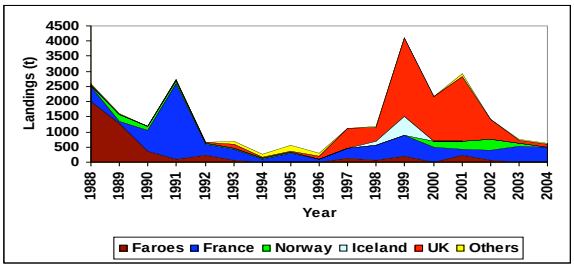

Figure 3.47 Blue ling: The reported landings of blue ling by country for ICES Division VIb

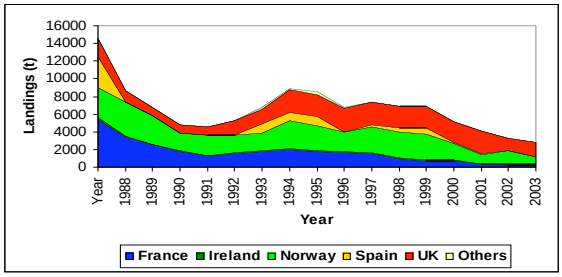

Figure 3.48 Ling: The reported landings of ling by country for ICES Division VIa

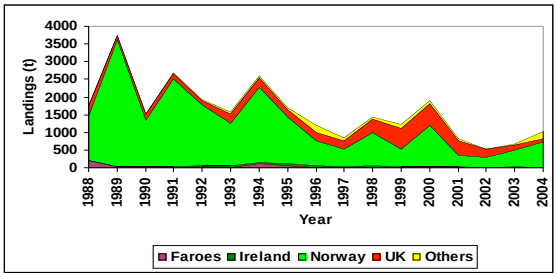

Figure 3.49 Ling: The reported landings of ling by country for ICES Division VIb

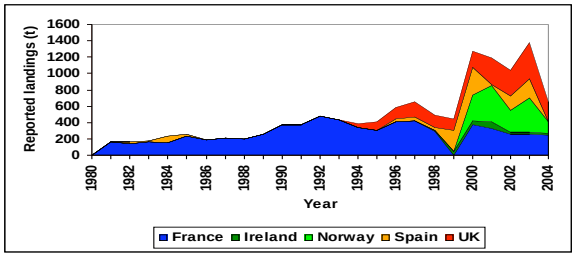

Figure 3.50 Greater forkbeard: The reported landings by country for Division VIa

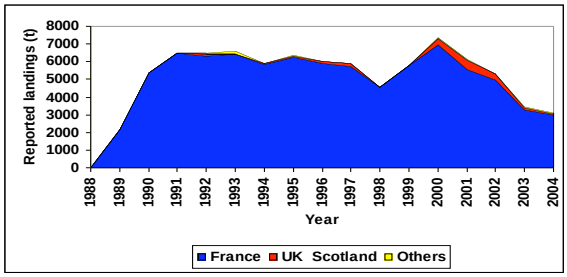

Figure 3.51 Roundnose grenadier: Reported landings of roundnose grenadier by country for ICES Division VIa. (French landings for 1999 – mean of 1998 and 2000)

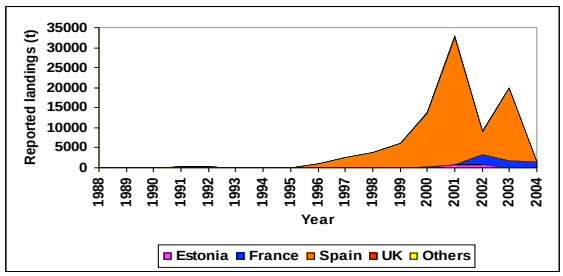

Figure 3.52 Roundnose grenadier: Reported landings of roundnose grenadier by country for ICES Division VIb with addition of Spanish landings for ICES Sub -area XII

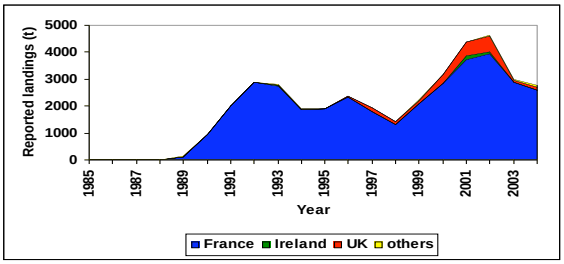

Figure 3.53 Black scabbardfish: The reported landings of black scabbardfish by country for ICES Division VIa. (French landings for 1999 – mean of 1998 and 2000)

