Advisory Committee on Fisheries Management **ICES CM 2000/ACFM:8**

REPORT OF THE

STUDY GROUP ON THE BIOLOGY AND ASSESSMENT OF DEEP-SEA FISHERIES RESOURCES

ICES Headquarters
4–10 February 2000

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1.1 Terms of Reference

At the 1999 Annual Science Conference, ICES Resolution 2ACFM02 decided that the **Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources** [SGDEEP] (Chair: Dr J.D.M. Gordon, UK) will meet at ICES Headquarters from 4–10 February 2000 to:

a) compile the available data on landings of deep-water species, including blue ling, ling, and tusk, by ICES Sub-area or Division;

b) update descriptions of deep water fisheries in waters inside and beyond coastal state jurisdiction, for species such as grenadiers, scabbard fishes, orange roughy, forkbeards, sharks, ling, blue ling, and tusk, especially catch statistics by species, fleets and gear – and if possible the biological status of these stocks;

c) update the data on length/age at maturity, growth and fecundity and document other relevant biological information on deep-water species;

d) update information on quantities of discards by gear type for the stocks and fisheries considered by this group and make an inventory of deep-water fish community data;

e) consider the possibilities of carrying out assessments for deep-sea resources and developing advice consistent with the precautionary approach;

f) investigate what further information is needed to provide a basis for comprehensive management measures for appropriate stock units (which might include conventional catch, effort and gear restrictions) to conserve deep water species.

The above Terms of Reference are set up to provide ACFM with the information required to respond to requests for advice/information from NEAFC and EC XIV Fisheries.

SGDEEP will report to ACFM at its May 2000 meeting.

2 OVERVIEW

2.1 Background

The first ICES Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources was held in 1994 (C.M. 1995/Assess:4). It provided the background information on what was known about deep-water fisheries within the ICES area and compiled landings data from both official statistics, where available, and from individual members of the Study Group. The report also summarised the current status of knowledge on the biology of these deep-water species. At this time ling, blue ling and tusk were the responsibility of the Northern Shelf Working Group.

The Study Group met by correspondence in 1995 (C.M.1995/Assess:21) but had little to report. The next meeting of the Study Group was in February 1996 (C.M.1996/Assess:8). Its terms of reference were to: (a) compile and analyse available data on a number of deep-water species (namely argentines, orange roughy, roundnose grenadier, black scabbard fish, golden eye perch (*Beryx splendens*) and red (blackspot) seabream (*Pagellus bogaraveo*)) in the ICES area and, if possible, provide assessments of the state of the stocks and the level of exploitation, and (b) provide information on the stocks and state of exploitation of the stocks of blue ling, ling, and tusk in Sub-areas IIa, IVa, V, VI, VII and XIV and identify outstanding data requirements. The Study Group met by correspondence in 1997 (C.M.1997/Assess:17) and, in addition to updating descriptions of fisheries, the available information on length/age at maturity, growth and fecundity of deep-water species, including blue ling, ling and tusk, was presented in tabular form. The available information on discards was also compiled.

The terms of reference for the 1998 meeting of the Study Group included the additional request to consider the possibility of carrying out assessments of fisheries for deep-sea resources and developing advice consistent with the precautionary approach. Although the possibilities for age structured assessments were still limited, there was sufficient expertise amongst those attending the Study Group to begin examining alternative assessment methodologies. The layout of the report (CM 1998/ACFM:12) was modified to conform to the format of an assessment working group report and the existing data were reformatted to allow for year on year updating. Several provisional assessments were carried out using DeLury constant recruitment and Schaefer production models.

The catch and effort assessment methods used by the Group suggested that time series of effort and CPUE may be particularly valuable for the assessment of deep-water species. The Study Group therefore recommended that member states maintain and refine long-term data series and where possible collate historical data. The Study Group recommended that the members be encouraged to provide discard and fish community data.

2.2 ACFM Report

The 1998 Report by ACFM (Anon., 1999, Coop.Res.Rep. No.229- Part 2) on the Deep-water Fisheries Resources south of 63° reflected the reorganisation of the Study Group report. The introductory section provided the background and the overall management considerations. It also included landings tables for species for which no assessment was possible. Previously only ling, blue ling and tusk were treated separately from the general consideration of deep-water species. Roundnose grenadier, black scabbardfish, argentines and orange roughy were treated separately in the 1998 report.

2.3 NEAFC

The European Commission hosted and chaired an Open Hearing on Deep-Sea Species in June 1999. This followed the extraordinary meeting of NEAFC in February 1999 at which the seriousness of the 1998 ICES management advice for deep-sea species was discussed. The hearing was intended as an opportunity for all NEAFC contracting parties to constructively discuss deep-sea fisheries management in an open atmosphere. Of particular focus were the biological status of stocks, scientific activities aimed at deep-sea species and the scope for systematic management of deep-sea fisheries.

The main results of the 1998 report of ICES Study Group and the recommendations of ACFM were presented to the meeting which included representatives from The European Commission, France, Germany, UK, Spain, Portugal, Denmark, Sweden, Ireland, Norway, Faroe Islands, Iceland, ICES and NEAFC.

The subject of deep-water fishing was discussed at the November 1999 meeting of NEAFC and the following requests were made to ICES:

- What further information is needed to provide a basis for comprehensive management measures for appropriate stock units (which might include conventional catch, effort and gear restrictions) to conserve deep-water species.

- What interim management measures could be introduced based on existing biological information.

In the press statement issued after the November 1999 meeting it was stated that:

"The Commission discussed several proposals for the management of fisheries for deep sea species outside national jurisdiction in the North East Atlantic in order to improve the collection of information and reduce the effort in fisheries that are not sustainable. This will be given priority during the working year of NEAFC".

2.4 Data availability

At the end of the 1998 meeting of the Study Group species co-ordinators were appointed. Their task was to collate all the available data prior to the meeting and send them to an assessment co-ordinator. Although not perfect, this arrangement facilitated the assessment work at the meeting.

In addition to the normal sources from ICES and individual institutes the following projects relevant to deep-water species were noted by the Study Group and the data were referenced or utilised where appropriate.

2.4.1 EC FAIR 95-655 Developing deep-water fisheries: data for their assessment and for understanding their interaction with and impact on a fragile environment (Deep-fisheries)

In December 1995 The European Commission funded a three year DGXIV FAIR project entitled "Developing deep-water fisheries: data for their assessment and for understanding their interaction with and impact on a fragile environment (CT 95/655). The project aimed to describe these fisheries, ensure that existing survey data were worked up and archived, scientifically record the species being landed or discarded and investigate aspects of the biology of both target and non-target species. The project which had 13 partners covered the continental margin from Iceland to Greece and the inputs of partners from Iceland, Norway, United Kingdom, Ireland, Germany, France, Spain and Portugal are relevant to the ICES area. The final report was accepted by the Commission in December 1999 and it is anticipated that it will be made generally available on a web-site.

Under task 1 partners from Iceland, Norway, United Kingdom, Spain and Portugal provided detailed descriptions of the deep-water fisheries of their countries. Task 2 involved the compiling of mainly historical survey data and where appropriate its analysis. This was undertaken by Iceland, United Kingdom, Ireland, Germany, and Spain. Task 3 was concerned with collecting and analysing discard data. France and the United Kingdom sent observers on commercial trawlers fishing for deep-water species to the west of the British Isles. Norway collected data on the discards from the deep-water longline fisheries. Task 4 recognised that many deep-water species tend to be landed by grouped categories, for example deep-water sharks, and therefore involved sampling the landings. This was being carried out by Iceland, France, United Kingdom and Portugal. The final task, which involved all partners, carried out research on the biological parameters of deep-water species. The work content varied considerably between partners but the key elements were distribution, age estimation, growth and reproduction.

The final report of this project was available to the Study Group so that relevant areas of research could be referenced.

2.4.2 EC DGXIV 97/84 Environment and biology of deep-water species *Aphanopus carbo* in NE Atlantic: basis for its management (BASBLACK)

This project, which is being funded by the European Commission (DGXIV in support of the Common Fisheries Policy), began in early 1998. The project is being coordinated by Portugal and also has partners from Spain and the United Kingdom. The main objectives are to review the available information on black scabbardfish, establish a sampling programme of landings, investigate stock discrimination, investigate biological parameters (especially growth, feeding, and reproduction); collect relevant data on the habitat and environment, monitor the levels of bioaccumulation and establish a system of data management. Some preliminary results of this project were provided to the Study Group (Figueiredo, Working Document). (See also Section 13)

2.4.3 EC DGXIV 97/81 Seasonal changes in biological and ecological traits of demersal and deep-water fish species in the Azores

This project, which is being funded by the European Commission (DGXIV in support of the Common Fisheries Policy), began in early 1998 and is being coordinated by Portugal with the United Kingdom as a partner. The overall objective is to improve current knowledge on age estimation, growth and reproduction of some of the commercially important demersal and deep-water species exploited in the Azores. Investigations are also being carried out on stock

discrimination using micro-satellite DNA. The ecological studies include the relationship between local hydrography, topography, life-history parameters, and spatial scales of genetic differentiation in deep-sea fish for a better understanding of the population biology of the target species. The vertical and horizontal migrations, changes in the feeding habits and some other aspects of the biology of the target species between seamounts and islands margins are also being studied.

2.4.4 EC FAIR 98/4365 Otolith microchemistry as a means of identifying stocks of deep-water demersal fish (Otomic)

This project is being coordinated by the United Kingdom with Spain as a partner. The objective is to use the chemical signal embedded in the otoliths to discriminate between stocks of deep-water species. The underlying principle is that otoliths are inert objects and during their life incorporate a chemical signature of water mass in which they live. Differences in chemical composition, especially in the nucleus, could indicate different origin and hence stock. The project involves both the Atlantic and the Mediterranean. The species involved are the roundnose grenadier (*Coryphaenoides rupestris*), *Nezumia aequalis*, hake (*Merluccius merluccius*), bluemouth (*Helicolenus dactylopterus*).

2.4.5 DGXIV Study Contract 99/55 Development of elasmobranch assessment (DELASS)

This project, which is being funded by the European Commission (DGXIV in support of the Common Fisheries Policy), began in January 2000 is being co-ordinated the Netherlands (RIVO) and has 16 partners from 10 countries. The overall objective is to improve the scientific basis for the management of the fisheries on elasmobranch species. The project is selective for groups of elamobranch species. The deep-water sharks to be considered are *Centroscymous coelolepis, Dalatias licha* and *Galeus melastomus*

2.4.6 UK JNCC Contract

This two year contract with partners from the UK and France CEFAS, IFREMER is investigating the effects of deep-water fishing using trawl survey data from the Rockall Trough. Some stock assessments have also been carried out, and the data and results were made available to the study group.

2.5 Summary of landings

The estimated landings of deep-water species by ICES Sub-area and division for the period 1988 to 1999 (preliminary data) are given in Table 2.1. The data in this Table are derived from a variety of sources. Study Group members have provided information that has filled some of the gaps in the STATLANT database but an inspection of the more detailed information presented for each species in the following sections of this report will reveal that the data are still incomplete. For this reason, some of the apparent trends and fluctuations during the time series should be treated with caution. Some new data not available to previous meetings of the Study Group have been used to refine and correct landings data.

In ICES Sub-area II there are directed longline fisheries for ling and tusk. There is also a directed bottom and pelagic trawl fishery for *Argentina silus* and a minor fjord fishery for roundnose grenadier. Roughhead grenadier are taken as bycatch in the trawl, gillnet and longline fisheries for Greenland halibut and redfish.

In ICES Sub-area III there is a targeted trawl fishery for roundnose grenadier and *Argentina silus*. These species are also a bycatch of the *Pandalus* fishery, and probably only a minor part of this bycatch is landed.

In ICES Sub-area IV there is a bycatch of *Argentina silus* from the industrial trawl fishery. There is a longline fishery for tusk and ling with roughhead grenadier as a bycatch. There is a bycatch of some deep-water species in the trawl fisheries targeting *Lophius* spp. and Greenland halibut.

In ICES Sub-area V there are trawl fisheries which target blue ling, redfish, argentine (*Argentina silus*) and occasionally orange roughy. By-catch species are typically roundnose grenadier (*Coryphaenoides rupestris*), roughhead grenadier (*Macrourus berglax*), black scabbard fish (*Aphanopus carbo*), anglerfish (*Lophius piscatorius*), bluemouth (*Helicolenus dactylopterus*), Mora (*Mora moro*), greater forkbeard (*Phycis blennoides*), argentine (*Argentina silus*), deep-water cardinal fish (*Epigonus telescopus*) and rabbit fish (*Chimaera monstrosa*). There are traditional longline fisheries for ling and tusk and these species are also bycatches in trawl and gillnet fisheries. There are also targeted trawl and gill net fisheries for Greenland halibut and *Lophius* spp which have deep-water bycatch of for example deep-water red crab (*Chaceon affinis*). There have also been trap fisheries for the deep-water red crab (*Chaceon* (formerly *Geryon*) *affinis*).

In ICES Sub-areas VI and VII there are directed trawl fisheries for blue ling, roundnose grenadier, orange roughy, black scabbard fish and the deepwater sharks *Centroscymnus coelolepis* and *Centrophorus squamosus*. By catch species include bluemouth (*Helicolenus dactylopterus*), mora (*Mora moro*), greater forkbeard (*Phycis blennoides*), argentine (*Argentina silus*), deep-water cardinal fish (*Epigonus telescopus*) and chimaerids of which *Chimaera monstrosa* is the most important. In some years there are considerable bycatches of *Argentina silus* in the blue whiting fishery and *A.silus* has been targeted in some years. There are directed longline fisheries for ling and tusk and also for hake. Deep-water sharks are a bycatch of the longline fisheries. There are targeted fisheries for sharks in Sub-areas VI and VII. There is gill net fishery in Sub-area VII for ling.

In ICES Sub-area VIII there is a longline fishery which mainly targets greater forkbeard (*Phycis blennoides*). There are also some trawl fisheries targeting species such as hake, megrim, angler fish and *Nephrops* which have a bycatch of deep-water species. These include *Molva* spp., *Phycis phycis*, *Phycis blennoides*, *Pagellus bogaraveo*, *Conger conger*, *Helicolenus dactylopterus*, *Polyprion americanus* and *Beryx* spp.

In ICES Sub-area IX some deep-water species are a bycatch of the trawl fisheries for crustaceans. Typical species are bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*) conger eel (*Conger conger*), blackmouth dogfish (*Galeus melastomus*), kitefin shark (*Dalatias licha*) and gulper shark (*Centrophorus squamosus*). There is a directed longline fishery for black scabbard fish with a bycatch of the *Centroscymnus coelolepis*. There is also a artisanal longline (Voracera) fishery for *Pagellus bogaraveo*.

In ICES Sub-area X the main fisheries are by handline and longline and the main species landed are red (=blackspot) seabream (*Pagellus bogaraveo*), wreckfish (*Polyprion americanus*), conger eel (*Conger conger*), bluemouth (*Helicolenus dactylopterus*), golden eye perch (*Beryx splendens*) and alfonsino (*Beryx decadactylus*). At present the catches of kitefin shark (*Dalatias licha*) are made by the longline and handline deep-water vessels and can be considered as accidental. There are no vessels at present catching this species using gillnets. In 1998 and 1999 two commercial longliners from Madeira, operated in this Sub-area. In 1998 and 1999 some commercial fishing experiments targeting deep-water crustaceans species (deep water crabs and shrimps), were also undertaken. There are trawl fisheries for golden eye perch (*Beryx splendens*), orange roughy (*Hoplostethus atlanticus*), cardinal fish (*Epigonus telescopus*), black scabbard fish (*Aphanopus carbo*) and wreckfish (*Polyprion americanus*).

In ICES Sub-area XII there are trawl fisheries on the Mid Atlantic Ridge for orange roughy (*Hoplostethus atlanticus*) and black scabbard fish (*Aphanopus carbo*). There is also a targeted roundnose grenadier fishery on the Mid Atlantic Ridge. There is a multi-species trawl fishery on Hatton Bank.

In ICES Sub-area XIV there are trawl and longline fisheries for Greenland halibut and redfish that have bycatches of roundnose grenadier, roughhead grenadier and tusk.

2.6 Aims

The Study Group was encouraged by the ACFM evaluation of the 1998 and with the addition of, in most cases, a further two years of data decided to continue with non-aged based assessments.

No action had been taken on a recommendation of the 1998 report (CM 1998/ACFM:12) that the elasmobranch fishes be transferred to the Study Group for Elasmobranch Fishes. However, in the interim a new EC funded project on the assessment of elasmobranch fishes was funded. Although this project has a much wider remit than deep-water species, many of the partners belong to one or both of the Study groups. It was agreed to continue to document the data and carry out assessments on deep-water sharks using information available to the members of SGDEEP.

Table 2.1 Estimated landings (tonnes) of deep-water species by ICES Sub-areas and Divisions, 1988-1997.