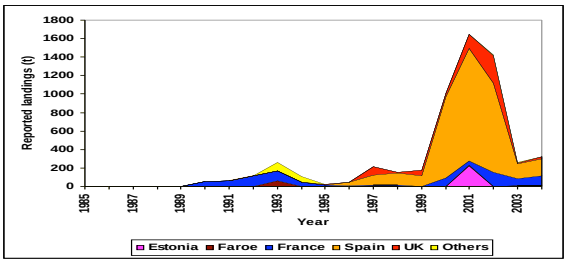

Figure 3.54 Black scabbardfish: Reported landings by country for ICES Division VIb with the addition of Spanish landings from ICES Sub-area XII

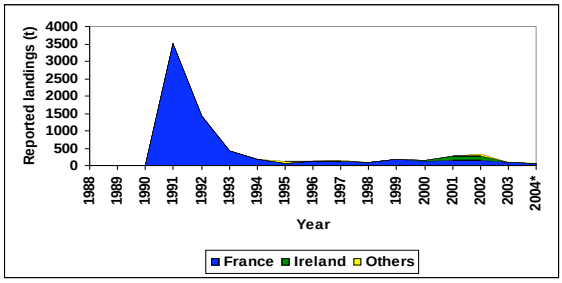

Figure 3.55 Orange roughy: Reported landings of orange roughy for Sub -area VI

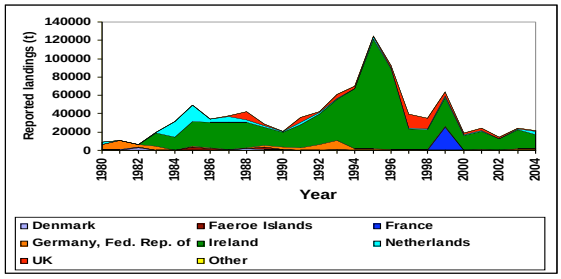

Figure 3.56 Horse mackerel: Reported landings by country for ICES Sub -area VI

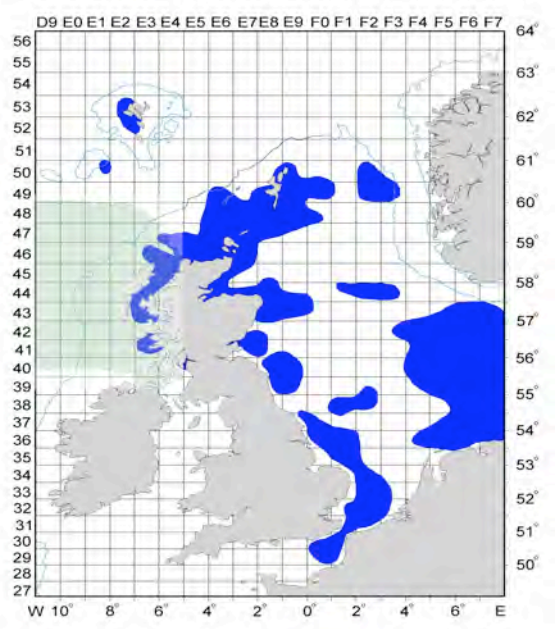

Figure 3.57 Sandeel spawning grounds around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

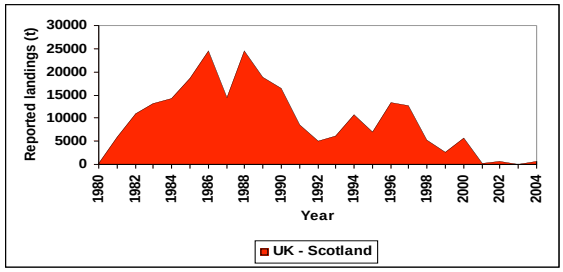

Figure 3.58 Sandeel: reported landings by Scotland. (Landings by other countries negligible)