I+II	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)												
	ARGENTINES (Argentina silus)	11351	8390	9120	7741	8234	7913	6807	6775	6604	4463	7465	7057
	BLUE LING (Molva dypterigia)	3537	2059	1413	1480	1039	1020	410	357	270	300	280	289
	BLACK SCABBARDFISH (Aphanopus carbo)												
	GREATER FORKBEARD (Phycis blennoides)	0	0	23	39	33	1	0	0	0	0	0	0
	LING (Molva molva)	6119	7368	7628	7793	6521	7093	6309	5954	6219	5404	9195	7645
	MORIDAE												
	ORANGE ROUGHY (Hoplostethus atlanticus)												
	RABBITFISHES (Chimaerids)												
	ROUGHHEAD GRENADIER (Macrourus berglax)	0	0	589	829	424	136	0	0	0	17	55	
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)		22	49	72	52	15	15	7	2	106	100	44
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)												
	SHARKS, VARIOUS	37	15	0	0	0	0	0	0	0	0	0	0
	SILVER SCABBARDFISH (Lepidopus caudatus)												
	SMOOTHHEADS (Alepocephalidae)												
	TUSK (Brosme brosme)	14403	19350	18628	18306	15974	17584	12566	11388	12634	9332	15280	17153
	WRECKFISH (Polyprion americanus)												

III+IV	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)	0	0	1	0	2	0	0	0	0	0	0	0
	ARGENTINES (Argentina silus)	2714	3786	2321	2554	4435	3275	1146	1082	2051	2721	1587	7
	BLUE LING (Molva dypterigia)	385	481	514	642	592	436	434	503	194	290	289	269
	BLACK SCABBARDFISH (Aphanopus carbo)	2	0	57	0	0	0	16	2	4	2	9	0
	GREATER FORKBEARD (Phycis blennoides)	15	12	115	181	145	34	12	3	18	7	12	7
	LING (Molva molva)	11933	12486	11025	10943	11881	13985	12114	13960	13543	12322	14466	10374
	MORIDAE												
	ORANGE ROUGHY (Hoplostethus atlanticus)												
	RABBITFISHES (Chimaerids)												
	ROUGHHEAD GRENADIER (Macrourus berglax)	0	0	0	0	7	0	0	0	0	36	30	22
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	618	1055	1439	2053	4247	1929	2139	2312	1238	2301	4793	56
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)												
	SHARKS, VARIOUS	5	16	20	17	139	63	99	39	56	91	64	34
	SILVER SCABBARDFISH (Lepidopus caudatus)	0	0	0	0	27	0	0	0	0	0	0	0
	SMOOTHHEADS (Alepocephalidae)												
	TUSK (Brosme brosme)	4490	6515	4319	4623	5015	5221	3429	3405	3446	2289	3459	2452
	WRECKFISH (Polyprion americanus)												

Va	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)	0	0	5	0	4	0	1	0	0	0	0	0
	ARGENTINES (Argentina silus)	206	8	112	247	657	1255	613	492	808	3367	13387	7243
	BLUE LING (Molva dypterigia)	2171	2533	3021	1824	2906	2233	1921	1634	1323	1344	1153	1898
	BLACK SCABBARDFISH (Aphanopus carbo)	0	0	0	0	0	0	0	0	0	1	0	0
	GREATER FORKBEARD (Phycis blennoides)												
	LING (Molva molva)	5861	5612	5598	5805	5116	4854	4604	4192	4060	3933	4302	4646
	MORIDAE												
	ORANGE ROUGHY (Hoplostethus atlanticus)	0	0	0	65	382	717	158	64	40	79	28	0
	RABBITFISHES (Chimaerids)	0	0	0	499	106	3	60	106	21	15		37
	ROUGHHEAD GRENADIER (Macrourus berglax)	0	0	0	0	0	0	0	0	15	4	0	
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	2	4	7	48	210	276	210	398	140	198	120	0
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)												
	SHARKS, VARIOUS	0	31	54	58	70	39	42	45	65	70	1	0
	SILVER SCABBARDFISH (Lepidopus caudatus)												
	SMOOTHHEADS (Alepocephalidae)	0	0	0	0	10	3	1	1	0	0	0	0
	TUSK (Brosme brosme)	6855	7061	7291	8732	8009	6075	5824	6225	6102	5394	5171	7288
	WRECKFISH (Polyprion americanus)												

Table 2.1 (Continued)

Vb	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)	0	0	5	0	4	0	0	1	0	0	0	0
	ARGENTINES (Argentina silus)	287	227	2888	60	1443	1063	960	12286	9498	8433	17570	5*
	BLUE LING (Molva dypterigia)	9,528	5,266	4,799	2,962	4,702	2,836	1,637	2,440	1,602	2798	2584	4,881
	BLACK SCABBARDFISH (Aphanopus carbo)	0	166	419	152	33	287	160	424	186	68	180	165
	GREATER FORKBEARD (Phycis blennoides)	2	1	38	53	49	22	0	9	7	7	8	33
	LING (Molva molva)	4488	4652	3857	4512	3614	2856	3622	4070	4896	5657	5359	5196
	MORIDAE	0	0	0	5	0	0	0	0	0	0	0	0
	ORANGE ROUGHY (Hoplostethus atlanticus)	0	0	22	48	13	37	170	420	79	18	3	4
	RABBITFISHES (Chimaerids)	0	0	0	0	0	0	0	1	0	0	0	0
	ROUGHHEAD GRENADIER (Macrourus berglax)												
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	1	258	1549.05	2311.46	3817.5	1681.42	667.936	1223.39	1077.66	1112	1667	2054
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)												
	SHARKS, VARIOUS			140	81	162	477	192	262	380	308	433	285
	SILVER SCABBARDFISH (Lepidopus caudatus)												
	SMOOTHHEADS (Alepocephalidae)												
	TUSK (Brosme brosme)	5,665	5,122	6,181	6,266	5,391	3,439	4,315	3,977	3,310	3319	2710	3952
	WRECKFISH (Polyprion americanus)												

* preliminary

VI+VII	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)	0	12	8	0	3	1	5	3	178	25	81	78
	ARGENTINES (Argentina silus)	10438	25559	7294	5197	5906	1577	5707	7546	5863	7301	5555	270
	BLUE LING (Molva dypterigia)	9,288	9,422	5,964	6,235	6,645	5,526	4,355	4,839	6,915	6866	7278	8,169
	BLACK SCABBARDFISH (Aphanopus carbo)	0	154	1060	2759	3436	3529	3101	3278	3689	2995	1967	1631
	GREATER FORKBEARD (Phycis blennoides)	1898	1815	1921	1574	1640	1462	1571	2138	3590	2335	3040	2176
	LING (Molva molva)	28,092	20,545	15,766	14,684	12,671	13,763	17,439	20,856	20,838	16668	19863	14910
	MORIDAE	0	0	0	1	25	0	0	0	0	0	0	8
	ORANGE ROUGHY (Hoplostethus atlanticus)	0	8	17	4908	4523	2097	1901	947	995	1039	1071	1401
	RABBITFISHES (Chimaerids)	0	0	0	0	0	0	2	0	0	0	0	0
	ROUGHHEAD GRENADIER (Macrourus berglax)												
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	32	2440	5730	7793	8338	10121	7860	7767	7095	7070	6364	5747
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)	252	189	134	123	40	22	10	8	33	36	13	15
	SHARKS, VARIOUS	85	40	345	1438	3441	4818	5473	5516	5460	6224	5590	3743
	SILVER SCABBARDFISH (Lepidopus caudatus)	0	0	0	0	0	2	0	0	0	0	0	0
	SMOOTHHEADS (Alepocephalidae)										7		
	TUSK (Brosme brosme)	3,002	4,086	3,216	2,719	2,817	2,378	3,233	3,085	2,417	1832	2240	1775
	WRECKFISH (Polyprion americanus)	7	0	2	10	15	0	0	0	83	0	12	5

VIII+IX	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)	0	0	1	0	1	0	2	82	88	135	269	47
	ARGENTINES (Argentina silus)												
	BLUE LING (Molva dypterigia)	0	0	0	0	0	0	0	0	0	14	33	2
	BLACK SCABBARDFISH (Aphanopus carbo)	2602	3473	3274	3979	4389	4513	3429	4272	3815	3556	3152	2511
	GREATER FORKBEARD (Phycis blennoides)	81	145	234	130	179	395	320	384	456	361	665	56
	LING (Molva molva)	1028	1221	1372	1139	802	510	85	845	1041	1034	1799	676
	MORIDAE								83	52	88		
	ORANGE ROUGHY (Hoplostethus atlanticus)	0	0	0	0	83	68	31	7	22	27	15	10
	RABBITFISHES (Chimaerids)												
	ROUGHHEAD GRENADIER (Macrourus berglax)												
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	0	0	5	1	12	18	5	0	1	0	1	0
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)	826	948	906	666	921	1175	1135	939	1001	1036	831	554
	SHARKS, VARIOUS	5270	3397	1555	3876	4883	934	807	1596	1354	2498	3183	1569
	SILVER SCABBARDFISH (Lepidopus caudatus)	2666	1385	584	808	1374	2397	1054	5672	1237	1723	966	3058
	SMOOTHHEADS (Alepocephalidae)										7		
	TUSK (Brosme brosme)	1	0	0	0	0	0	0	0	0	0	1	0
	WRECKFISH (Polyprion americanus)	198	284	163	194	269	338	409	393	294	214	227	144

Table 2.1 (Continued)

X	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)	225	260	338	371	450	728	1500	623	536	983	228	175
	ARGENTINES (Argentina silus)												
	BLUE LING (Molva dypterigia)	18	17	23	69	31	33	42	29	26	21	13	10
	BLACK SCABBARDFISH (Aphanopus carbo)	0	0	0	166	370	2	0	3	11	3	99	45.668
	GREATER FORKBEARD (Phycis blennoides)	29	42	50	68	81	115	135	71	45	30	38	41
	LING (Molva molva)												
	MORIDAE	0	0	50	0	0	0	0	0	0	0	0	0
	ORANGE ROUGHY (Hoplostethus atlanticus)	0	0	0	0	0	1	0	0	471	6	177	0
	RABBITFISHES (Chimaerids)												
	ROUGHHEAD GRENADIER (Macrourus berglax)												
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	0	0	0	0	0	0	0	0	3	1	1	1
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)	637	924	889	874	1110	829	983	1096	1036	1012	1114	1222
	SHARKS, VARIOUS	1098	2703	1204	3864	4241	1183	309	1246	1117	859	995	39
	SILVER SCABBARDFISH (Lepidopus caudatus)	70	91	120	166	2160	1722	373	789	815	1115	1186	86
	SMOOTHHEADS (Alepocephalidae)												
	TUSK (Brosme brosme)												
	WRECKFISH (Polyprion americanus)	191	235	224	170	237	311	428	240	240	177	139	133

XII	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)	0	0	0	0	0	0	0	2	0	0	0	0
	ARGENTINES (Argentina silus)	0	0	0	0	0	6	0	0	1	0	0	0
	BLUE LING (Molva dypterigia)	263	70	0	47	440	1127	485	573	788	417	422	1002
	BLACK SCABBARDFISH (Aphanopus carbo)	0	0	0	0	512	1144	824	0	444	200	154	109
	GREATER FORKBEARD (Phycis blennoides)					1	1	3	4	2	2	1	1
	LING (Molva molva)	0	0	3	10	0	0	5	50	2	9	2	2
	MORIDAE										32	42	114
	ORANGE ROUGHY (Hoplostethus atlanticus)	0	0	0	0	8	32	93	676	818	808	629	70
	RABBITFISHES (Chimaerids)	0	0	0	0	0	0	0	0	0	32		
	ROUGHHEAD GRENADIER (Macrourus berglax)												
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	10000	8000	2300	7610	2397	2341	1161	285	1728	9216	11978	9085
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)	0	0	0	0	0	0	75	0	0	0	0	0
	SHARKS, VARIOUS				3864	4241	1183	309	1246	1117	859	1106	1063
	SILVER SCABBARDFISH (Lepidopus caudatus)	0	102	20	0	0	19	0	0	0	0	0	0
	SMOOTHHEADS (Alepocephalidae)	0	0	0	0	0	0	0	0	230	3692	4632	6549
	TUSK (Brosme brosme)	1	1	0	1	1	12	0	18	158	30	1	1
	WRECKFISH (Polyprion americanus)												

XIV	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	ALFONSINOS (Beryx spp.)												
	ARGENTINES (Argentina silus)	0	0	6	0	0	0	0	0	0	0	0	0
	BLUE LING (Molva dypterigia)	242	71	79	155	110	3725	384	141	14	4	55	8
	BLACK SCABBARDFISH (Aphanopus carbo)	0	0	0	0	0	0	0	0	0	0	2	0
	GREATER FORKBEARD (Phycis blennoides)												
	LING (Molva molva)	3	1	9	1	17	9	6	17	0	61	6	1
	MORIDAE												
	ORANGE ROUGHY (Hoplostethus atlanticus)												
	RABBITFISHES (Chimaerids)												
	ROUGHHEAD GRENADIER (Macrourus berglax)	0	0	0	0	0	52	5	2	0	0	6	14
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	52	45	47	29	31	26	15	27	25	59	126	124
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)												
	SHARKS, VARIOUS	0	0	0	0	0	0	0	0	0	9	15	0
	SILVER SCABBARDFISH (Lepidopus caudatus)												
	SMOOTHHEADS (Alepocephalidae)												
	TUSK (Brosme brosme)	2	4	19	134	202	80	25	87	281	118	14	9

3 ASSESSMENT METHODOLOGY AND SOFTWARE

This section summarises the methods and software used by Study Group.

3.1 Methods

Catch curve analysis

The Group were aware of the assumption of constant recruitment implied when constructing catch curves within years. Lack of historical data frequently required this course of action rather than the preferred option of analysing individual year classes by cohort.

Depletion models

A catch and effort data analysis package (CEDA) was used to apply modified Delury constant recruitment models when sufficient data were available. The Study Group recognised that depletion models in general assume that data are from a single stock (i.e., there is no immigration or emigration) and that this approach should not be applied to components of stocks or fisheries. Notwithstanding these assumptions, and the lack of knowledge regarding the stock structure of deep-water species, the Group still felt these methods were worth trying as an investigative tool. The general procedure adopted was to use sensitivity analysis to evaluate the effect on results (goodness of fit, residual plots, parameter estimates- principally carrying capacity, catchability and current population size) of a range of assumptions for stock size in the first year as a proportion of carrying capacity and error models. Indexed recruitment depletion models could not be attempted because of a lack of recruit data.

Production models

CEDA was also used to fit dynamic (ie non-equilibrium) Schaefer production models. Again sensitivity analysis of outputs was used to evaluate the effect of error models and ratio of initial to virgin biomass. A time-lag of zero was used in the majority of assessments because available time-series of catch and CPUE were too short (frequently 8-10 years) to explore the effect of time-lag over a range of years commensurate to age of recruitment. It was assumed, therefore, that growth rather than recruitment was the main contributor to biomass production. For some of the stocks assessed, available time-series data of CPUE comprise a gradual decline across the time period studied. The Study Group were aware that the results from production models in these circumstances (the so called 'one way trip') can be unreliable.

Length and age-based VPA analysis

These methods were not used because where data were available they were considered to be insufficient for analysis.

Assuming that data continue to be collected, it is anticipated that there may be sufficient catch-at-age and tuning data for *Pagellus bogaraveo* in Sub-area X and ling in Vb to attempt an XSA based VPA for these stocks when the Study Group next meets in 2002.

***Ad hoc* methods**

Where *ad hoc* methods have been used these are described in the relevant species assessment sections.

3.2 Software

The main assessment software used at the Study Group was CEDA: Catch Effort data analysis, produced by MRAG Ltd, 27 Campden Street, London W8 7EP, UK.

4 PRECAUTIONARY APPROACH

Deep-water fishes continue to receive increased attention from national and international management authorities, conventions and non-governmental organisations. Increasing fishing effort on species many of which are generally considered to be long-lived, slow growing, with low reproductive potential for replacement is a potentially serious threat to deep-water fish stocks in many parts of the world. Moreover, for most stocks the effect of increased levels of fishing is difficult to determine because of a lack of scientific data. However, this is now no longer justification for not introducing management measures. Article 7.5 of the FAO Code of Conduct states that:-

"*States should apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment. The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation or management measures. In implementing the precautionary approach, States should take into account, inter alia, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities, including discards on non-target and associated and dependent species as well as environmental and socio-economic conditions. States and subregional or regional fisheries management organisations and arrangements should, on the basis of the best scientific evidence available, inter alia, determine stock specific limit reference points and, at the same time, the action to be taken if they are exceeded."*

The urgent need to implement the precautionary approach to manage deep-water fish stocks is exacerbated by the low survival rate of discarded species and escapees. Thus, increasing fishing effort will affect deep-water fish assemblages in general and not just species of commercial importance.

With regard to suitable biological reference points for deep-water stocks, given that the basic data available for these stocks is still comparatively sparse the Group felt that the measures of limit and pa reference points suggested for data-poor situations by the ICES Study Group on the Precautionary Approach to Fishery Management (ICES C.M. 1997/Assess:7) remain appropriate:-

$F_{lim} = F_{30\ \%SPR}$

$F_{pa} = M$

$U_{lim} = 0.2 * U_{max}$ (may be a smoothed abundance index)

$U_{pa} = 0.5 * U_{max}$

Where U is the index of exploitable biomass (notation used for deep-water stocks by ACFM in May 1998).

The Group have attempted to comment on the state of stocks in relation to these reference points whenever possible.

5 STOCK SUMMARY

Table 5.1 Stock summary for species considered by ICES Deep Sea Study Group. The Study Group acknowledges that stock units are not well defined for the above species.

Species	ICES Sub-area/division	Assessment type and final year of data	Salient features	State of stock	Concerns / comments
Ling *(Molva molva)*	IIa,IVa,V,VI and VII	Catch curve + CPUE. 1997 and 1999 for Vb	Strong decline in CPUE except for Va. Average Z in recent years is about 0.7 for all areas.	Stock declining (except Va). Remains below Upa and may be near Ulim	Length and age data series still inadequate for analytical assessment. Effort series interrupted for all areas except Vb
Blue ling *(Molva dypterygia)*	I-XII and XIV	CPUE only. 1998.	Strong decline in CPUE	Stock declining considered to be below Ulim	Fishing on spawning concentrations implies that CPUE trend may underestimate the stock trends and should be treated with caution -. Still major difficulty with age determination
Tusk *(Brosme brosme)*	IIa,IVa,V,VI	Catch curve + CPUE only. 1997 and 1999 for Vb	Strong decline in CPUE, particularly in Vb and VI.	Stock declining except Va May be below Ulim in Vb	Length and age data series still inadequate for analytical assessment. Effort series interrupted for all areas except Vb
Greater Argentine *(Argentina silas)*	Mainly IIa,III,V,VI,VI I	No recent assessment		No new information	Dutch fishery has remained stable Fishery in Va and Vb has increased.
Orange Roughy *(Hoplostethus atlanticus)*	Mainly V, VI, VII and XII	Modified De Lury, Schaefer in VI and Schaefer in VII.	Stock fished down very quickly in VI. Situation in VII unclear	Stock biomass in 1998 below U pa and maybe close to Ulim. Situation on VII less clear	CPUE trends may only reflect fish density on successively exploited aggregations..Assessment based on short time-series. Short CPUE series
Roundnose Grenadier *(Coryphaenoides rupestris)*	III,V, VI VII and XII. Data mainly from V,VI & VII	Schaefer V, VI and VII	CPUE declining	Below Upa may be close to Ulim	Requirement for age data. Short CPUE series
Black Scabbardfish *(Aphanopus carbo)*	Mainly V,VI,VII,VIII and IX	Modified De Lury .and Schaefer in V,VI VII and XII.	Strong decline in CPUE for VI. Which is the main fishing area	Below Upa in V VI VII and XII and maybe below Ulim. Situation in IX unclear.	Short CPUE series. Stock structure unknown.
Golden Eye Perch *(Beryx splendens)*	Mainly X	No information		Unknown	Concern about reporting from internnational waters.
Red (blackspot) Seabream *(Pagellus bogaraveo)*	Mainly in and X. and residual in VI, VII and VIII	No assessement	In x decreasing until 1994 and slight increase. LPUE in IX decreasing since 1997	Uncertain in IX and X. Historical trend of landings for other areas indicates a collapse of fishery.	Updated information for X. New information for IX. Ongoing survey data for X reqired.
Deepwater sharks Mainly *Centroscymnus coelolepis* and *Centrop-horus squamosus*	Vb,VI and VII	De Lury and Schaefer on Vb, VI and VII	Strong decline in CPUE, particularly in VI	Below Upa	Short CPUE time series. Need for species separated data
Phycis blennoides	All areasbut mainly VI, VII, VIII and IX	No assessment	No trends in CPUE for VI + VII	Unknown	Mainly bycatch

6 GENERAL

6.1 Descriptions of fisheries

6.1.1 Faroe Islands

Longline fisheries for tusk *(Brosme brosme)*, ling *(Molva molva)* and blueling *(Molva dypterygia)* have been well established for many years. In the late 1970s the trawl fishery extended into deeper water targeting redfish *(Sebastes spp.)* and blue ling and to a lesser degree black scabbardfish *(Aphanopus carbo)* and roundnose grenadier *(Coryphaenoides rupestris).* In the 1990s a gill net fishery directed at monkfish *(Lophius piscatorius)* and Greenland halibut *(Reinhardtius hippoglossoides)* developed and more recently a directed longline fishery on deepwater sharks (*Centroscymnus coelolepis* and *Centrophorus squamosus*) was initiated. A trawl fishery for argentine *(Argentina silus)* has been expanded rapidly in recent years. Most fisheries take place inside the Faroese zone, but from time to time the fishery has been expanded to the Hatton Bank/Rockall area, eg. targeting blue ling during spawning season.

In the early 1990s one trawler fished continuously on Hatton Bank for 5-6 years. During the first quarter of the year the vessel was targeting blue ling. In the second quarter black scabbardfish became the most important species and later in the year roundnose grenadier had increasing importance. The trawler has now changed to fishing on the shelf.

Following a special exploratory trawl fishing programme initiated in 1992 aimed at orange roughy (*Hoplostethus atlanticus*), one trawler has been regularly fishing on the Mid-Atlantic Ridge. The fishery is directed towards orange roughy most of the time, but sometimes other deep-sea species as black scabbardfish, roundnose grenadier and deep-water sharks are taken.