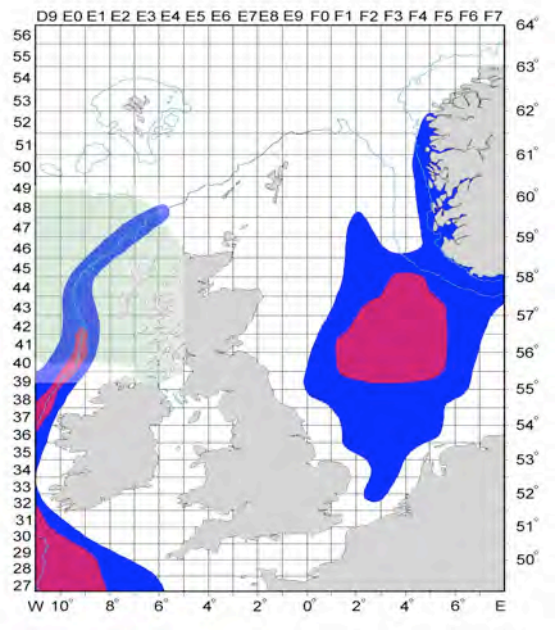

Figure 3.59 Mackerel spawning areas around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

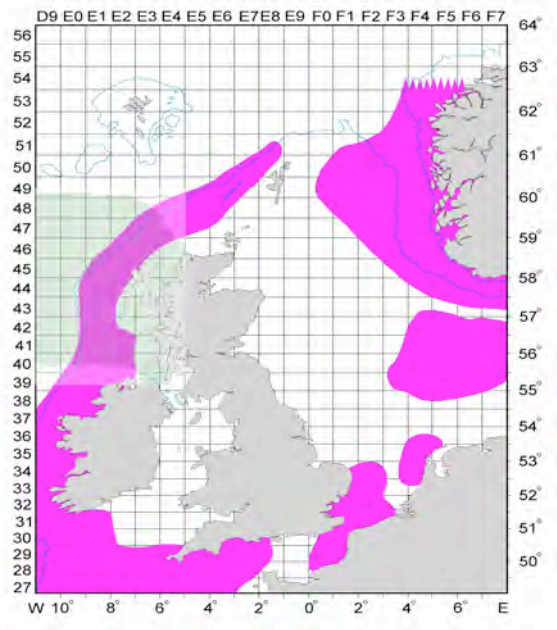

Figure 3.60 Mackerel nursery grounds around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

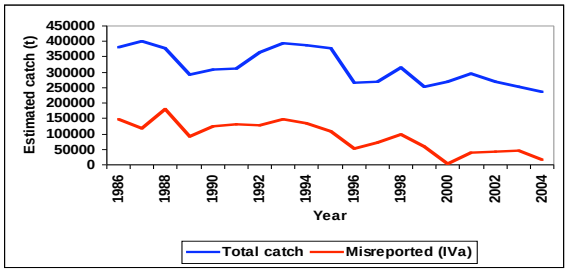

Figure 3.61 Mackerel: ICES Working Group's estimate of the total western area catch (reported landings by country, unallocated landings not reported to country, estimated discards) adjusted for misreported catches into the area) and the weight of fish thes e misreported catches caught in North Sea (IVa) but reported to the western area

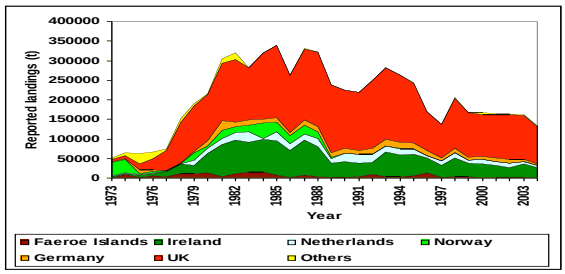

Figure 3.62 Mackerel: Reported landings by country for ICES Division VIa

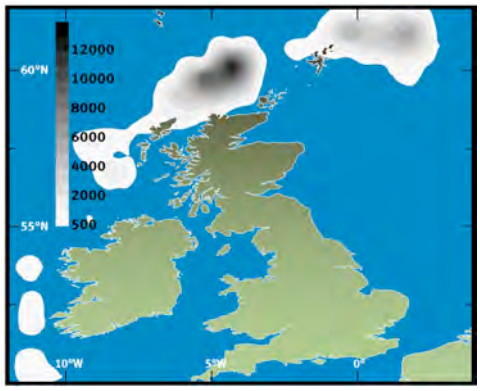

Figure 3.63 Mackerel: 2004 distribution of catches by Scottish vessels (t). Reproduced with permission from Fisheries Research Services.