6.1.2 France

Deep-water fishery for typical deep-water species (*Coryphaenoides rupestris*, *Hoplostethus atlanticus*, deep-water squalids, *Molva dipterygia*, *Aphanopus carbo*)

Almost all the landings of deep-water fishes are now recorded in three ports: Boulogne sur mer, Concarneau and Lorient (Lorance and Lespagnol, working document). The landings are all from the high seas trawlers from these ports. There are roughly two categories of high seas trawlers involved in the French deep-water fishery: large trawlers (14 vessels from 50 to 55 m long, from Boulogne sur mer and Lorient and medium trawlers (31 vessels from 32 to 40 m long for Concarneau and Lorient). Many of these vessels land a part of their catches in Scotland and Ireland, however, these catches are carried to France by lorries or cargo boats and sold in French fish auction markets.

Smaller trawlers from the southern Brittany ports which had been fishing for deep-water species have now ceased this activity for 2-3 years.

One port specialised in longline fishing recorded a catch of about 20 tons of deep-water squalids in 1999, probably from the Bay of Biscay.

Fishery for other “deep-water” species.

The ports involved in deep-water fishing only account for two thirds of the catch of ling (*Molva molva*) and in those ports this species is also landed by artisanal (17-28 m) trawlers fishing on the shelf is Sub-areas VII and XIII. Similarly *Beryx splendens* and *Phycis blennoides* are landed both by the deep-water fleet and shelf trawlers.

6.1.3 Germany

There have been no new developments since the 1998 report.

6.1.4 Greenland

Traditionally there have been reported small by-catches of roundnose grenadier from the Greenland fisheries for Greenland halibut in ICES Division XIVB, but nothing was reported for 1999.

6.1.5 Iceland

The deep-water fisheries of Iceland have been briefly described in previous reports of the Study Group no changes have been reported. A review of the deep-water fisheries of Iceland has been published by Magnusson (1998) and in EC FAIR, 1999.

6.1.6 Ireland

The deepwater species that are regularly landed by Irish boats are ling, blue ling, tusk and forkbeard. The most important species is ling which is landed in considerable quantities (344 t) from Divisions VIIb, VIIc and VIIk mainly by otter trawl but also by gill-netters. In Division VIIg it is landed in about equal quantities by otter trawl and gill nets and as a by-catch in beam trawl fisheries targeting flat fish. Tusk and blue ling were landed in some quantities by larger Irish otter trawlers mainly from Division VIb. Some blue ling was landed by gill netters working in VIIk. Greater forkbeard was landed by gill-netters from Divisions VIIb and VIIc. However the main landings of this species were by larger trawlers in Sub Areas VI and VII. Some Irish pelagic trawlers landed argentine from Sub-area VI during 1999. Most landings of grenadier, orange roughy and black scabbardfish were landed from VI. Landings of sharks in Ireland are reported as various but few deepwater sharks were landed in 1999.

6.1.7 Norway

Longline fisheries

The longline fishery for ling (*Molva molva*) and tusk (*Brosme brosme*) remains the most important aimed deep-sea fishery in Norway (e.g. Bergstad and Hareide 1996). In 1997 and 1998, 53 and 58 vessels longer than 70 feet were engaged in these fisheries which are mainly conducted in ICES Divisions and Sub-areas IIa, IVa, V, VI, VII, and XIV. The longliner fleet also has other often preferred target species for parts of the year, primarily northeast Arctic cod in area I and IIa. A time series of effort data on the fisheries in the period 1974–1996, i.e., number of vessels, weeks at sea, distribution of effort by species and Norwegian Directorate of Fisheries statistical areas, were given in the 1998 report. The number of vessels declined until 1994, but the number increased again in the most recent years. Due to technological advances, effort in terms of number of hooks increased throughout the series despite the decline in number of vessels and number of weeks engaged in the fishery (see Hareide and Godø 1996; Bergstad and Hareide 1996; Magnússon *et al.* 1997a).

The same vessels may also temporarily target other species such as redfish (*Sebastes* sp.) and Greenland halibut (*Reinhardtius hippoglossoides)*. In recent years a longline fishery developed off southeastern Greenland at depths down to 1500 m. The target species is Greenland halibut), but probably as much as 30 % of the by-catch is roughhead grenadier (*Macrourus berglax*). The area of this fishery has expanded to eastern and western slopes of the Reykjanes Ridge south of Iceland.

In 1996, a dropline (and gillnet) fishery targeting "giant redfish" (*Sebastes marinus*) also developed on the Reykjanes Ridge (Sub-areas XII and Division XIVb). Detailed data on this fishery and estimated catches were presented in the final report of the EC FAIR project (EC FAIR, 1999). In 1996, 9 vessels were engaged in the fishery for a few weeks (number of active fishing days was 399). Tusk (*Brosme brosme*) and Atlantic halibut (*Hippoglossus hippoglossus*) were significant landed by-catches. By-catches of the deep-water shark *Centroscyllium fabrici* and some other species were discarded. In 1997, the number of vessels participating dropped to 7 and the effort in terms of fishing days declined by 77%. The activity declined further to low levels in 1998 and 1999, suggesting that this fishery was not viable at the level observed in 1996.

In 1999, some exploratory longlining was carried out on the northwestern slope of the Hatton Bank (see Langedal and Hareide (Working Document).

Trawl fisheries

The relevant trawl fisheries were described in previous reports (ICES C.M. 1994/Assess:4; ICES C.M. 1996/ Assess:8). There have been no major changes in the recent years.

Argentina silus has been targeted in trawl fisheries off mid-Norway (Division IIa) and the Skagerrak (IIIa) since the late 1970s. These fisheries have continued as described in ICES C.M. 1996/ Assess:8, but the effort directed at *A. silus* varies strongly with market demand. In Division IIa landings declined from top levels at 10 000 –11 000 t in the mid 1980s to about half that level in the early 1990s. In the most recent years there has been a slight increase. The fishery in the

Skagerrak is conducted by 1–3 trawlers and annual landings were 1 000–2 000 t/year in the late 1980s and early 1990s. Since then the activity declined and varied considerably, and landings ranged from less than 10 to 700 tonnes per year. In the Skagerrak (IIIa) and the northeastern North Sea (IVa), there are, however, trawl fisheries for Norway pout, blue whiting and deep-water shrimp (*Pandalus borealis*) that may have significant by-catches of *Argentina silus.*

No landings of by-catches of *Argentina silus* in the pelagic trawl fishery for blue whiting to the west of Scotland and Ireland (Sub-areas VI and VII) were recorded in recent years.

There is a minor fishery in mid-Norway (IIa) targeting roundnosed grenadier *Coryphaenoides rupestris* and *Argentina silus*. Six 120-140 foot trawlers have licences. Details on this fishery were given in the report of the EC FAIR project (EC FAIR, 1999). The roundnosed grenadier is also a by-catch in the shrimp and *Argentina silus* fisheries in the Skagerrak (IIIa), but the by-catches not landed for human consumption have not been quantified. Interview-based estimates suggest a total catch of around 1000 t/year in the shrimp fishery alone. The recorded landings are at most a few hundred tonnes.

As described in previous reports, some exploratory trawling was carried out on the Hatton Bank (VIa) and along the Mid-Atlantic Ridge (XII), but these were short-term experiments that have not thus far lead to the development of lasting new fisheries.

Gillnet fisheries

There is an aimed gillnet fishery for ling (*Molva molva*) on the upper slope off mid-Norway (Area IIa). This fishery started in 1979 as an aimed fishery for blue ling, but the catches of that species declined through the following decade to the extent that the fishery in the 1990s has become almost entirely focused on ling. Further details were presented in EC FAIR (1999).

6.1.8 Portugal

Mainland

Detailed descriptions of the three main deep-water fisheries of mainland Portugal have been contributed to the EC FAIR Deep-fisheries project (EC FAIR, 1999). A brief description is also given Moura *et al.* (1998) and Figueiredo *et al.* (Working Document). The three fisheries are the deep-water crustacean trawl fishery, the longline fishery for black scabbardfish and a longline fishery for deep-water sharks.

The crustacean trawl fishery targets rose shrimp (*Parapenaeus longirostris*) and Norway lobster (*Nephrops norvegicus*) off the south and southwest coasts of Portugal. The fleet is made up of about 35 open decked trawlers (17-35 m) most of which are about 20 years old. There are also two trawlers registered to fish on the west coast from the port of Cascai. The fishing grounds exploited range from 200 to 700 m depth but taking the fleet as a whole deep-water fishing has not been a major part of the effort in recent years. Some 17 species of fish are caught as a bycatch and some such as European conger (*Conger conger*) greater forkbeard (*Phycis blennoides*), blackmouth catshark (*Galeus melastomus*) and blackbelly rosefish (*Helicolenus dactylopterus*) are landed for human consumption.

The longline fishery for black scabbardfish began in 1983 and is based on the port of Sesimbra. In 1996 the fleet was made up of 22 vessels of which 15 are engaged all the year round. The fleet consists of wooden open decked vessels with lengths from about 8 to 22m which set their lines at depths between 800 to 1200 m. The bycatch consists of about six species of deep-water sharks which can generate extra income for the fishery. The fishery takes place on hard ground along canyon slopes.

The longline fishery for deep-water sharks targets mainly one species, the gulper shark (*Centrophorus granulosus*). It is based on the northern port of Viano do Castelo and was carried out by a fleet of six open decked vessels with a mean length of 18.6 m. in 1992. In 1997 there has been only one longliner engaged full time in this fishery. The lines are fished at depths of 800 to 1400 m and are fished closer to the bottom than those used for black scabbardfish.

Azores

The evolution of demersal fishery in the Azores can be characterised in three main phases. A first phase, before the beginning of 80's, was based on a traditional fishery by small open deck boats (<12 m), operating near the coast, using mainly handline gears and with small and selective catches. A second phase, started at the early 80's, is characterised by an important development of the fishery with introduction of the bottom longline gear and new fishing vessels

(longliners >12 m and < 30 m). As a consequence new species and new fishing areas and depths were explored, new markets were developed, and an abrupt increase in the total demersal catches and fishing effort were observed. The third phase is characterised by a stationary total catch and fishing effort and some of the stocks being considered intensively exploited. However, the effect of the multispecific character on the dynamics of the fishery is not yet very well understood.

This fishery can be considered as multispecific, since more than 20 species were caught by the longline fleet, which comprises more than 80% of the catches. Moroever, *Pagellus bogaraveo* can be considered the target species, other species have being caught and commercialised in significant quantities, like *Helicolenus dactylopterus*, *Conger conger*, *Beryx splendens*, *Beryx decadactylus*, *Pontinus khulii*, *Lepidopus caudatus*, *Polyprion americanus.* Some small quantities of other deeper species are also caught occasionally. This is the case of *Mora mora*, *Phycis blennoides*, *Molva dypterygia macrophthalma*, *Epigonus telescopus*, and some elasmobranches species like *Deania calceus*, *Deania profundorum*. Landings of some of these species are pooled in the fishery statistics and/or are not discriminated. Catches of demersal and deep-water species by the local fleets are all sold at aucton in the Azores. The catches of mainland longliners targeting the *Lepidopus caudatus* that operate in Azores are mainly landed in mainland Portugal.

At present the catches of kitefin shark (*Dalatias licha*) are made by the longline and handline deep-water fleets and can be considered as accidental. There are no vessels at present catching this species using gillnets. This change was related to local market problems and not with the biological state of the stock.

In 1998 and 1999 two longliners from Madeira, operated in the Azores (Area X), targeting black scabbardfish, during May/September and August/November periods respectively. The catch rates were high and there are prospects for an the increment of this fishery in the region in the near future. These commercial fishing experiments were undertaken with observers on board and some data were collected. Some quantities of *Centrophorus squamosus* were also caught as by-catch.

Experimental fishing surveys for deep sea crabs, *Chaceon affinis* and *Cancer bellianus* were carried out during 1997 and 1998. The results of these surveys suggest that a small fishery targeting these species could be established in the Azores. During 1999 a new experimental fishing survey starting in the coastal zones of Azores targeting deep water shrimps, mainly of the family Pandalidae. The exploitation of both of these new deep-water resources might contribute to the diversification of the present fishery and decrease the effort on traditional resources. Commercial fishing experiments for transference of technology of this fishery were realized during 1999.

Madeira

The most important deep-water fishery in Madeira Island (Portugal) is the longline fishery for black scabbardfish (*Aphanopus carbo*). The number of vessels is declining. In fact in 1988 there were 90 fishing vessels while in 1999 only 40 were engaged in this fishery. Despite this decline, effort in terms of number of hooks maintained throughout the series at the same level. The fishing vessels are made of wood with open deck; with an average overall length of 9m, a mean power of engine of 80 Hp and an average gross registered tonnage of 12 tonnes. There are around 500 fishermen directly involved in this fishery (Sena-Carvalho, Reis and Afonso-Dias, in preparation).

6.1.9 Russia

The recent Russian deep-water fishery has been described by Vinnechenko, Working Document.

Mid-Atlantic Ridge

The fishery for roundnose grenadier (*Coryphaenoides rupestris*) on the Ridge was started by one STM-type vessel (engine power 2400 h.p.) in April. The results from the directed fishery are given in Table 6.1. During June-July, one trawler of STM-type was operating on seamounts, with another BMRT-type vessel (engine power 2000 h.p.) joining for a short time in May. During an entire period of fishing the fleet operated along the section of the Ridge between 49°-53°N (ICES Subarea XII). Both pelagic and bottom trawls were used in the fishery. In 1999 the catch of roundnose grenadier (519 t) taken by Russian trawlers was less than in the two previous years.

Rockall

From May to November 1999 one or two trawlers of the BMRT-type operated in the Rockall area (Division VIb) outside the 200-mile economic zone. The fishery, mainly on haddock (*Melanogrammus aeglefinus*), grey gurnard (*Eutrigla gurnardus*) and on small redfish (*Sebastes viviparus*), was conducted with bottom trawls. Occasionally, when operating

at the depths below 250m the catches of deep-water fish, among which the most frequent were greater silver smelt (*Argentina silus*) and rabbit fish (*Chimaera monstrosa*), were taken by the trawlers. Total greater silver smelt catch made up 4.7 t (round weight) and 2.5 t of rabbit fish (round weight). In catch statistics, presented to the ICES by Russia, the fish species mentioned are included in Sections 10 and 17.

Norwegian Sea

Longliners and trawlers, conducting the fishery on demersal fish in the Norwegian Sea (Divisions IIa, IIb) during 1998-1999, occasionally caught roughhead grenadier (*Macrurus berglax*) and tusk (*Brosme brosme*) as by-catch.

Catches of roughhead grenadier were discarded by most longliners (10 vessels operated in 1998 and 17 - in 1999). Fish were processed and frozen only onboard three vessels The catches were 13 t (round weight) in 1998 and 12 t (round weight) in 1999. The entire catch was taken in the northern Norwegian Sea (Division IIb). Roughhead grenadier occurred also in small quantities from catches taken by the bottom trawlers fishing for cod and haddock. Almost the whole bycatch of roughhead grenadier is discarded and no information was recorded. Data on grenadier catches taken by three trawlers were reported only in 1999; the total catch taken in Divisions. IIa and IIb made up 0.3 t (round weight). From the results from the observations on research vessels, as well as by those used for experimental fishery, the catches of roughhead grenadier taken by a bottom trawl did not usually exceed several specimens/per hour. Longline catches from 200-400m depth did not exceed 15 kg/1000 hooks. However, at 400-700m depth the catch rates increased and attained 100-150 kg/1000 hooks.

Total Russian catches of tusk in 1999 constituted 32.2 t, including longliners 32.0 t. The results from the observations during experimental fishing in August-October 1999 (Division IIa) showed that tusk were caught by longline in small quantities, on average around 30 kg/longline (4-5 thousand hooks).

6.1.10 Spain

A comprehensive description of Spanish deep-water fisheries was given in the 1998 Report of the Study Group (ICES CM 1998/ACFM 12). The following main changes have taken place since 1998, all of them related with the directed fisheries on deep-water species.

The artisanal longline ("voracera") fleet in Division IXa.

A more complete description of the artisanal longline fleet ("voracera") focused on *Pagellus bogaraveo* ("Voraz", local name) fishery was given to the present Study Group by Gil *et al* (WORKING DOCUMENT). In 1999 around 100 vessels fished red seabream in a very small area close to the Gibraltar Strait (ICES Division IXa). All catches are landed in only two ports, Algeciras and mainly in Tarifa. The standard vessel is a boat 6-9 m overall length, displacing around 5 GTR and with 2 to 4 crew. As the fishery has experienced an important decline of the catches in the recent years, a local fishing plan conducted by the regional Government of Andalucia for the resource recuperation has been implemented in 1999. Between the regional technical measures adopted there are: close season of two months (February - March), maximum number of lines per boat (30), hook size and maximum number per line (100), maximum number of automatic machines for hauling per boat (3), minimum size of fish retained or landed (25 cm total length).

The freezer trawler Spanish fleet on Hatton Bank.

The number of boats fishing in this sea area has increased in the last two years. The mean technical characteristics are given below:

Year	Vessels	Length	GTR	HP
1998	13	52.8	559.1	1298.5
1999	18	53.6	558.3	1381.2

The presence of this fleet in Hatton bank is not continuous. Fishing trips in this area have a variable duration: from 15 days to 3 months. It is due to that this fleet consider the fishing in Hatton bank like a complement of its main fishing area (NAFO).

Longliner(s) targeted on ling in Sub-area VI-VII.

In the last two years 1 or 2 boats that previously focused on the hake fishery and with bycatches of ling and other species have changed to ling as main target species.

6.1.11 United Kingdom

England and Wales

There has been little change to the UK(E+W) fisheries since last described in the 1998 report of the Study Group. Long-liners and gill netters target hake in *(Merluccius merluccius*) in VIa,b and VIj,k with deep-water sharks as a by-catch. Depending on market prices, sharks can sometimes be the target species. The majority of the catch is landed into Spain. Landings in England and Wales are confined mainly to Newlyn, as a by-catch from gill and drift netters, and to Milford Haven by long-liners and gill-netters.

Scotland

At least one Scottish vessel is known to work full time in deep water. The majority work in a variety of fisheries including the traditional shelf fisheries in the North Sea and west of Scotland, on the Rockall Bank and along the shelf edge fishery for monkfish and megrim as well as in deep water fisheries in the Rockall Trough and the Faroe-Shetland Channel. Vessels move between fisheries according to fishing opportunities, fish prices, quota restrictions and weather. At the end of 1998, 21 vessels in the fleet were known to have fished in deep water in the past or were newly built boats with the capability and intention of doing so in the future. Most of these vessels were modern and in the 25 to 35 metre length range although two of the most recent additions to the fleet were over 40 metres. Since 1997, most new vessels have been built to work as twin rig trawlers while many of the existing vessels have converted to this gear type. The majority of these vessels can probably fish to depths of around 1100 metres but in practice fish down to about 900 metres. It has been reported that the conversion to twin rig gear has restricted the depth to which vessels can fish. Vessels in the 25 to 35 metre length range cannot fish safely in deep water during severe weather so that fishing effort may be restricted during the winter months (EC FAIR, 1999)

6.2 International waters

The Study Group expressed concern over deep water catches in international waters, i.e. outside national EEZs. Large fractions of Sub-areas X, XII, VI and XIV comprising parts of the fishing areas around the Rockall bank, Hatton bank and south-west part of Lousy bank, the Mid-Atlantic Ridge north of the Azores EEZ (Sub-area X), and part of the Reyjanes Ridge south of the Icelandic EEZ (Sub-areas XII, Division XIVb) lie outside EEZs. Recently added to this category is also the substantial fishing area off Rockall that was formerly within the UK EEZ.

Russia has reported fishing activity by 1-2 trawlers each year on the Mid Atlantic Ridge (Vinnichenko, Working Document 2000), and a single Faroese trawler has targeted orange roughy in this area every year since 1992 (Ch 11). Norwegian and Faroese fisheries for "giant" redfish and Greenland halibut, partly in international waters on the Reykjanes Ridge, has also been reported (Working Documents for 1998 meeting, EC FAIR 1999). The Study Group was however aware of anecdotal evidence of fishing activity and landings, also from ICES member states, which were not reported to ICES. There is therefore concern that the landings statistics as presented by the Study Group may not reflect the true scale of the recent fishing activity in these waters.

A relevant example is provided by the landings statistics for roundnose grenadier from Sub-area XII for the last decade (Table 12.1). The Study Group was unable to ascertain whether the strong fluctuations in the landings were real or reflected inconsistent reporting. Unofficial reports of extensive fishing activity from countries not providing statistics would suggest that the landings reported by the Study Group may be appreciably underestimated.

There was some information about recent fishing by Russian and Baltic vessels targeting alfonsino (Beryx sp.) in the North-Azores area (Sub-area X) in 1998-1999, but landings and effort data were not available (Working Document by Vinnichenko, 2000). Substantial recent Polish landings of roundnose grenadier were reported in 1997 and 1998, but the Study Group had no information on the geographical distribution and duration of the fishery. Latvian and Lithuanian trawlers allegedly also worked on the Mid-Atlantic Ridge in recent years, primarily fishing roundnose grenadier, but no catches were reported after 1994.

From results of investigations and trawl fisheries in previous years the most important deepwater species in international waters are roundnose grenadier (Sub-area XII, Division VIb), blue ling (Sub-area XII, Division VIb), golden eye perch (Sub-area X), orange roughy (Sub-areas X and XII), black scabbardfish (Sub-areas X and XII) and various species of sharks (all of above mentioned areas). As for longline fishery they are blue ling (Sub-area XII, Divisions VIb and XIVb), "giant" red-fish (Sub-area XII, Division XIVb), tusk (Sub-area XII, Divisions VIb and XIVb), Greenland halibut (Division VIb and XIVb) and various species of sharks (all of above mentioned areas).

The fact that either juveniles, a limited range of maturity stages, or only mature specimens of certain species are found at the continental margin and on offshore banks or vice versa may be indicative of migrations between these areas. Some species may spend only part of their life cycle along the continental slopes of western Europe. On the assumption that at least some of the deep-water species may form a stock in the NE Atlantic, reliable information on additional fishing mortality, e.g., on the Mid Atlantic Ridge could be very important especially if these are important spawning areas. The more the commercial fisheries become regulated in areas under national and/or EC jurisdiction, the greater will be the tendency for exploration and unregulated exploitation of international waters. Increased exploitation in these areas could have an effect on the stocks of these species in waters under national jurisdiction.

There are also historical records and circumstantial evidence that resources on e.g. the Mid Atlantic Ridge have been depleted to uneconomical levels after a short period of intensive fishing. It is recognised that such "boom and bust" fisheries may also occur within national EEZs. However, given the lack of management measures, the opportunities for such fishing practices would seem even greater in international waters. There are several examples that suggest that the target stocks on e.g. the Mid Atlantic Ridge are vulnerable. Since 1972, both the roundnose grenadier and the alfonsino of the Mid Atlantic Ridge were targeted by trawlers from the USSR, and the landings statistics given in a paper by Troyanovsky and Lisovsky (1995) and the Working Dokument by Vinnichenko suggest a pattern of initially high catches followed by a rapid decline to low levels. Unfortunately, detailed effort data have not been presented for this time series. In recent years, despite considerable exploratory fishing, no country has reported particularly profitable fisheries for these species along the Mid Atlantic Ridge. It was suggested that the recent decrease in landings of alfonsino from the traditional fishery within the Azorean EEZ may be a result of enhanced exploitation of this species on the seamounts of the Mid Atlantic Ridge outside the EEZ, but the Study Group had no information to determine whether this could be the case.

Another example of a transient fishery was the primarily Norwegian dropline and gillnet fishery for "giant" redfish and Greenland halibut on the southern Reykjanes Ridge. The newly discovered resources attracted a substantial fleet in 1996. However, already the next season the effort declined by 77% and the fishery effectively lasted only two seasons before becoming unprofitable (EU FAIR, 1999). Another example may be the substantial blue ling fishery that developed on the Reykjanes Ridge (in XII and XIV) in the early 1990s. This fishery was exploited and apparently depleted a spawning concentration, and landings from this area have been small ever since (see Ch. 8.1 for details).

These examples, and the above comments on the lack of knowledge on the stock separation of many species, underline the need for more information. In order for the Study group to carry out its tasks there is a need for greater emphasis on monitoring of activities and reporting of sufficiently detailed information on catch, effort, geographical distribution of the fisheries, length compositions and biological data.

6.3 Stock identity

The Study Group was not aware of any current results on stock identity of the main deep-water species. Two EC DGXIV Study contracts and one EC FAIR contract will provide new data on stock identity (see Section 2). The study contracts involves (1) both DNA and otolith microchemistry of the black scabbardfish in the eastern Atlantic and (2) a study of seasonal aspects of deep-water demersal fish at the Azores which includes work on stock discrimination. The FAIR project is investigating the use of otolith microchemistry for stock discrimination of roundnose grenadier, Nezumia aequalis, Helicolenus dactylopterus and hake.

A study on the morphometrics of the black scabbardfish has been completed as part of the EC BASBLACK Project (Carvalho *et al.*,submitted).

A study on the geneticsof the stocks of *Macrourus berglax* is in press (Katsarou and Naevdal, in press)

In the Pacific, previous studies have shown that there are several genetic populations of orange roughy in New Zealand and Australian waters. The differences between Atlantic and Pacific samples were of the same order of magnitude as between the Pacific samples (Smith, 1986)

The results of new comparisons between the Pacific and the Atlantic are in press and were not available to the Study Group. No results on stock structure in the North Atlantic are available.

6.4 Discards

Norway

Discard data from the Norwegian longline fishery for ling and tusk in the period 1993-1997 were assembled as part of the EU FAIR project (EC FAIR, 1999). Most samples came from ICES area IVa, i.e. around Shetland and in the Norwegian Deep, and the catch composition and discards in terms of catch by 1000 hooks based on 51 longline settings is given in Table 6.2. From area VIa (Hebrides), 7 settings were sorted, and the catch composition is given in Table 6.3. *Phycis blennoides* is the main discard species in these areas. No new data were collected from this fishery after 1997.

From the experimental trawl fishery at the Hatton Bank in 1998, catch composition in terms of weight by depth zone is available (Langedal and Hareide, 1998). During the experiment 43 fish species were recorded, but the catches were dominated by *Coryphaenoides rupestris* (50% by weight), *Alepocephalus bairdii* (21 %), and *Centroscymnus coelolepis* (11 %).

A considerable amount of information on the fish communities of the Mid-Atlantic Ridge from the Reykjanes Ridge to the Azores were presented by Hareide and Garnes (1998). The data came from experimental longline and trawl fishing in five sub-areas from the years 1993, 1996, and 1997. The depth zone 500-2000 m was fished. Catches by sub-area and depth zone were presented.

From the exploratory longlining carried out by Norway in 1999 at 600-1800 m depth on the slope of the Hatton Bank (VIa) (Langedal and Hareide, 1999 and Working Document), detailed accounts of catch composition by depth zone and discards are presented. In contrast with the results from deep-water trawling in the same area in 1998, deep-water sharks dominated the longline catches (80.3%) (Table 6.4), Although one of the aims of this experiment was to market unconventional species, about 36% of the catch in terms of weight was presently considered unmarketable and discarded. By comparison, about 50 % of the trawl catches from 1998 were considered unmarketable, and the discards were mainly juvenile *Coryphaenoides rupestris.*

Ireland

An Irish trawl survey in 1997 carried out repeat tows with commercial 105 mm deepwater rock hopper trawl, with and without a small mesh cod-end liner. The length frequencies show two distinct modes - landings (marketable size fish 12-25 cm) and discards (6-16 cm) of roundnose grenadier. The results show that the commercial trawl retains very small roundnose grenadier and that mesh size may not be a viable technical conservation measure in deepwater fisheries (Kelly *et al.*, 1998; EC FAIR, 1999). Revised discard rates from deepwater trawling in the Rockall Trough in 1997 are reported by Clarke *et al.* (1999). In 1998 and 1999 the Marine Institute monitored discarding of deep-water fish from trawlers in the multi-species fishery in the Faroe-Shetland Channel. The discard levels in this fishery were low. The total estimate of discards was estimated as less than 8.0% of total catch. Roughhead grenadiers (*Macrourus berglax*) were the most important discard species by weight followed by the greater argentine. Numerically, however, blue whiting *Micromistius poutassou*, was the most common discard species. The most common cephalopod discard species was the Northern flying squid, *Todarodes sagittatus*, (Lordan, 1998).

Discarding from long-line gears was also investigated by the Marine Institute in 1997 and 1999 during surveys using chartered Norwegian vessels. The survey vessels used commercial Mustad auto-line systems and commercial size hooks. Discarding of teleosts from long-lines was shown to be very low with the lines selecting for only marketable sized fish. However discards of non-marketable chonrichthyan fish were very high (Clarke, Hareide and Hoey, in prep). In the 1999 survey on the slopes of the PorcupineBank and in the depth range 500 – 700 m, *Deania calcea* dominated the catch (Table 6.5). Though the livers of this species are retained by some vessels the carcasses are discarded. Furthermore, small specimens of chondrichthyans are also caught. While the gear used on this survey is different to the longlines normally used by fleets in Sub-area VII it does give rise to concerns about discarding of these species (Clarke, 1999).

French and Scottish discard studies from the trawl fisheries in Sub-area VI as a contribution to EC FAIR Deep-fisheries project were described in the 1998 Study Group Report (ICES CM/ 1998:ACFM12; Table 6.1). Full details can be found in Blasdale and Newton (1998), Dupouy *et al.* (1998) and EC FAIR (1999).

Table 6.1. Information on the operations done by the Russian fleet during the fishery for roundnose grenadier on the Mid-Atlantic Ridge area in 1999 (Subarea XII).

Month	Type of vessel	No. of vessel fishing day	Catch, t	Catch per vessel/ fishing day, t
April	STM	5	34,1	6,8
May	STM	25	284,9	11,4
	BMRT	3	4,0	1,3
June	STM	25	191,4	7,7
July	STM	1	4,6	4,6
Total		59	519,0	8,8

Table 6.2 Mean catch and discards (kg) per 1000 hooks in area IVa in the years 1993-1997.

Species	**1993**	**1994**	**1995**	**1997**	**Total**	**Discarded**
Molva molva	115.01	88.04	98.05	87.04	91.6	
Brosme brosme	22.90	18.74	23.89	17.05	19.4	0.00
Pollachius virens	0.48	38.29	0.14	10.54	7.43	
Melanogrammus aeglefinus	0.40	33.57	2.68	5.95	5.25	
Gadus morhua	7.43	25.79	0.52	4.87	4.02	
Unidentified skates				5.23	3.28	
Phycis blennoides	0.91		8.25		2.62	2.62
Galeus melastomus	3.06		1.34	0.24	0.69	0.69
Squalus acanthias	0.68		1.43	0.30	0.67	0.67
Raja fullonica		4.80	0.17		0.15	
Chimaera monstrosa	0.52		0.31	0.01	0.13	0.13
Conger conger	1.20			0.09	0.10	0.10
Scyliorhinus caniculus			0.02	0.10	0.07	0.07
Helicolenus dactylopterus			0.21		0.06	0.06
Sebastes viviparus			0.19		0.06	0.06
Molva dipterygia			0.16		0.05	
Pollachius pollachius		2.07		0.01	0.05	
Etmopterus sp			0.15		0.05	0.05
Anarhichas lupus		1.20	0.03		0.03	0.03
Eutrigla gurnardus				0.04	0.03	0.03
Prionace glauca				0.03	0.02	0.02
Sebastes marinus			0.05	0.01	0.02	
Merlangius marlangus				0.02	0.01	
Merluccius merluccius				0.01	0.01	0.01
Raja radiata		0.36			0.01	0.01
Hippoglossus hippoglossus				0.02	0.01	
Lepidorhombus whiffiagonis				0.0024	0.00	0.0015
Total	152.59	212.86	137.59	131.56	135.	4.55

Table 6.3 Mean catch and discards (kg) per 1000 hooks in area VIa in the years 1993-1995.

Species	**1993**	**1994**	**1995**	**Total**	**Discarded**
Molva molva	83.89	18.07	163.16	110.38	
Brosme brosme	8.79	100.33	11.36	36.41	
Gadus morhua		82.53	1.47	24.42	
Sebastes marinus		14.47	3.78	6.29	
Phycis blennoides	24.04	0.24	3.81	5.68	5.68
Galeus melastomus	1.48		3.97	2.48	2.48
Melanogrammus aeglefinus		7.26		2.07	2.07
Chimaera monstrosa	9.91		0.47	1.69	1.69
Helicolenus dactylopterus	5.23			0.75	0.75
Pollachius virens		2.38		0.68	
Squalus acanthias	1.35		0.46	0.46	0.46
Molva dipterygia	2.54			0.36	
Conger conger	2.14			0.31	0.31
Merlangius marlangus		0.37		0.11	
Etmopterus sp			0.08	0.05	0.05
Raja naevus	0.21			0.03	
Anguilla anguilla			0.03	0.02	0.02
Total	139.57	225.65	188.60	192.18	13.49

Table 6.4 Summary of species composition in Norwegian exploratory longline and trawl catches on the slope of the Hatton Bank in 1998 and 1999.

Species	**Longline, 1999,** (Langedal and Hareide, 1999)	**Trawl, 1998** (Langedal and Hareide 1998)
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 dipterygia	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

Table 6.5.. Discard levels, as percentage of total catch per haul, from Irish long line survey on Porcupine Bank and Sea Bight in December 1999.

Latitude	Longitude	Mean Depth	Haul No.	*Deania calcea*	*G. melastomus*	*E. princeps*	*C.monstrosa*	*H. afinis*	*C.crepidater*	*C. fabricii*	*E. spnax*	*G. murinus*	*S. ringens*	*S. rostratus*	*S. grandis*	*S. kaupi*	*S. rostratus*	*L. eques*
53.88	13.30	988	1	47	0				5									
53.57	13.26	748	2	55	1		2											
53.56	13.23	557	3	48	5		1											
54.05	13.33	1277	4	19		18			10			1				1		
53.53	13.24	468	5		7		4			9								
53.55	13.26	745	6	63	3		2											
52.26	14.47	514	7		69		2											
52.25	14.47	585	8	4	70													
52.25	14.52	765	9	60	11		1											
54.24	15.01	944	10	34	0		1		2									
52.24	15.60	1097	11	40	0		1		0					1			1	
52.25	14.12	1304	12	3		2			2									
52.24	15.16	1378	13	2		8			8									
51.91	13.10	1227	14	7		6	1		7									
51.91	14.57	1038	15	27			1		5									
51.91	14.52	907	16	34	3				1				1					
51.91	15.21	1403	17	1		4			9									
51.61	13.49	695	18	1	71				2				8					
51.51	13.32	1209	19	7					2			1						
50.01	11.38	1251	20	51					3									
49.59	11.35	610	21	58					1									
49.57	11.31	883	22	76									1					
50.30	11.47	1798	23			1		45							6			
50.11	11.44	1720	24			19										1		
50.48	11.57	1974	25												14			
50.53	11.49	1823	26			1		16							1	32		
50.56	11.42	1603	27			17												
50.55	11.33	1444	28	7		26			12									
50.55	11.31	1188	29				23		18									2
50.49	11.28	1032	30	15					1									
50.55	11.25	849	31	6	26								13					
50.57	11.30	995	32	11	27				6									
50.57	11.32	988	33	30	3	4			2									
50.59	11.33	1105	34	38					4									
51.00	11.34	1071	35	14	1				2					1			1	
50.10	11.36	1071	36	24					5									
51.30	11.29	565	37		2													
50.20	11.37	1125	38	49					4				8					

7 LING *(MOLVA MOLVA)*

7.1 Catch Trends

Landings by Sub-area or Division for the period 1988-1999 are given in Table 7.1. The 1999 data are provisional.

The major fishery in Division IIa is the Norwegian longline fishery, but there are also by-catches by other gears, i.e., trawls and gill-net. The total landings of almost 10 000 t in 1998 was the highest in the period 1988-1998, and the preliminary figure 7,561 for 1999 is also among the higher in this period. Landings in areas I, IIb, and III remained small and are mostly by-catches.

In Division IVa the total landings increased somewhat in recent years, primarily due to an increase in the trawl landings of the United Kingdom. In 1997 the Norwegian landings decreased substantially compared with recent years, but increased again in 1998. The total landing in 1998 was the highest in the period 1988-1998, but the provisional figure for 1999 indicates a decline. The major aimed ling fishery in IVa is the Norwegian longline fishery conducted around Shetland and in the Norwegian Deep. Other landings in IVa, and the comparatively low landings from the central and southern North Sea (IVbc), are by-catches in various other fisheries.

In Divisions Va the landings decreased from 5 600-5 800 t in the late 1980s to about 4 000 t in recent years and most are by-catches in fisheries for other species. In 1999 the landings were somewhat higher, about 4 600 t. Landings in Division Vb1, which are mainly longline catches, appear to have increased in the recent four years to 4 000-4 700 t, and in 1998 there was also an increase in Vb2 compared with the level in the mid-1990s. The increase is observed in both Faroese and Norwegian landings.

In Division VIa the statistics are incomplete for the period 1989-1993, and no conclusions on trends can be drawn other than that the United Kingdom landings increased in recent years. In the period 1994-1998 when the data are complete, there was no trend. In Division VIb landings declined in the period 1994-96, primarily due to reduced Norwegian contributions, but increased somewhat in 1998.

In Sub-area VII the Divisions b, c, and g-k provide most of the landings of ling. There appears to have been an increasing trend in the 1990s and landings in the period 1995-1997 were above 10 000 t. In 1998 the total landing was 11,107 tonnes. Norwegian landings are mostly longline catches whereas other landings are primarily by-catches in trawl fisheries.

7.2 Stocks

No new information on stock separation was available. Relevant data were presented and discussed in reports of recent Norwegian and Nordic projects (Bergstad and Hareide 1996; Magnússon *et al.* 1997a) and summarised in the 1998 report of the study group (ICES C.M. 1998/ACFM:12). There is currently no evidence of genetically distinct populations within the ICES area. However, ling at widely separated fishing grounds may still be sufficiently isolated to be considered management units, i.e., stocks, between which exchange of individuals is limited and has little effect on the structure and dynamics of each unit. It was suggested that Iceland (Va), the Norwegian Coast (II), and the Faroes and Faroe Bank (Vb) have separate stocks, but that the existence of distinguishable stocks along the continental shelf west and north of the British Isles and the northern North Sea (Sub-areas IV, VI, VII and VIII) is less probable.

7.3 Catch-effort data

The extensive Norwegian longliner CPUE data based on skipper's logbooks presented in the 1996 report were not updated after 1994. In the 1998 report (Table 6.5 of ICES C.M. 1998/ACFM:12), effort data were given for the period 1974-1996 based on official statistics. The system for recording of effort has changed since 1997, and it is presently not possible to extend the series in a consistent manner.