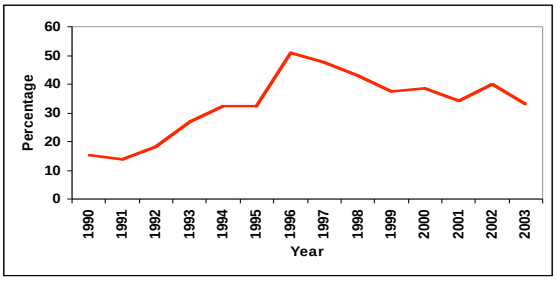

Figure 3.64 Megrim: ICES Working Group estimate of the weight of megrims caught in Division VIa but reported to Sub -area IV as a percentage of the catch.

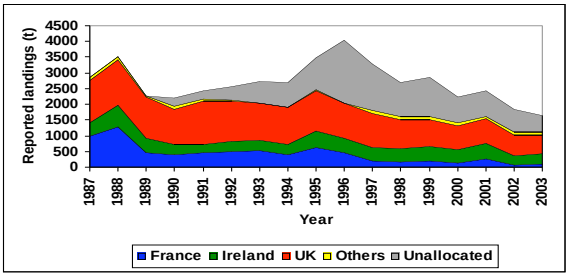

Figure 3.65 Megrim: The officially reported landings of megrim in Division VIa and the estimate of unreported landings

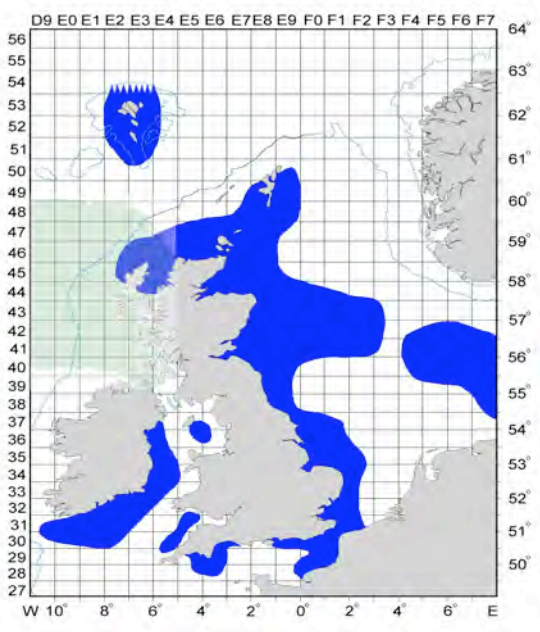

Figure 3.66 Lemon sole spawning areas around the British Isles with SEA7 area shaded (modified from Coull et al. 1998).

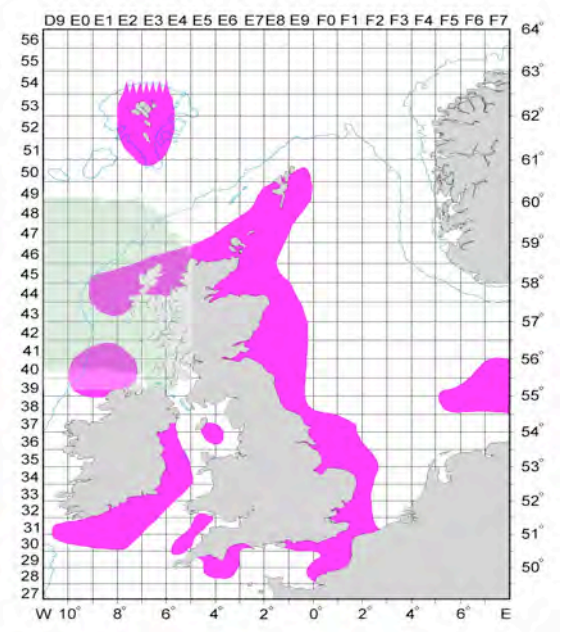

Figure 3.67 Lemon sole nursery grounds around the British Isles with SEA7 area shaded (modified from Coull et al. 1998)