Revised commercial CPUE data for Division Vb were available from Faroese longliners for the period 1986-1999 (Table 7.2, Fig. 7.1). The effort (in terms of number of hooks) is that aimed at ling and tusk, and the series is therefore considered more representative than that presented in the 1998 report. The effort was not corrected for changes in efficiency, however such changes were assumed small in the period presented.

CPUE data for Basque trawlers and longliners fishing in Sub-area VI and VII in the years 1994–1998 were also available (Fig. 7.2). CPUE series from France and Iceland presented in the 1998 meeting (ICES C.M. 1998/ACFM:12) could not be updated.

7.4 Length Distribution, Age Composition, Mean Weight and Maturity at Age

Data available from different countries and Divisions were indicated in Tables 6.3.1–6.3.6 of ICES C.M. 1996/Assess:8 and in ICES C.M. 1998/ACFM:12. Overviews of Norwegian samples from 1995 and earlier were given by Bergstad and Hareide (1996). Very little data were collected by Norway after 1995.

Catch in numbers by age of the international landings from Division Vb from 1996-1999 are given in Table 7.3. The distributions were adjusted to total catch using Faroese age-length keys. From Va, length distributions for the 1998 Icelandic landings were tabulated in the 1999 report (CM 1999/ACFM:21).

Mean weight at age and mean length at age of the Vb catches are given in Tables 7.4 and 7.5.

7.5 Biological parameters

Considerable information on biological parameters from many parts of the distribution area were presented in two recent project reports, i.e., Bergstad and Hareide (1996) and Magnússon *et al.* (1997a). Following efforts to intercalibrate age readings (Bergstad *et al.* 1998), there is now a higher degree of confidence in the precision of age distributions and age-related population parameters being presented. No new data were presented to the Study Group this year.

7.6 Assessment: CPUE analyses and mortality estimates

Catch per unit of effort analyses of the Norwegian longliners operating in most of the Divisions under consideration presented at the 1998 meeting indicated an overall downward trend since the early 1970s. The same trend was indicated in an area-specific analysis (Hareide and Godø, 1996; Bergstad and Hareide 1996; Magnússon *et al.* 1997a). These observations suggest that a reduction in abundance had occurred in several Divisions. The development in the period after 1994 is not clear due to the interruption of the Norwegian series. However, the 1996 combined longliner CPUE (based on official logbooks only) of ling and tusk at "western grounds" (Shetland, Rockall, Faroes, Hebrides) was 43 kg/1000 hooks, i.e., the same as or slightly lower than in 1994. Since the target species is ling in these fisheries, this estimate is primarily reflecting the availability of ling. The data series could not be extended for the years beyond 1996, hence it is unclear whether the declining trend has continued. Considering that the fishery has been conducted in the same areas and that the number of vessels has increased from 53 to 58 between 1997 and -98, there is no reason to assume that the effort has decreased, rather the opposite. The total Norwegian landings increased in 1998 and 1999. This could reflect increased effort aimed at ling, probably caused by declining opportunities in other fisheries, primarily the cod fishery in IIa (see comments in ICES C.M. 1998/ACFM:12).

For the period 1986-99, catch, effort for Faroese longliners and CPUE from longliners fishing in Vb are available (Table 7.2 and Figure 7.1). The majority of the catch in this area is taken by longliners, especially vessels greater than 100 GRT. The CPUE series shows no obvious trend. However, the effort data were not adjusted for increased efficiency. Taking this into account, there may have been a declining trend in the CPUE since 1994 as seen for the Norwegian longliners fishing in Division Vb.

Spanish CPUE data from trawlers and longliners were available for the period 1994–1998 (Figure 7.2). The effort unit is number of trips. The number of longline vessels included in the analysis is very low and the trawler data, primarily from vessels targeting hake, should be considered somewhat more reliable. There was a consistent decline in the trawler CPUE of ling in Sub-area VI in the period 1994-1998, and an apparent increase in 1999. In Sub-area VII, the CPUE level may have been lower in the last half of the period than in the first half.

In 1994, the Northern Shelf Working Group undertook a production model analysis based on available CPUE data, but with limited success. Since the database had not changed significantly since then, the Study Group did not pursue this option except for Division Vb. For the ling in Vb, an assessment was attempted using total international catch and the Faroese longline CPUE data from 1986 to 1999. The output from both the DeLury constant recruitment model and Schaefer surplus production model proved very unreliable, probably due to the lack of contrast in the CPUE time-series.

In 1996, estimates of total mortality, Z, were obtained for different Divisions by catch-curve analyses based on new age-distributions from Norwegian longliners in Divisions IIa, IVa and Vb (ICES C.M. 1996/Assess:8). The estimates were in the range 0.4–1.0, with a mean value of 0.6 (S.D.=0.2, n=9). These mortality estimates are also presented and discussed in Bergstad and Hareide (1996) and Magnússon *et al.* (1997a). Emigration and variability in recruitment may affect these

estimates, and they were considered preliminary. There were no Norwegian age distributions available for estimation of Z after 1995. Estimates of Z from catch curves based on Faroese samples from Vb in 1996 and 1997 were 0.7 and 0.8, respectively, i.e. as high or higher than previous estimates. For the present meeting, the catch curve series for Vb was extended to include data for 1998 and 1999 (Figure 7.3). The estimates of Z in 1998 and 1999 were 0.7 and 0.8, similar to earlier years. These values are considered to approximate the average annual total mortality over the last decade or so. Age-disaggregated CPUE in numbers for Vb based on longliner data are given in Table 7.6. Estimates of Z based on these data (excluding 1996) were similar to the previous estimates based on catch curves.

The range of years was still considered too limited to estimate Z by cohorts.

7.7 Comments on Assessment

It is still not possible to make analytical assessments for the ling stocks due to lack of good time series of data. The situation is likely to improve somewhat in the coming years, but only in Sub-area V. The cessation of the Norwegian sampling after 1995 constitutes a significant weakening of the basis of future analytical assessments in many important fishing areas. The Study Group is of the opinion that further improvement in the recording of effort and catch data from all fleets and areas should be encouraged, since CPUE analyses are used as an index of abundance and as basis of production analyses.

7.8 Management considerations

The Norwegian CPUE analyses presented to the Study Group in 1996 (Hareide and Godø, 1996) and discussed also by Bergstad and Hareide (1996) and Magnússon *et al.* (1997a), support the conclusion drawn by the Northern Shelf Working Group in 1994 that there has been a downward trend in the stocks of ling, perhaps with the exception of the Iceland stock (Va). At the 1998 meeting (ICES C.M. 1998/ACFM:12), the study group presented Norwegian analyses of ling and tusk combined for 1996 which suggested that the downward trend had continued. The same declining trends was seen in the Faroese and French CPUE data, and also in the Basque data from trawlers in Sub-area VI.

The extended Faroese CPUE series indicate no major change in the most recent years, but there is some uncertainty given that change in efficiency has not been taken into account. The Basque trawler series may not be as reliable, and no firm conclusion on trends should be drawn. The longline series suggest an increase, but this reflects a change of target species from hake to ling.

Both the steadily declining CPUE in all areas in the last decades (except in Division Va) and the high mortality estimates strongly suggest that the availability/abundance of ling has continued to decrease and that exploitation rates remain high.

No new data were available for evaluating reference points suggested previously. There is, however, no evidence to suggest that the state of the ling stocks has changed since the last assessment in 1998. This may mean that the biomass in the most heavily exploited areas remains below the suggested U_{pa} and may even be near or at U_{lim}.

Table 7.1. Ling. Study Group estimates of landings (tonnes). *Preliminary

LING I

Year	Norway	**Total**
1996	136	**136**
1997	31	**31**
1998	123	**123**
1999*	64	**64**

LING IIa

Year	Faroes	France	FRGermany	Norway	UK (EW)	UK (Scot)	**Total**
1988	3	29	10	6,070	4	3	**6,119**
1989	2	19	11	7,326	10	-	**7,368**
1990	14	20	17	7,549	25	3	**7,628**
1991	17	12	5	7,755	4	+	**7,793**
1992	3	9	6	6,495	8	+	**6,521**
1993	-	9	13	7,032	39	-	**7,093**
1994	101	n/a	9	6,169	30	-	**6,309**
1995	14	6	8	5,921	3	2	**5,954**
1996	0	2	17	6,059	2	3	**6,083**
1997	0	15	7	5,343	6	2	**5,373**
1998		13	6	9,049	3	1	**9,072**
1999*		13	7	7,557	2	2	**7,581**

LING IIb

Year	Norway	U K (EW)	**Total**
1988		7	**7**
1989		-	
1990		-	
1991		-	
1992		-	
1993		-	
1994		13	**13**
1995		-	
1996	127	-	**127**
1997	5	-	**5**
1998	5	+	**5**
1999*	6		**6**

LING III

Year	Belgium	Denmark	FRGermany	Norway	Sweden	UK (EW)	**Total**
1988	2	165	-	135	29	-	**331**
1989	1	246	-	140	35	-	**422**
1990	4	375	3	131	30	-	**543**
1991	1	278	-	161	44	-	**484**
1992	4	323	-	120	100	-	**547**
1993	3	343	-	150	131	15	**642**
1994	2	244	+	116	112	-	**474**
1995	4	222	-	113	83	-	**422**
1996		212	1	124	65	-	**402**
1997		159	+	105	47	-	**311**
1998		103	-	111	-	-	**214**
1999*		105	-	115		-	**220**

LING IVa

Year	Belgium	Denmark	Faroes	France	FRGermany	Netherlands	Norway	Sweden (1)	UK (EW)	UK (NI)	UK (Scot)	**Total**
1988	3	408	13	1,143	262	4	6,473	5	55	1	2,856	**11,223**
1989	1	578	3	751	217	16	7,239	29	136	14	2,693	**11,677**
1990	1	610	9	655	241	-	6,290	13	213	-	1,995	**10,027**
1991	4	609	6	847	223	-	5,799	24	197	+	2,260	**9,969**
1992	9	613	2	414	200	-	5,945	28	330	4	3,208	**10,753**
1993	9	629	14	395	726	-	6,522	13	363	-	4,138	**12,809**
1994	20	528	25	n/a	770	-	5,355	3	148	+	4,645	**11,494**
1995	17	406	51	290	425	-	6,148	5	181		5,517	**13,040**
1996	8	512	25	241	448		6,622	4	193		4,650	**12,703**
1997	3	640	6	206	320		4,715	5	242		5,175	**11,312**
1998	8	552	19	175	176		7,069	-	125		5,501	**13,625**
1999*	16	595	n.a.	204	141		5,077		240		3,444	**9,717**

(1) Includes IVb 1988-1993.

Table 7.1 (CONTINUED)
LING IVb,c

Year	Belgium	Denmark	France	FRGermany	Norway	U K (EW)	UK (Scot)	Sweden	**Total**
1988				-	100	173	106		**379**
1989				-	43	236	108		**387**
1990				-	59	268	128		**455**
1991				-	51	274	165		**490**
1992				-	56	392	133		**581**
1993				-	26	412	96		**534**
1994				-	42	40	64		**146**
1995				23	39	301	135		**498**
1996				45	100	187	106		**438**
1997	33	166	1	48	57	215	170	9	**699**
1998	47	164	5	18	129	128	136		**627**
1999*	35	136	-	10	51	106	99		**437**

LING Va

Year	Belgium	Faroes	FRGermany	Iceland	Norway	U K (EW)	UK (Scot)	**Total**
1988	134	619	-	5,098	10			**5,861**
1989	95	614	-	4,898	5			**5,612**
1990	42	399	-	5,157	-			**5,598**
1991	69	530	-	5,206	-			**5,805**
1992	34	526	-	4,556	-			**5,116**
1993	20	501	-	4,333				**4,854**
1994	3	548	+	4,053				**4,604**
1995		463	+	3,729	-			**4,192**
1996		358		3,670	20	12		**4,060**
1997		299		3,634	0	-		**3,933**
1998		699		3,603	-	-		**4,302**
1999*		542	+	3,980	120	4	+	**4,646**

LING Vb1

Year	Denmark	Faroes	France (2)	FRGermany	Norway	UK (EW) (1)	UK (Scot) (1)	**Total**
1988	42	1,383	53	4	884	1	5	**2,372**
1989	-	1,498	44	2	1,415	-	3	**2,962**
1990	-	1,575	36	1	1,441	+	9	**3,062**
1991	-	1,828	37	2	1,594	-	4	**3,465**
1992	-	1,218	3	+	1,153	15	11	**2,400**
1993	-	1,242	5	1	921	62	11	**2,242**
1994	-	1,541	6	13	1,047	30	20	**2,657**
1995		2,789	4	13	446	2	32	**3,286**
1996		2,672			1,284	12	28	**3,996**
1997		3,224	7		1,428	34	40	**4,733**
1998		2,422	6		1,452	4	145	**4,029**
1999*		2,446	9	3	2,034	0	42	**4,534**

(1) Includes Vb2. (2) Includes Vb2 and Va

LING Vb2

Year	Faroes	Norway	**Total**
1988	832	1,284	**2,116**
1989	362	1,328	**1,690**
1990	162	633	**795**
1991	492	555	**1,047**
1992	577	637	**1,214**
1993	282	332	**614**
1994	479	486	**965**
1995	281	503	**784**
1996	102	798	**900**
1997	526	398	**924**
1998	511	819	**1,330**
1999*	164	498	**662**

Table 7.1 (CONTINUED)
LING VIa

Year	Belgium	Denmark	Faroes	France (1)	FRGermany	Ireland	Norway	Spain (2)	UK (EW)	UK (Man)	UK (NI)	UK (Scot)	**Total**
1988	4	+	-	5,381	6	196	3,392	3575	1,075	-	53	874	**14,556**
1989	6	1	6	3,417	11	138	3,858		307	+	6	881	**8,631**
1990	-	+	8	2,568	1	41	3,263		111	-	2	736	**6,730**
1991	3	+	3	1,777	2	57	2,029		260	-	10	654	**4,795**
1992	-	1	-	1,297	2	38	2,305		259	+	6	680	**4,588**
1993	+	+	-	1,513	92	171	1,937		442	-	13	1,133	**5,301**
1994	1	1		1,713	134	133	2,034	1,027	551	-	10	1,126	**6,730**
1995	-	2	0	1,970	130	108	3,156	927	560	n/a		1,994	**8,847**
1996			0	1,762	370	106	2,809	1,064	269			2,197	**8,577**
1997			0	1,631	135	113	2,229	37	151			2,450	**6,746**
1998				1,531	9	72	2,910	292	154			2,394	**7,362**
1999*				1,751	4	148	2,997	322	152			2,156	**7,530**

(1) Includes VIb until 1996. (2) Includes minor landings from VIb.

LING VIb

Year	Faroes	France (2)	FRGermany	Ireland	Norway	Spain (3)	UK (EW)	UK (NI)	UK (Scot)	**Total**
1988	196		-	-	1,253		93	-	223	**1,765**
1989	17		-	-	3,616		26	-	84	**3,743**
1990	3		-	26	1,315		10	+	151	**1,505**
1991	-		-	31	2,489		29	2	111	**2,662**
1992	35		+	23	1,713		28	2	90	**1,891**
1993	4		+	60	1,179		43	4	232	**1,522**
1994	104		-	44	2,116		52	4	220	**2,540**
1995	66		+	57	1,308		84		123	**1,638**
1996	0		124	70	679		150		101	**1,124**
1997	0		46	29	504		103		132	**814**
1998		1	10	44	944		71		324	**1,394**
1999*		16	25	39	498		86		483	**1,147**

(1) Includes XII. (2) Until 1996 included in VIa. (3) Included in VIa.

LING VII

Year	France	**Total**
1988	5,057	**5,057**
1989	5,261	**5,261**
1990	4,575	**4,575**
1991	3,977	**3,977**
1992	2,552	**2,552**
1993	2,294	**2,294**
1994	2,185	**2,185**
1995	(1)	
1996	(1)	
1997*	(1)	

(1) Reported by Division

LING VIIa

Year	Belgium	France	Ireland	UK (EW)	UK (Man)	UK (NI)	UK (Scot)	**Total**
1988	14	(1)	100	49	-	38	10	**211**
1989	10	(1)	138	112	1	43	7	**311**
1990	11	(1)	8	63	1	59	27	**169**
1991	4	(1)	10	31	2	60	18	**125**
1992	4	(1)	7	43	1	40	10	**105**
1993	10	(1)	51	81	2	60	15	**219**
1994	8	(1)	136	46	2	76	16	**284**
1995	12	9	143	106	1	(2)	34	**305**
1996	11	6	147	29	-	(2)	17	**210**
1997	8	6	179	59	2	(2)	10	**264**
1998	7	7	89	69	1	(2)	25	**198**
1999*	7	8	31	29		(2)	13	**88**

(1) French catches in VII not split into divisions, see Ling VII, (2) Included with UK (EW)

Table 7.1 (CONTINUED)

LING VIIb,c

Year	France	FRGermany	Ireland	Norway	Spain (3)	UK (EW)	UK (NI)	UK (Scot)	**Total**
1988	(1)	-	50	57		750	-	8	**865**
1989	(1)	+	43	368		161	-	5	**577**
1990	(1)	-	51	463		133	-	31	**678**
1991	(1)	-	62	326		294	8	59	**749**
1992	(1)	-	44	610		485	4	143	**1,286**
1993	(1)	97	224	145		550	9	409	**1,434**
1994	(1)	98	225	306		530	2	434	**1,595**
1995	78	161	465	295		630	(2)	315	**1,944**
1996	57	234	283	168		1,117	(2)	342	**2,201**
1997	65	252	184	418		635	(2)	226	**1,780**
1998	32	1	190	89		393		329	**1,034**
1999*	71	4	291	288		488		7	**1,149**

(1) See Ling VII. (2) Included with UK (EW). (3) Included with VII g-k

LING VIId,e

Year	Belgium	Denmark	France (1)	Ireland	UK (EW)	UK (Scot)	UK (Ch. Isl.)	**Total**
1988	36	+	(1)	-	743	-		**779**
1989	52	-	(1)	-	644	4		**700**
1990	31	-	(1)	22	743	3		**799**
1991	7	-	(1)	25	647	1		**680**
1992	10	+	(1)	16	493	+		**519**
1993	15	-	(1)	-	421	+		**436**
1994	14	+	(1)	-	437	0		**451**
1995	10	-	885	2	492	0		**1,389**
1996	15		960		499	3		**1,477**
1997	12		1,049	1	372	1	37	**1,472**
1998	10		953	-	510	1	26	**1,500**
1999*	7		503	-	507	1		**1,018**

(1) See Ling VII.

LING VIIf

Year	Belgium	France (1)	Ireland	UK (EW)	UK (Scot)	**Total**
1988	77	(1)	-	367	-	**444**
1989	42	(1)	-	265	3	**310**
1990	23	(1)	3	207	-	**233**
1991	34	(1)	5	259	4	**302**
1992	9	(1)	1	127	-	**137**
1993	8	(1)	-	215	+	**223**
1994	21	(1)	-	379	-	**400**
1995	36	110	-	456	0	**602**
1996	40	121	-	238	0	**399**
1997	30	204	-	313		**547**
1998	29	204	-	328		**561**
1999*	16	190	-	188		**394**

(1) See Ling VII.