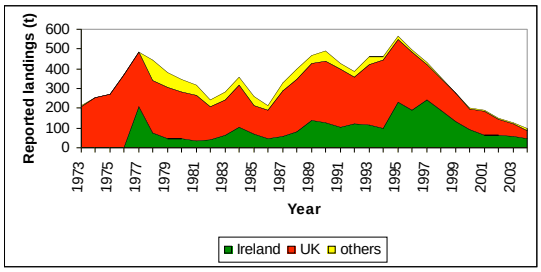

Figure 3.68 Lemon sole: Reported landings for ICES Division VIa

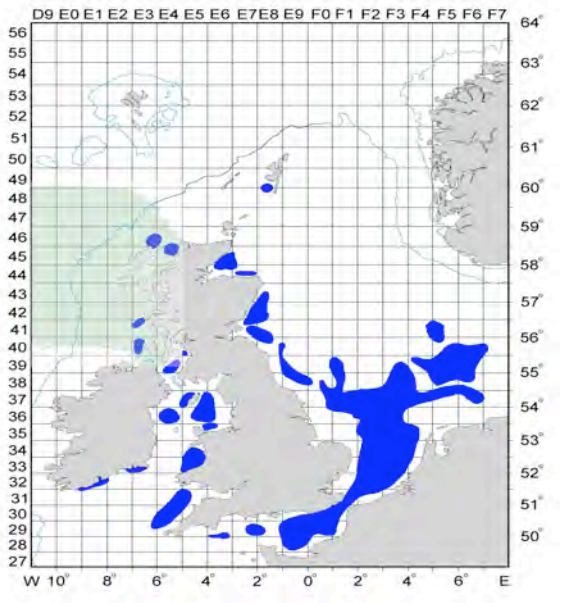

Figure 3.69 Plaice spawning areas around the British Isles with SEA7 area shaded (modified from Coull et al. 1998).

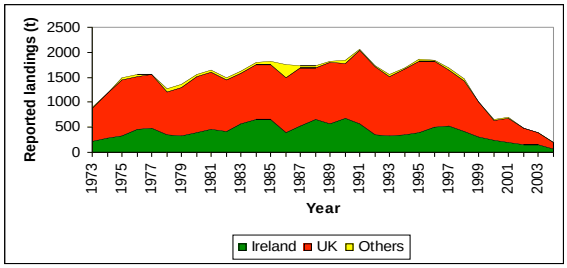

Figure 3.70 Plaice: Reported landings for ICES Division VIa

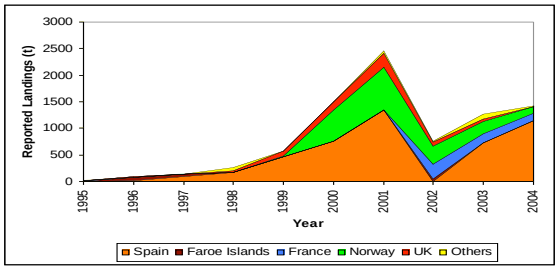

Figure 3.71 Greenland halibut: Reported landings for ICES Division VIb and Sub -area XII combined (Hatton Bank)

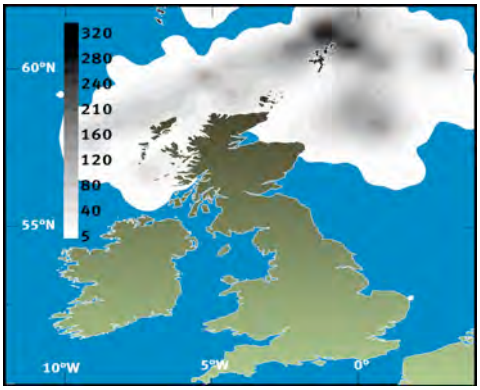

Figure 3.72 Anglerfish: 2004 distribution of catches by Scottish vessels (t). Reproduced with permission from Fisheries Research Services.

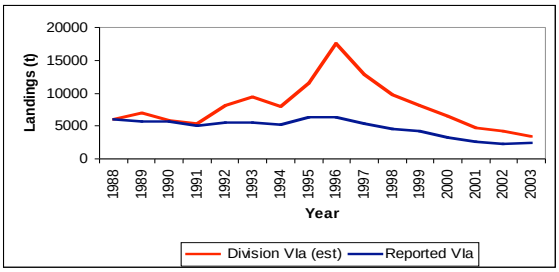

Figure 3.73 Anglerfish: The reported landings in Division VIa and the ICES Working Group's estimate of the true catch in Division VIa

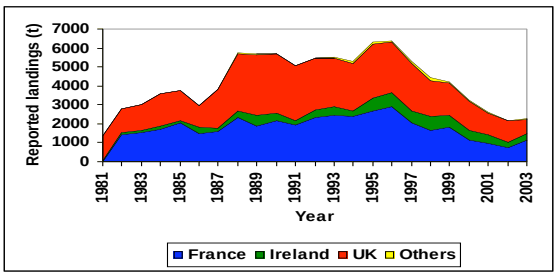

Figure 3.74 Anglerfish: Reported landings by country in Division VIa

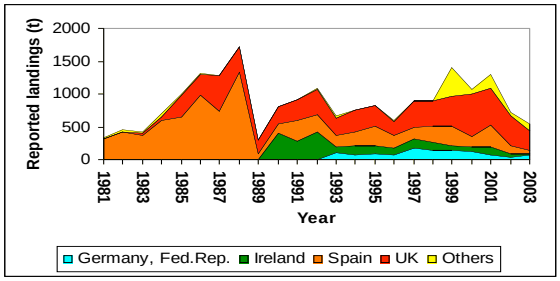

Figure 3.75 Anglerfish: Reported landings by country in Division VIb

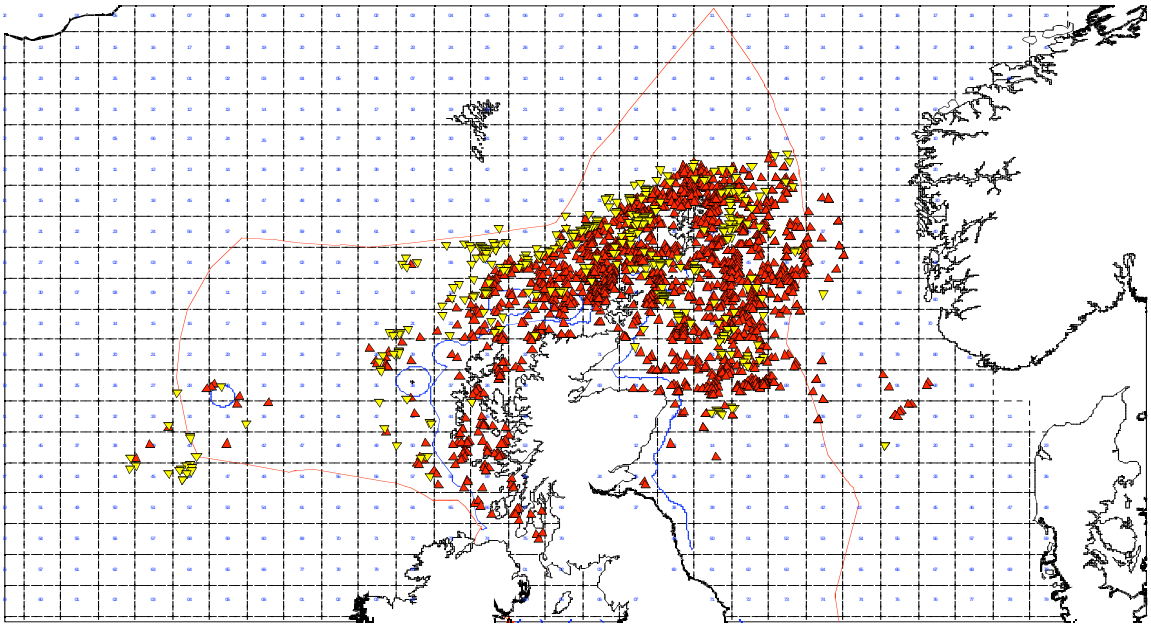

Figure 4. 1 Aircraft sightings of fishing vessels – 3month period. Red – UK vessels; yellow Foreign vessels (Reproduced with permission of the Scottish Fisheries Protection Agency)