LING VIIg-k

Year	Belgium	Denmark	France (1)	FRGermany	Ireland	Norway	Spain (2)	UK (EW)	UK (Man)	UK (NI)	UK (Scot)	**Total**
1988	35	1	(1)	-	286	-	2,652	1,439	-	-	2	**4,415**
1989	23	-	(1)	-	301	163		518	-	+	7	**1,012**
1990	20	+	(1)	-	356	260		434	+	-	7	**1,077**
1991	10	+	(1)	-	454	-		830	-	-	100	**1,394**
1992	10	-	(1)	-	323	-		1,130	-	+	130	**1,593**
1993	9	+	(1)	35	374			1,551	-	1	364	**2,334**
1994	19	-	(1)	10	620		184	2,143	-	1	277	**3,254**
1995	33	-	1,597	40	766	-	195	3,046		(3)	454	**6,131**
1996	45	-	1,626	169	771		583	3,209			447	**6,850**
1997	37	-	1,574	156	674	-	33	2,112			459	**5,045**
1998	18	-	1,362	88	877		1669	3,465			335	**7,814**
1999*	-		1,353	49	418		144	1,619			1	**3,584**

(1) See Ling VII. (2) Includes VIIbc (3) Included in UK (EW)

Table 7.1 (CONTINUED)
LING VIII

Year	Belgium	France	FRGermany	Spain	U K (EW)	**Total**
1988		1,018			10	**1,028**
1989		1,214			7	**1,221**
1990		1,371			1	**1,372**
1991		1,127			12	**1,139**
1992		801			1	**802**
1993		508			2	**510**
1994		n/a		77	8	**85**
1995		693		106	46	**845**
1996		825	23	170	23	**1,041**
1997	1	705	+	290	38	**1,034**
1998	5	1,220	-	543	29	**1,797**
1999*	22	582	-	63	8	**675**

LING IX

Year	Spain	**Total**
1997	0	**0**
1998	2	**2**
1999*	1	**1**

LING XII

Year	Faroes	France	Norway	U K (EW)	UK (Scot)	FR Germany	**Total**
1988				-			**0**
1989				-			**0**
1990				3			**3**
1991				10			**10**
1992				-			**0**
1993				-			**0**
1994				5			**5**
1995	5			45			**50**
1996	-		2				**2**
1997	-	-	+	9			**9**
1998	-	1	-	1			**2**
1999*	-	n.a.	-	-	+	2	**2**

LING XIV

Year	Faroes	FRGermany	Iceland	Norway	UK (EW)	UK (Scot)	**Total**
1988		3	-	-	-	-	**3**
1989		1	-	-	-	-	**1**
1990		1	-	2	6	-	**9**
1991		+	-	+	1	-	**1**
1992		9	-	7	1	-	**17**
1993		-	+	1	8	-	**9**
1994		+	-	4	1	1	**6**
1995	-	-		14	3	0	**17**
1996	-			0			**0**
1997	1			60			**61**
1998	-			6			**6**
1999*	-			1			**1**

Table 7.1 (CONTINUED)

LING, total landings by Sub-area or Division

Year	I	IIa	IIb	III	IVa	IVb,c	Va	Vb1	Vb2	VIa	VIb	VII	VIIa	VIIb,c	VIId,e	VIIf	VIIg-k	VIII	IX	XII	XIV	All areas
1988		6,119	7	331	11,223	379	5,861	2,372	2,116	14,556	1,765	5,057	211	865	779	444	4,415	1,028		0	3	57,531
1989		7,368		422	11,677	387	5,612	2,962	1,690	8,631	3,743	5,261	311	577	700	310	1,012	1,221		0	1	51,885
1990		7,628		543	10,027	455	5,598	3,062	795	6,730	1,505	4,575	169	678	799	233	1,077	1,372		3	9	45,258
1991		7,793		484	9,969	490	5,805	3,465	1,047	4,795	2,662	3,977	125	749	680	302	1,394	1,139		10	1	44,887
1992		6,521		547	10,753	581	5,116	2,400	1,214	4,588	1,891	2,552	105	1,286	519	137	1,593	802		0	17	40,622
1993		7,093		642	12,809	534	4,854	2,242	614	5,301	1,522	2,294	219	1,434	436	223	2,334	510		0	9	43,070
1994		6,309	13	474	11,494	146	4,604	2,657	965	6,730	2,540	2,185	284	1,595	451	400	3,254	85		5	6	44,197
1995		5,954		422	13,040	498	4,192	3,286	784	8,847	1,638		305	1,944	1,389	602	6,131	845		50	17	49,944
1996	136	6,083	127	402	12,703	438	4,060	3,996	900	8,577	1,124		210	2,201	1,477	399	6,850	1,041		2	0	50,726
1997	31	5,373	5	311	11,312	699	3,933	4,733	924	6,746	814		264	1,780	1,472	547	5,045	1,034	0	9	61	45,093
1998	123	9,072	5	214	13,625	627	4,302	4,029	1,330	7,362	1,394		198	1,034	1,500	561	7,814	1,797	2	2	6	54,997
1999*	64	7,581	6	220	9,717	437	4,646	4,534	662	7,431	1,147		88	1,149	1,018	394	3,584	675	1	2	1	43,357

Table 7.2. Ling in Division Vb. Total international landings and CPUE of Faroese longliners >100 grt.

Year	Landing, t	CPUE (kg/1000 hooks)
1986	4957	11.55
1987	6367	14.11
1988	4488	8.77
1989	4652	10.06
1990	3857	7.21
1991	4512	10.47
1992	3614	7.17
1993	2856	7.42
1994	3622	10.01
1995	4070	8.73
1996	4896	6.68
1997	5657	16.81
1998	5359	11.11
1999	5196	9.81

Table 7.3 Catch at age in numbers *1000 for total international catch in ICES Division Vb.

Age	1996	1997	1998	1999
3	4	0	13	0
4	92	4	0	15
5	226	139	34	53
6	353	287	134	40
7	370	465	269	192
8	247	425	328	359
9	118	283	390	338
10	69	137	186	230
11	28	44	70	91
12	12	33	30	55
13	7	7	3	27
14	4	2	24	2
15	7	4	12	4
Total	3532	3830	1492	1407
Catch, t	4896	5657	5359	5196

Table 7.4 Mean length (cm) at age for total international catch in ICES Division Vb.

Age	1996	1997	1998	1999
3	42		55	
4	53	49	57	59
5	65	57	64	59
6	73	66	71	75
7	80	73	77	76
8	84	82	83	83
9	92	90	90	90
10	104	98	96	97
11	113	111	103	104
12	124	117	109	119
13	126	125	114	116
14	119	140	124	
15	141	136	134	138

Table 7.5 Meanweight (kg) at age for total international catch in ICES Division Vb

Age	1996	1997	1998	1999
3	0.5		1.085	
4	0.94	0.727	1.254	1.285
5	1.669	1.111	1.723	1.231
6	2.346	1.702	2.216	2.421
7	3.02	2.295	2.788	2.564
8	3.532	3.119	3.429	3.269
9	4.485	3.953	4.246	4.137
10	6.498	5.04	5.121	5.241
11	8.017	7.254	6.239	6.213
12	10.59	8.289	7.505	9.593
13	10.881	9.597	8.387	8.147
14	9.388	13.315	10.866	
15	15.643	12.822	12.953	15.23

Table 7.6. Ling in Division Vb. Age disaggregated CPUE in numbers for 5 selected vessels from the fleet of longliners > 100 GRT Only including sets where the weight of ling + tusk is more than 50% of total catches.

Age	1996	1997	1998	1999
3	12	631	368	0
4	313	19	11	289
5	770	1594	930	1037
6	1203	6151	3589	736
7	1263	11501	6710	3542
8	842	12487	7286	6216
9	403	13321	7772	5376
10	235	5636	3289	3489
11	96	2304	1344	1322
12	42	849	495	847
13	24	100	59	441
14	12	725	423	49
15	24	410	239	50
Total No.	5240	55728	32516	23394
Total effort, 1000' hooks	2503	10943	9662	8483
Total catch, t	16.7	183.9	107.3	83.23

For both ling and tusk the same fleet is used. This fleet, longliners larger than 100 GRT, shows two different pattern of fishing behavior. Mostly they are engaged in a mixed fishery on the shelf, primarily targeting cod and haddock with by-catches of other species, occasionally also ling and tusk. The proportion of ling+tusk in their catches is always small, even in cases with small catches of the target species. From time to time, the fleet change fishing grounds, i.e. they move towards deeper waters in a targeted ling+tusk fishery with very small by-catches of other species; sometimes blue ling amount to a few percent of total catch. The proportions of ling and tusk, respectively, can vary considerably, but taken together, they almost always constitute more than 50% of the catch (in fact, the sum of the two species is almost 100% in most sets). In order to select those sets, which are directed to this ling+tusk fishery, the criteria ling+tusk+blue ling > 50% is used. The same criterion is used to select out the mixed shelf fishery for cod and haddock. The Group is confident that these definitions of fisheries are appropriate for the given fisheries and thus that biases in cpues calculated for these fisheries are negligible.

The data for 1996 are out of line with the other years and are uncertain, maybe due to reporting problems in the logbooks.

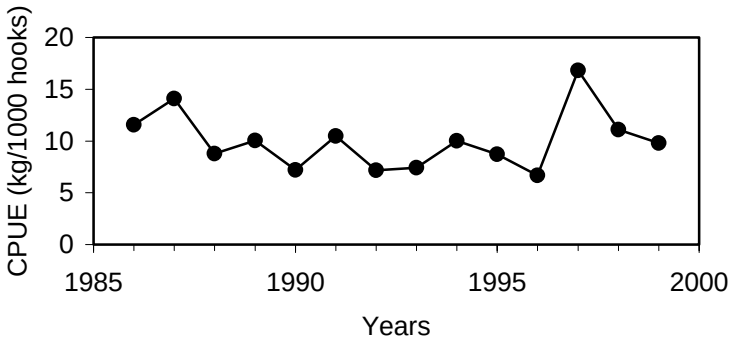
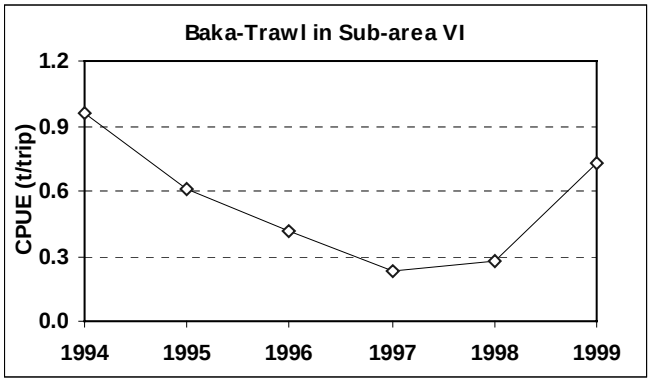
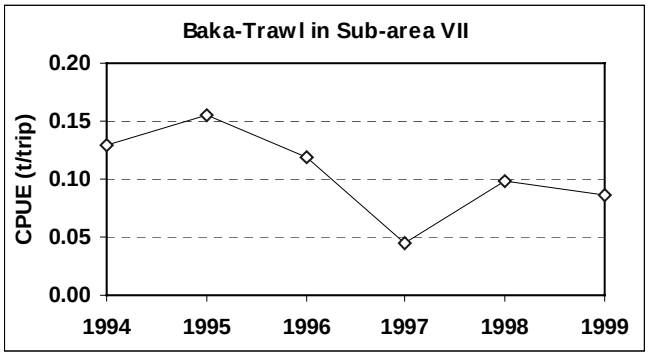
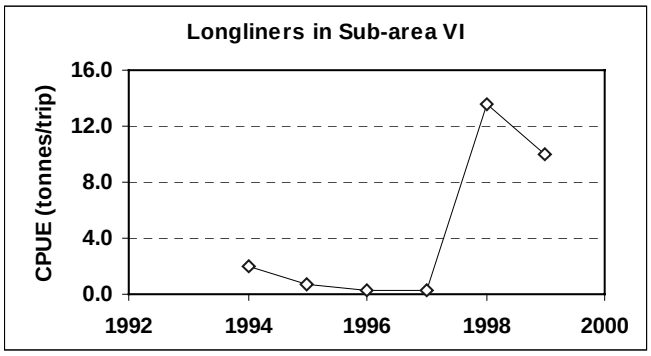


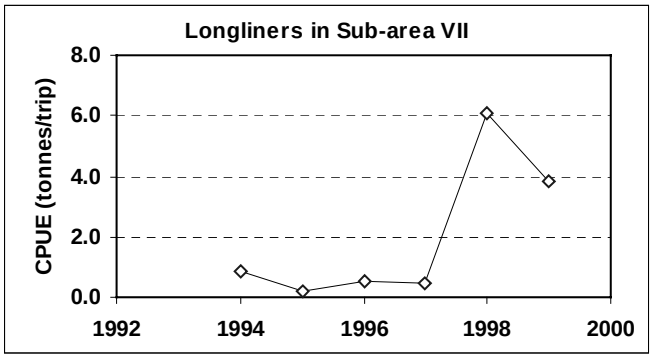
Figure 7.1. Ling in ICES Division Vb. CPUE 1986-1999 for longliners > 100 GRT.

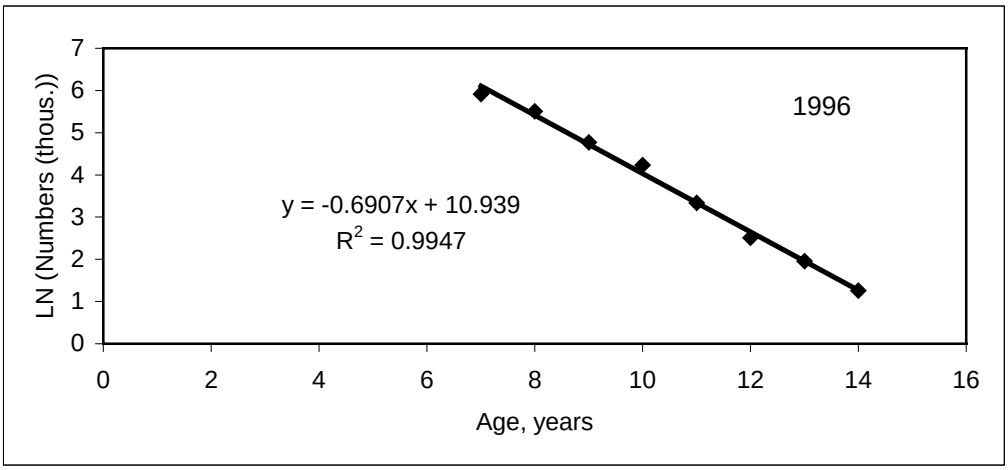
Figure 7.2. Ling. Catch per unit of effort of Basque trawlers and longliners in Sub-area VI and VII. (extracted from working document by Lucio *et al.*). Data for longliners represent 1-3 vessels only.

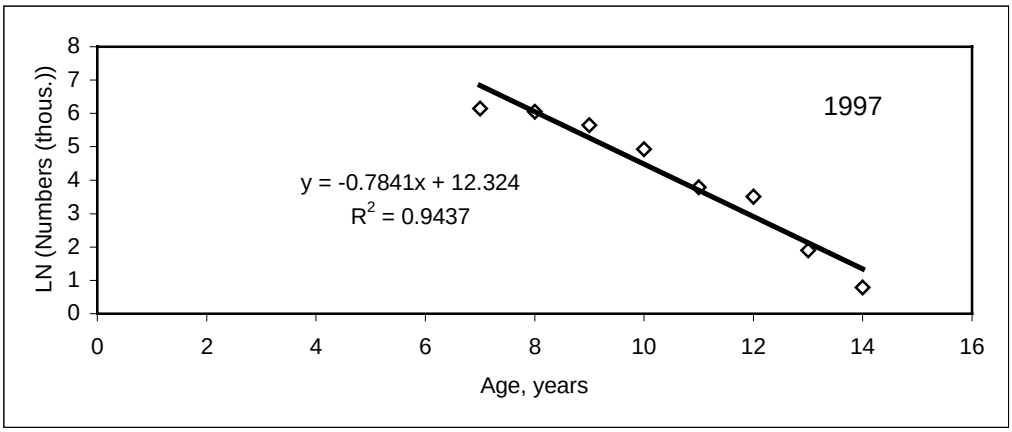


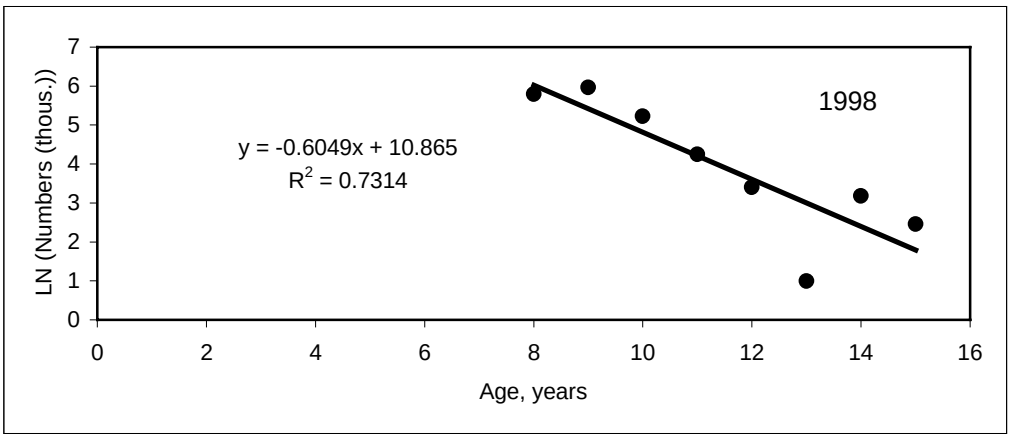












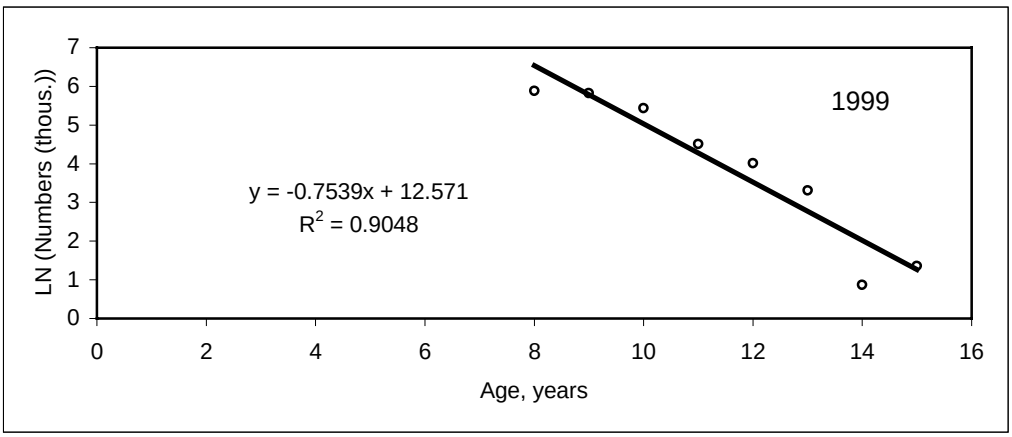


Figure 7.3. Catch curves 1996-1999 for ling in ICES Division Vb based on catch at age.

8 BLUE LING *(MOLVA DYPTERYGIA)*

8.1 Catch trends

Table 8.1 shows the landings data for blue ling by ICES Sub-areas and Divisions as used by the Study Group.

Landings from Sub-area I are very small and derive from by-catches in other fisheries.

Landings from Division IIa are mainly catches in a gillnet fishery off mid-Norway. The landings declined from 3 500 t in 1988 to 1 000 t in 1993 and have since declined to a very low level of 3-400 t in recent years.

The relatively minor landings from Sub-areas III and IV are by-catches in trawl fisheries and have been declining in recent years.

In Division Va, blue ling has been taken mainly as a by-catch by trawlers engaged in the redfish and Greenland halibut fishery in recent years. Iceland takes most of the catches. During the years 1980–1984, a directed fishery for blue ling was carried out in a very limited area on spawning aggregations. No aggregation of spawning blue ling has been detected in this area since then and consequently the landings have declined from about 8 500 t in 1980 to a level of 2 000–3 000 t since 1985. In the most recent years the landings have declined further to 1 000–1 500 t and catches of blue ling must now exclusively be regarded as bycatch in other fisheries.

The total landings from Division Vb fluctuated between 5 000 and 10 000 t during the 1980s, but have since then declined to about 1 500-3 000 t in recent years; however, preliminary landings for 1999 were almost 5 000 t. Most of the catches are taken in the spawning time by trawlers; at other times blue ling is taken as by-catch when the effort moves to other areas/species in order to maintain catch rates. In recent years most of the catches have been taken by Faroese and French trawlers.

The landings from Sub-area VI peaked at about 13 000 t in 1985, but have since then declined to 4 000-7 000 t in the 1990s. The preliminary landing figures for 1999 were almost 8 000 t. French trawlers used to take more than 95 % of the total catch but in the most recent years the share of the total catches by UK trawlers has increased considerably.

The landings from Sub-areas VII-X are very small as the blue ling is taken as by-catch in other fisheries only.

The landings from Sub-area XII peaked in 1993 at more than 1 100 t but have since declined to about 400 t in 1997 and 1998. However, preliminary landing figures for 1999 show an increase to more than 1 000 t. Faroese and French trawlers used to take most of the catch but in the most recent years Spanish vessels have taken the majority of the catches. There are reasons to believe that the reportings of landings to Sub-areas VI and XII are not consistent from year to year.

In 1993 the Icelandic fleet fished on aggregations of spawning blue ling in a small area on the Reykjanes ridge at the border between Sub-areas Va and XIV. This resulted in landings by Iceland of more than 3 000 t from Sub-area XIV. The French fleet fished in this area prior to the Icelandic fleet but information on landings are lacking. Landings have been very small in recent years.

8.2 Stocks

Biological investigations in the early 1980s suggested that at least two adult stock components were found within the area, a northern one in Sub-area XIV and Division Va with a small component in Vb, and a southern one in Sub-area VI and adjacent waters in Division Vb. However, the observations of spawning aggregations in each of these areas and elsewhere suggest further stock separation. This is supported by differences in length and age structures between areas as well as in growth and maturity. Egg and larval data from early studies also suggest the existence of many spawning grounds. The conclusion must be that the stock structure is uncertain within the areas under consideration.

However, in this years assessment, based on a.o. similar trends in the CPUE series from Division Vb and Sub-areas VI and VII, the blue ling from these areas were treated as one unit.

8.3 Catch-Effort Data

Commercial CPUE are available from the French fleet for ICES Sub-areas VI, VII and Division Vb. The deep-water French fleet is composed of high sea trawlers. In 1999, 14 large high sea trawlers (50 to 55 meters long) and 31 medium size trawlers (32 to 39 meters). Due to the differing sizes, both in power and activity (some vessels fishing on both the shelf and the slope while others have been almost entirely deep-water trawlers since the early 90s), the CPUE was calculated for a fleet of strictly deep-water trawlers which is better related to fish abundance (Lorance and Dupouy, 1998). The directed catch and effort data during 1989-98 were analysed using a multiplicative model taking into account month and area effects. The annual standardised CPUE index (Table 8.2) derived from this model was then used as input data for the subsequent surplus production model assessment (see below). During each fishing trip of an individual trawler, the catch in each statistical rectangle visited is considered as a directed catch if it represents more than 10% of the total catch. CPUE data show a gradual decline across the time series (Figure 8.1).

Two Spanish CPUE series were provided in a WORKING DOCUMENT by Lucio *et al.* for Sub-areas VI and VII, respectively (Figure 8.2). They are difficult to use for assessment purposes as they are not standardised, the effort is not directed towards blue ling and the catches are small. But they all show a declining tendency during the period, i.e. 1994-1999.

The Icelandic and Faroese time series of catch, effort and CPUE in Divisions Va and Vb, respectively, as represented in the 1998 report of this Study Group, are not included in this year's report. Due to lack of data it was not possible to update the Icelandic series. In the available Faroese series, effort is measured as numbers of days at sea which is not regarded as a precise effort measure. Moreover, the effort is not purely directed towards blue ling. And by comparison with the available French CPUE series it was seen that these two series show the same overall trend.

8.4 Length distribution, age composition, mean weight at age, maturity at age, natural mortality

Data on Age Composition, Mean Weight at Age and Maturity at age were available for many Sub-areas but are not presented in the report due to the difficulties in ageing of this species as stated in last years report (see also section 8.6).

Data on length distributions in the landings in the most recent years were available for Faroese landings in Division Vb as well as for the combined French trawler landings from Division Vb and Sub-areas VI and VII (Figures 8.3-8.4). Both series of length distributions indicate that the proportion of large fish in the landings has decreased in the most recent years.

From Division Va, length distributions for the 1998 Icelandic landings were tabulated in the 1999 report of this Study Group (ICES C.M. 1999/ACFM:21).

No information was available on natural mortality (M). However, as an estimate of M is required for the Delury constant recruitment model (see section 8.5), M was estimated using the relationship:

$$M = LN(100)/\text{maximum age}$$

The maximum age can be set at the age where 1% of a year-class is still alive. Based on Faroese and French age readings, it is not very wrong to assume the maximum age for blue ling be 30 years. Given this and the relationship above, M might be in the order of 0.15.

8.5 Assessment

A modified DeLury constant recruitment model and a Schaefer production model were attempted using total international catch data for Division Vb and Sub-areas VI and VII combined (1963-98) and CPUE from the French directed trawl fishery (1988-98) in these areas (see above).

The results from DeLury (not presented but included in ICES folders) were very unreliable, reflecting a poor fit by the model for a range of assumptions of initial proportion of stock to virgin biomass and error models.

The results from Schaefer were also unreliable. The fit was reasonable but estimates of the intrinsic rate of growth (r) and MSY were extremely variable (results not presented but included in ICES folders).

8.6 Comments on assessments

Age related data were available to the Group for Division Vb and Sub-area VI, but as there still are problems with age reading of blue ling it was not felt worthwhile to carry out any analytical assessment at this time because essentially the results would be similar to those presented in the 1995 report of the Northern Shelf Demersal Working Group (ICES C.M. 1995/Assess:1). Length distributions from groundfish surveys in Division Vb have also been tried in length based assessment methods without success mainly because the survey catches of blue ling are so small and not representative of the stock as the survey only covers depths down to about 500 m (ICES C.M 1993/Assess 20). It was decided, therefore, to try DeLury and a Schaefer production model but both of them gave unreliable results.

It should be mentioned, that the total international catch in the period 1963-1988, as used in the DeLury and Schaefer models only refers to the ones in Division Vb. In the early years of this fishery, blue ling was landed together with ling under the name ling. The split between the two species in the early years has so far only been assessed for Division Vb.

8.7 Management considerations

All available evidence from the trends in catches and CPUE series indicates that blue ling in Divisions Va and Vb and in Sub-areas VI and VII is at a low level. The length distributions from Division Vb and Sub-areas VI and VII also indicate that the proportion of large fish in the landings has decreased in the most recent years.

Using French trawl CPUE as an index of exploitable biomass, current exploitable biomass (U) at the end of 1998 is considered to be below U_{lim} (20% of virgin biomass).

Table 8.1 Blue ling. Study Group estimates of landings (tonnes).

BLUE LING I

Year	Iceland	Norway	**Total**
1988			
1989			
1990			
1991			
1992			
1993			
1994		3	**3**
1995	+	5	**5**
1996		+	**+**
1997	+	1	**1**
1998		1	**1**
1999*		1	**1**

*Preliminary.

BLUE LING IIa+b

Year	Faroes	France	FRGermany	Greenland	Norway	UK (EW)	UK (Scot)	**Total**
1988	77	37	5	-	3,416	2	-	**3,537**
1989	126	30	5	-	1,883	2	-	**2,046**
1990	228	65	4	-	1,128	4	-	**1,429**
1991	47	32	1	-	1,408	-	-	**1,488**
1992	28	3	+	3	987	2	-	**1,039**
1993	-	5	2	3	1003	+	+	**1,020**
1994	-	4	2	-	399	9	-	**414**
1995	0	16	2	2	342	1		**363**
1996	0	11	1		254	2	2	**270**
1997	0	18	1		280	+		**299**
1998	0	4	-		272	+	3	**279**
1999*	0	0	1		285	2		**288**

*Preliminary.

BLUE LING III

Year	Denmark	Norway	Sweden	**Total**
1988	10	11	1	**22**
1989	7	15	1	**23**
1990	8	12	1	**21**
1991	9	9	3	**21**
1992	29	8	1	**38**
1993	16	6	1	**23**
1994	14	4	+	**18**
1995	16	4		**20**
1996	8	3		**11**
1997	14	5	2	**21**
1998	4	2		**6**
1999*	5	1		**6**

* Preliminary

BLUE LING IVa

Year	Denmark	Faroes	France (1)	FRGermany	Norway	UK (EW)	UK (Scot)	Ireland	**Total**
1988	1	13	221	6	116	2	2		**361**
1989	1	-	239	4	196	12	+		**452**
1990	+	-	312	8	162	4	+		**486**
1991	1	31	369	7	178	2	32		**620**
1992	1	-	237	9	263	8	36		**554**
1993	2	101	74	2	186	1	44		**410**
1994	+		136	3	241	14	19		**413**
1995	+	2	73	+	201	8	193		**477**
1996	+	0	45	4	67	4	52		**172**
1997	+	0	35	+	61	0	172		**268**
1998	+	1	26		55	2	191		**275**
1999*	2		18	+	96	144		2	**262**

*Preliminary. (1) Reported as area IV
N.B. 1999 values for UK (EW) are preliminary **UK** values

Table 8.1 (continued)

BLUE LING IVb

Year	France	U K (EW)	Norway	Faroes	Denmark	Germany	**Total**
1988		-					**-**
1989	2	-					**2**
1990	6	-					**6**
1991	7	-					**7**
1992	1	-					**1**
1993	0	3					**3**
1994	0	-	+	+			**0**
1995	3	3	+		+		**6**
1996	5	5	1		+		**11**
1997	1		+				**1**
1998	5		1				**6**
1999*	(1)	1	0			+	**1**

* Preliminary (1) Included in IVa

BLUE LING IVc

Year	U K (EW)	Norway	**Total**
1988	-	-	**-**
1989	-	-	**-**
1990	-	-	**-**
1991	-	-	**-**
1992	-		
1993	-	-	**-**
1994	3		**3**
1995	-	-	**-**
1996			
1997			
1998			
1999*		0	

* Preliminary

BLUE LING Va

Year	Faroes	FRGermany	Iceland	Norway	**Total**
1988	271	-	1,893	7	**2,171**
1989	403	-	2,125	5	**2,533**
1990	1,029	-	1,992	-	**3,021**
1991	241	-	1,582	1	**1,824**
1992	321	-	2,584	1	**2,906**
1993	40	-	2,193		**2,233**
1994	89	1	1,542		**1,632**
1995	113	3	1,519	-	**1,635**
1996	36	3	1,284		**1,323**
1997	25	+	1,319		**1,344**
1998	59	+	1,086	8	**1,153**
1999*	0	8	1,890		**1,898**

*Preliminary.

BLUE LING Vb1

Year	Faroes	France (3)	FRGermany(2)	Norway	UK (EW)	UK (Scot) (1)	**Total**
1988	3,487	3,038	49	94	-		**6,668**
1989	2,468	1,605	51	228	-		**4,352**
1990	946	3,073	71	450	-		**4,540**
1991	1,573	1,013	36	196	1		**2,819**
1992	1,918	407	21	390	4		**2,740**
1993	2,088	192	24	218	19		**2,541**
1994	1,065	147	3	173	-		**1,381**
1995	1,606	588	2	38	4		**2,238**
1996	1,100	301	3	82	+		**1,486**
1997	778	1,656	+	65	11		**2,510**
1998	1,026	1,411	0(4)	24	1		**2,462**
1999*	1,901	945(4)	4	38	29		**2,917**

*Preliminary. (1) Included in Vb2. (2) Includes Vb2.
(3) Reported as area V N.B. 1999 values for UK (EW) are preliminary **UK** values

Table 8.1 (continued)

BLUE LING Vb2

Year	Faroes	Norway	UK (Scot)(1)	**Total**
1988	2,788	72	-	**2,860**
1989	622	95	-	**717**
1990	68	191	-	**259**
1991	71	51	21	**143**
1992	1,705	256	1	**1,962**
1993	182	22	91	**295**
1994	239	16	1	**256**
1995	162	36	4	**202**
1996	42	62	12	**116**
1997	229	48	11	**288**
1998	64	29	29	**122**
1999*	1,915	49		**1,964**

*Preliminary. (1) Includes Vb1.

BLUE LING VIa

Year	Faroes	France	FRGermany	Ireland	Norway	Spain (1)	UK (EW)	UK (Scot)	**Total**
1988	14	6,616	2	-	29		2	1	**6,664**
1989	6	7,383	2	-	143		-	+	**7,534**
1990	-	4,487	44	-	54		-	1	**4,586**
1991	8	3,226	18	-	63		1	35	**3,351**
1992	4	5,483	4	-	129		-	24	**5,644**
1993	-	4,311	48	3	27		13	42	**4,444**
1994	-	2,999	24	73	90	433	1	91	**3,711**
1995	0	2,835	+	11	96	392	34	738	**4,106**
1996	0	4,115	4		50	681	9	1,407	**6,266**
1997	0	3,427	+	1	29	190	789	1,021	**5,457**
1998	0	4,160			21	142	11	1,416	**5,750**
1999*	0	3,953(1)	+	16	25	116	1,106		**5,216**

*Preliminary. (1) Includes VIb N.B. 1999 values for UK (EW) are preliminary **UK** values

BLUE LING VIb

Year	Faroes	France	FRGermany	Norway	UK (EW)	UK (Scot)	Iceland	Ireland	**Total**
1988	2,000	499	37	42	9	14			**2,601**
1989	1,292	61	22	217	-	16			**1,608**
1990	360	703	-	127	-	2			**1,192**
1991	111	2,482	6	102	5	15			**2,721**
1992	231	348	2	50	2	14			**647**
1993	51	373	109	50	66	57			**706**
1994	5	89	104	33	3	25			**259**
1995	1	305	189	12	11	38			**556**
1996	0	87	92	7	37	74			**297**
1997	138	331		6	65	562	1		**1,102**
1998	76	469		13	190	287	122		**1,035**
1999*		(2)	(2)	9	2579			17	**2,605**

*Preliminary. (1) Includes XII. (2) Included in VIa.
N.B. 1999 values for UK (EW) are preliminary **UK** values

BLUE LING VIIa

Year	France (1)	UK (Scot)	**Total**
1988	-	-	**-**
1989	-	-	**-**
1990		-	**-**
1991		1	**1**
1992		-	**-**
1993		-	**-**
1994		-	**-**
1995		-	**-**
1996			
1997			
1998			
1999*			

*Preliminary. (1) Included in VIa

Table 8.1 (continued)

BLUE LING VIIb,c

Year	France	FRGermany	Ireland	Norway	Spain (1)	UK (EW)	UK (Scot)	**Total**
1988	22	1	-	-		-	-	**23**
1989	265	-	-	2		-	-	**267**
1990	140	-	-	-		-	-	**140**
1991	108	-	-	-		-	-	**108**
1992	74	-	-	3		-	6	**83**
1993	161	-	-	2		11	28	**202**
1994	146	-	1	1		6	22	**176**
1995	42	-	3	-		3	11	**59**
1996	105			1		15	57	**178**
1997	46		0	2		36	3	**87**
1998	62			1		60	6	**129**
1999*	(1)			1		31		**32**

*Preliminary. (1)Included in VIIg-k
N.B. 1999 values for UK (EW) are preliminary **UK** values

BLUE LING VIId,e

Year	France (1)	**Total**
1988		**-**
1989	1	**1**
1990	0	**0**
1991	10	**10**
1992	15	**15**
1993	3	**3**
1994	8	**8**
1995	4	**4**
1996	4	**4**
1997	1	**1**
1998	3	**3**
1999*	(1)	

*Preliminary. (1) Included in VIIg-k

BLUE LING VIIg-k

Year	France	FRGermany	Spain (1)	UK (EW)	UK (Scot)	Ireland	**Total**
1988				-	-		
1989	21			-	-		**21**
1990	46			-	-		**46**
1991	44			-	-		**44**
1992	256			-	-		**256**
1993	164			5	2		**171**
1994	190		4	3	4		**201**
1995	56		13	40	5		**114**
1996	67		21	42	40		**170**
1997	65	8	0*(2)	134	12	9	**219**
1998	92		22*(2)	223	24		**361**
1999*	134(2)	2(2)	1*(2)	154		25	**316**

*Preliminary. (1) Includes VIIb,c (2) Reported as area VII
N.B. 1999 values for UK (EW) are preliminary **UK** values

BLUE LING VIII

Year	Spain	**Total**
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995		
1996		
1997*	14	**14**
1998*	32	**32**
1999*	2	**2**

*Preliminary.

Table 8.1 (continued)

BLUE LING IX

Year	Portugal	Spain*	**Total**
1988			
1989			
1990			
1991			
1992			
1993			
1994	+		**+**
1995			
1996		+	**+**
1997	+	0	**0**
1998	+	1	**1**
1999*		0	**0**

*Preliminary.

BLUE LING X

Year	Faroes	Portugal	France	**Total**
1988		18	-	**18**
1989		17	-	**17**
1990		23	-	**23**
1991		36	33	**69**
1992		31	-	**31**
1993		33	-	**33**
1994		42	0	**42**
1995	0	29	0	**29**
1996	2	26	0	**26**
1997	0	21	0	**21**
1998		13	0	**13**
1999*		10	0	**10**

*Preliminary.

BLUE LING XII

Year	Faroes	France	FRGermany	Spain	UK (EW)	UK (Scot)	**Total**
1988		263					**263**
1989		70					**70**
1990		0					**0**
1991		47					**47**
1992		440					**440**
1993	654	383	90				**1,127**
1994	382	78	25				**485**
1995	514	47			12		**573**
1996	445	60		264		19	**788**
1997	1	1		411*	4		**417**
1998	36	10		375*	1		**422**
1999*		9		943*	50		**1,002**

*Preliminary. (1) Included in VIa

BLUE LING XIV

Year	Faroes	France	FRGermany	Greenland	Iceland	Norway	UK (EW)	UK (Scot)	**Total**
1988	21	-	218	3	-	-	-	-	**242**
1989	13	-	58	-	-	-	-	-	**71**
1990	-	-	64	5	-	-	10	-	**79**
1991	-	-	105	5	-	+	45	-	**155**
1992	-	-	27	2	-	50	27	4	**110**
1993	-	390	16	-	3,124	173	21	1	**3,725**
1994	1	-	15	-	300	11	57	-	**384**
1995	0	-	5		117	+	16	3	**141**
1996	0	(1)	12			+	2	+	**14**
1997	1		1			+	2		**4**
1998	48					1	6		**55**
1999*						1	7		**8**

Table 8.1 (continued)

BLUE LING Total landings by area/division annd grande total

Year	I	II	III	IV	Va	Vb	VI	VII	VIII	IX	X	XII	XIV	Total
1988		3537	22	361	2171	9528	9265	23			18	263	242	25430
1989		2046	23	454	2533	5069	9142	289			17	70	71	19714
1990		1429	21	492	3021	4799	5778	186			23	0	79	15828
1991		1488	21	627	1824	2962	6072	163			69	47	155	13428
1992		1039	38	555	2906	4702	6291	354			31	440	110	16466
1993		1020	23	413	2233	2836	5150	376			33	1127	3725	16936
1994	3	414	18	416	1632	1637	3970	385		+	42	485	384	9386
1995	5	363	20	483	1635	2440	4662	177			29	573	141	10528
1996	+	270	11	183	1323	1602	6563	352		+	26	788	14	11132
1997	1	299	21	269	1344	2798	6559	307	14	0	21	417	4	12054
1998	1	279	6	281	1153	2584	6785	493	32	1	13	422	55	12105
1999*	1	288	6	263	1898	4881	7821	348	2	0	10	1002	8	16528

*Preliminary.