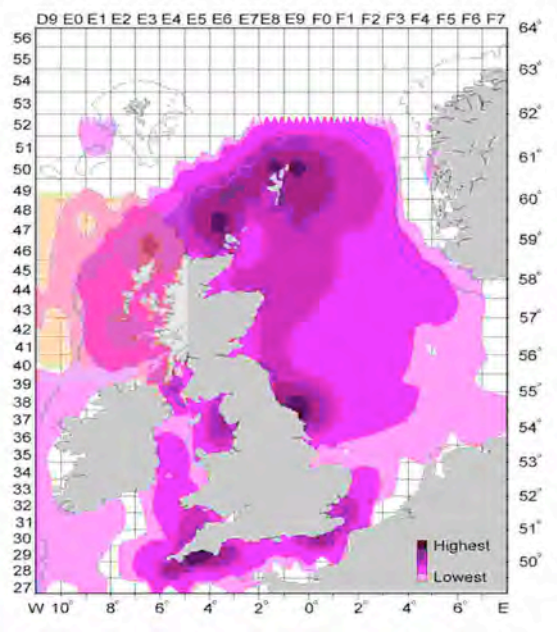

Figure 4.2 The distribution of fishing effort by bottom trawl (excluding beam trawl) (modified from Coull et al. 1998)

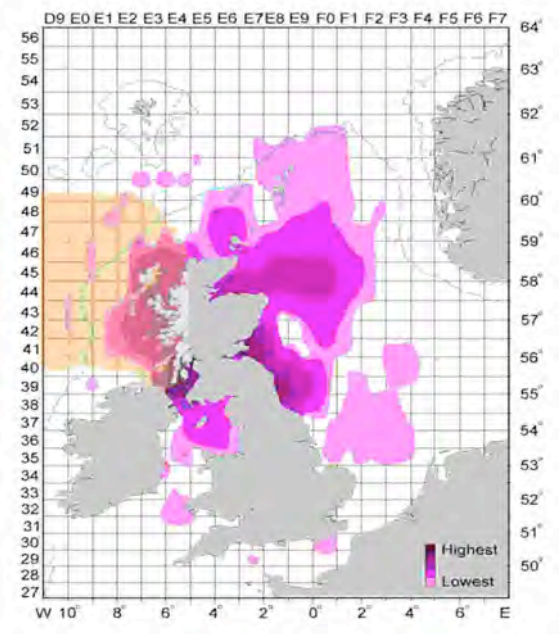

Figure 4.3 The distribution of fishing effort by *Nephrops* trawl (modified from Coull et al. 1998)

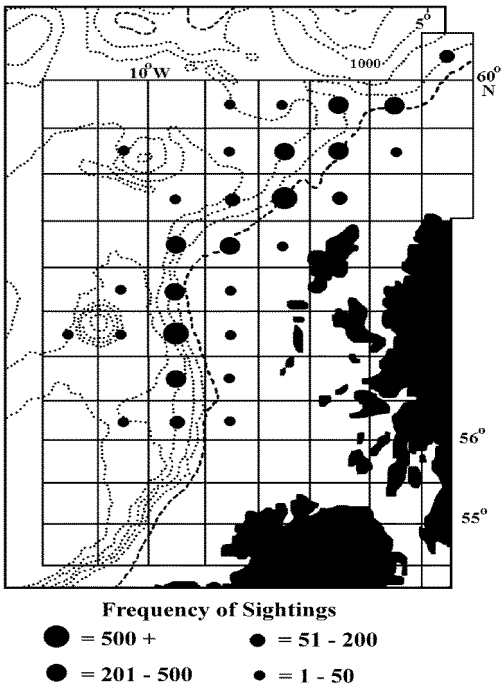

Figure 4.4 The frequency of sightings of French heavy demersal trawlers by spotter plane in the Scottish sector of ICES statistical area VIa for the years 1989 to 1993 (from data provided by the Scottish Fisheries Protection Agency)

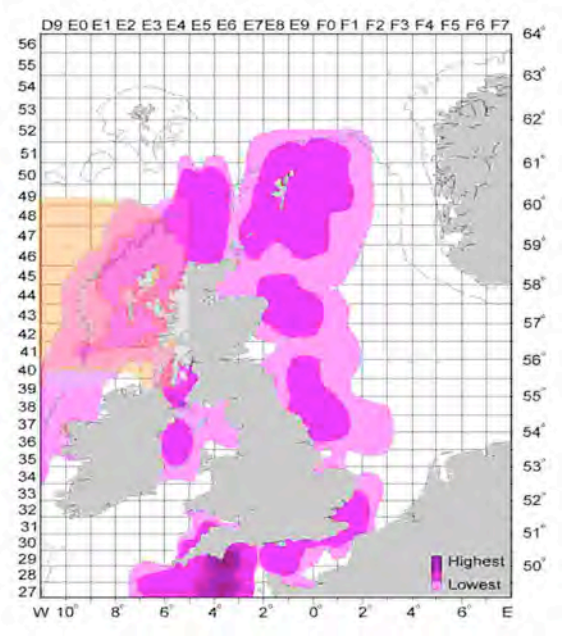

Figure 4. 5 The distribution of fishing effort on pelagic species (modified from Coull et al. 1998)

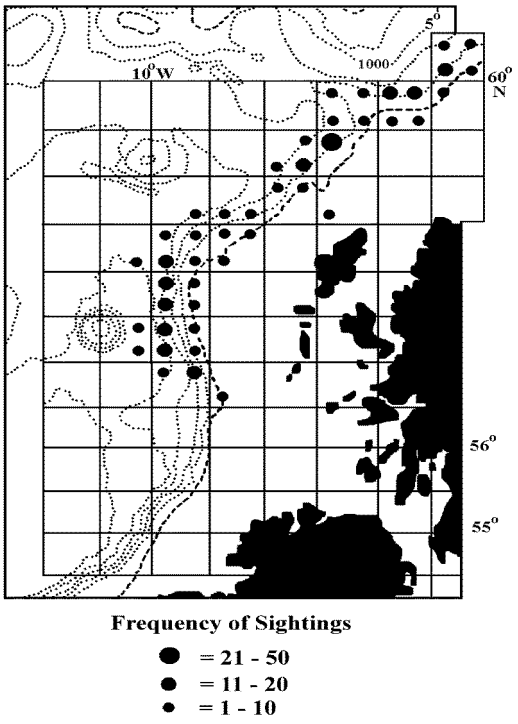

Figure 4.5 The frequency of sightings of Norwegian longliners by spotter plane in the Scottish sector of ICES statistical area VIa from 1 June 1992 to 30 June 1993 (from data provided by the Scottish Fisheries Protection Agency).

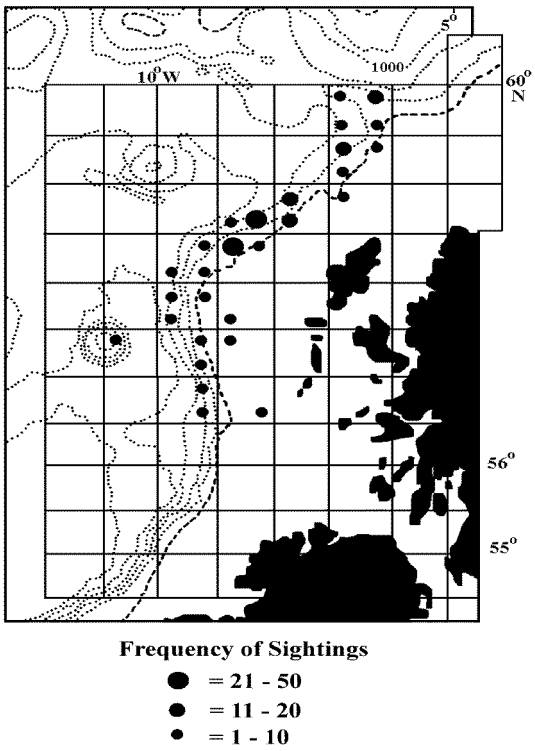

Figure 4.6 The frequency of sightings of Spanish longliners by spotter plane in the Scottish sector of ICES statistical area VIa from 1 June 1992 to 30 June 1993 (from data provided by the Scottish Fisheries Protection Agency).