Table 8.2. Blue ling, directed catch and effort and standardised CPUE from a reference fleet of trawlers in ICES Divison Vb and sub-areas VI and VII

ICES sub-area	Year	Total international catch (t)	Data for the reference fleet		
			Directed Catch (t)	Directed effort (hours)	Standardised cpue
V	85		1994	2579	696
V	86		2306	2981	715
V	87		3104	5462	531
V	88	6668	2916	6947	393
V	89	4352	1772	5834	280
V	90	4540	1536	6782	210
V	91	2819	367	2352	136
V	92	2740	133	992	125
V	93	2541	77	722	100
V	94	1381	129	910	128
V	95	2238	297	1450	178
V	96	1486	112	961	120
V	97	2510	372	2481	140
V	98	2462	752	4561	152
VI	85		2272	1103	1341
VI	86		1622	1779	680
VI	87		2354	2429	882
VI	88	9265	2272	3630	599
VI	89	9142	2325	3747	446
VI	90	5778	1237	2667	319
VI	91	6072	1945	2698	359
VI	92	6291	628	2012	210
VI	93	5150	701	2251	191
VI	94	3970	735	3377	151
VI	95	4662	962	5260	158
VI	96	6563	980	7502	119
VI	97	6559	1057	5362	157
VI	98	6785	1248	7026	144
Combined	85		4266	3682	898
Combined	86		3928	4760	732
Combined	87		5458	7891	659
Combined	88	15956	5188	10577	471
Combined	89	13783	4097	9581	337
Combined	90	10504	2773	9449	255
Combined	91	9054	2313	5087	226
Combined	92	9385	763	3071	170
Combined	93	8067	779	2989	154
Combined	94	5736	866	4376	130
Combined	95	7077	1269	6813	150
Combined	96	8401	1104	8567	105
Combined	97	9376	1431	7910	124
Combined	98	9740	2004	11690	111

Data from Sub-area VII are very small and not presented in the table. However, they have been included in the combined data in the table.

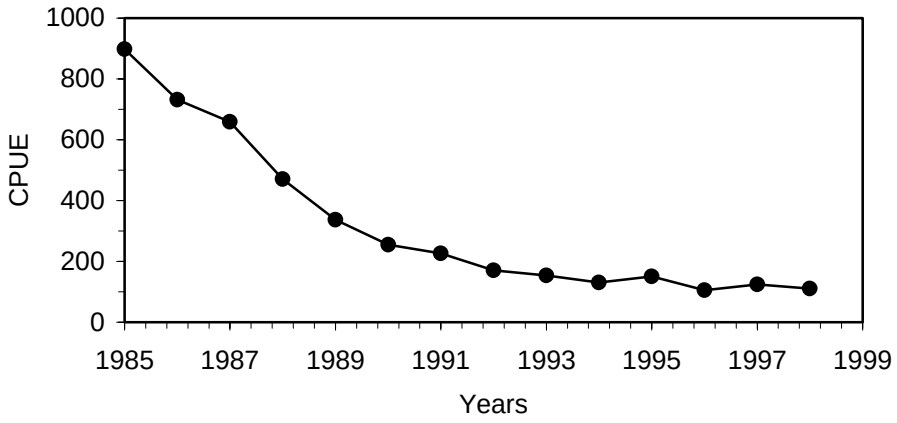


Figure 8.1. Blue ling in Division Vb and Sub-areas VI and VII. Standardised CPUE from directed catch and effort of French trawlers.

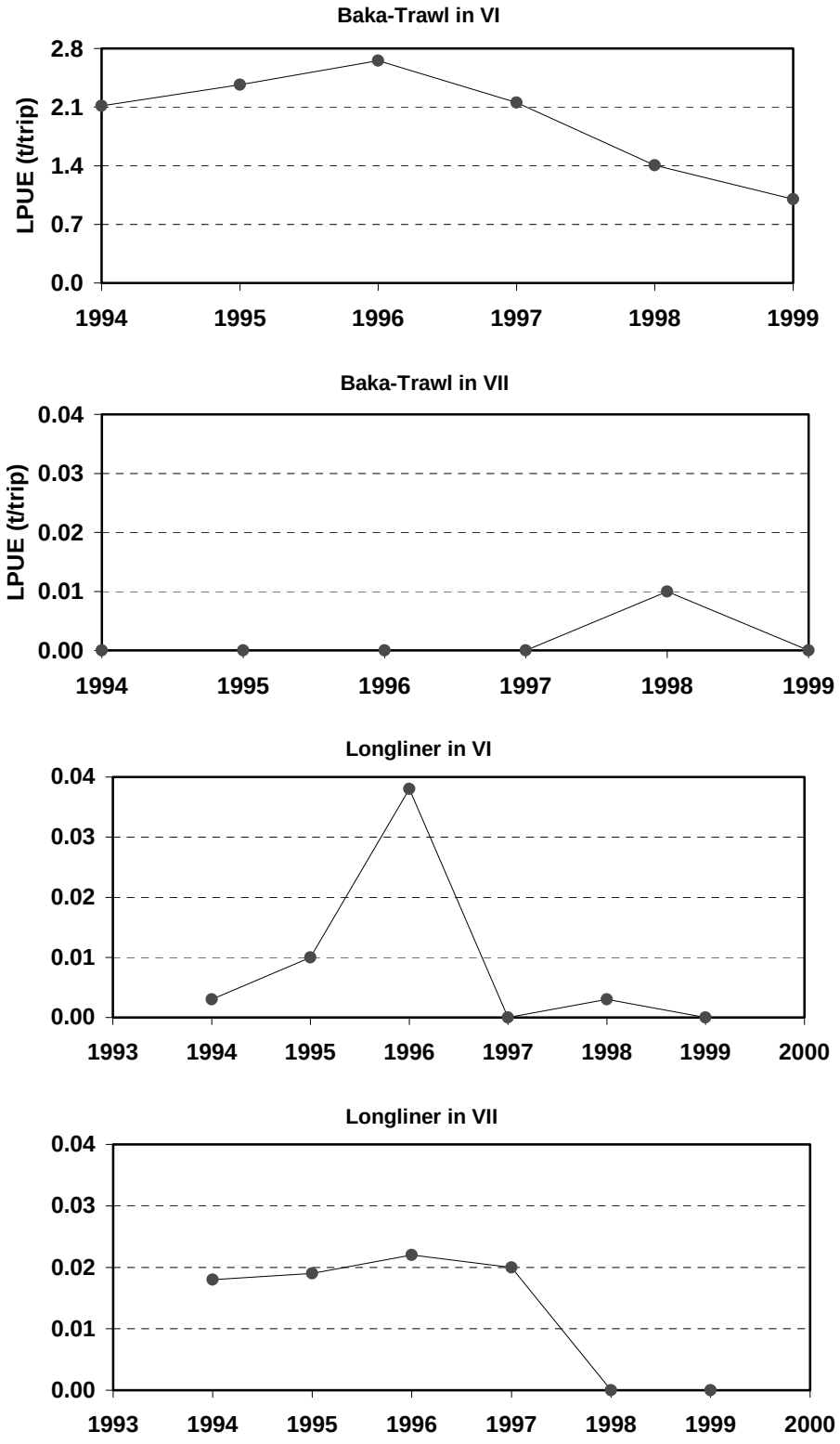


Figure 8.2. Landings per fishing effort (LPFE: tones/trip) of Blue ling in ICES Sub-area VI and VII of "Baka" trawlers and longliners of the Basque Country 1994-1999 (1999 preliminary).

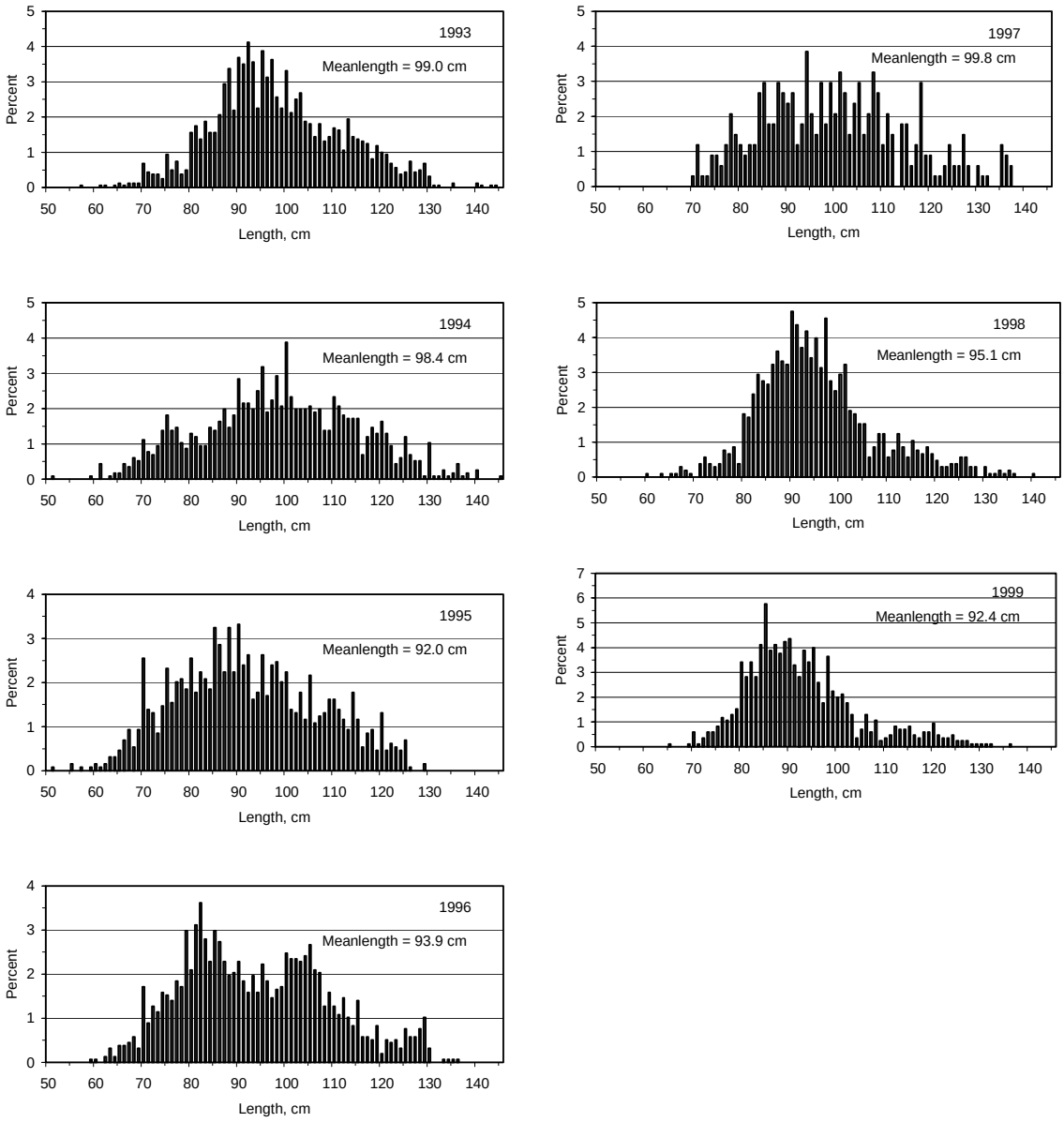


Figure 8.3. Blue ling in ICES Division Vb. Length distribution of Faroese catches.

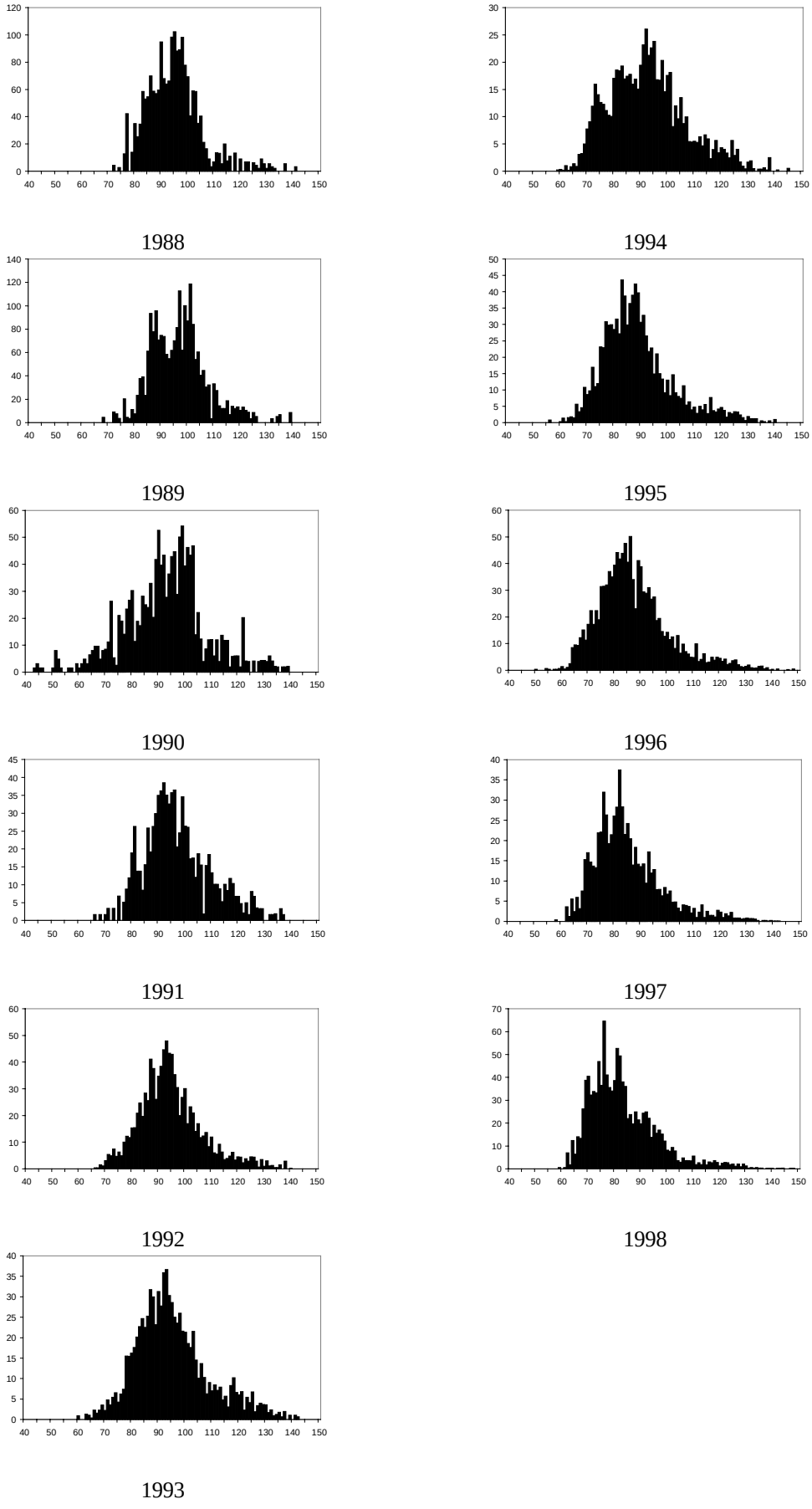


Figure 8.4. Length distribution (total length in cm, numbers in thousands) of the French landings of blue ling from 1988 to 1998.

9 TUSK (*BROSME BROSME*)

9.1 Catch Trends

The landings of tusk are given in Table 9.1.

In Division IIa the landings increased in 1998 and 1999 after a period with a decreasing trend from 1989 onwards. The total landing in 1998 was about 14 500 t, and in 1999 16 200 t. There was also an increase in Sub-area I. In Division IVa the landings in 1998 were about 3 400 which is at the level observed since 1994 but lower than the 4 000–6 500 t in 1988–1993. The decrease since the early 1990s is mainly due to decreasing Norwegian landings from this area.

In Va and Vb landings increased in the period 1989–1991 but decreased again in 1994–1998. The provisional Va landing for 1999 shows an increase. Both the Norwegian and Faroese landings from Vb1 were high in 1999 compared with the most recent years.

9.2 Stocks

No new information on stock structure was presented. In the 1998 report it was noted that ripening adult tusk and tusk eggs have been found in all parts of the distribution area, but the banks to the west and north of Scotland, around the Faroes and off Iceland, as well as the shelf edge along mid and north Norway seem to be the most important spawning areas (Magnússon *et al.* 1997a). Nothing is known about migrations within the area of distribution. In recent Norwegian studies of enzyme and haemoglobin frequencies no geographical structure could be found, hence it was concluded that tusk in all areas, at least of the North-east Atlantic, belong to the same gene pool (Bergstad and Hareide, 1996). Widely separated fishing grounds may support separate management units, i.e., stocks. It is suggested that Iceland (Va) and the Norwegian coast (I and II) have self-contained units, while the separation among possibly several stocks to the north and west of the British Isles remains unclear.

9.3 Catch And Effort Data

Catch per unit of effort data from Norwegian longliners were presented to the Study Group in 1996 (Hareide and Godo, 1996) and were further described in Bergstad and Hareide (1996). This series was not extended beyond 1994. A corresponding time-series extended to 1996 based on official statistics for ling and tusk combined was presented in the 1998 report (ICES C.M. 1998/ACFM:12). Since then the Norwegian system for recording effort has changed, and it has not been possible to extend this series beyond 1996 in a consistent manner. The number of Norwegian longliners participating in the fishery decreased in the last decades and was 53 in 1997. In 1998, the number increased again to 58. Tusk is usually not a target species for the longliners, rather a by-catch in the ling fishery. As suggested in the Chapter 7 on ling, there is little reason to assume that the effort has decreased since 1996, rather the opposite. Lost opportunities in other fisheries, i.e. the cod fishery in IIa and the Reykjanes Ridge fishery for Greenland halibut and redfish, may have caused an increase in the effort on traditional grounds in Sub-areas IIa and Vb1 in 1998 and 1999.

Revised commercial CPUE data for Division Vb were available from Faroese longliners for the period 1986-1999 (Table 9.2, Fig. 9.1). The effort (in terms of number of hooks) is that aimed at ling and tusk, and the series is therefore considered more representative than that presented in the 1998 report. The effort was not corrected for changes in efficiency, however such changes were assumed small in the period presented.

CPUE of the Basque trawlers and longliners fishing in Sub-areas VI and VII were presented (Fig. 9.2). The effort measure is number of trips. Of these series, the one from trawlers may be most reliable. The recent sharp increase of the longliner CPUE in VI is considered to reflect a change in target species from hake to ling and tusk.

9.4 Length Distribution, Age Composition, Mean Weight At Age, Maturity

Data available from different Divisions were indicated in Tables 8.3.1–8.3.6 of the 1996 report (ICES C.M. 1996/ Assess:8). Data series available to the Northern Shelf Working Group in 1994 were updated in 1998. The quality and quantity of data improved significantly after 1993 due to increased sampling effort in Iceland, the Faroes and Norway (Magnússon *et al.* 1997a). An overview of available Norwegian samples were given in Bergstad and Hareide (1996). Very little data were, however, available from Norway after 1995. Length compositions from Icelandic landings in Va were presented in the 1999 report (CM 1999/ACFM:21).

Length distributions for the Faroese landings from Division Vb from 1996-99 are given and Figure 9.3. Quarterly length distributions from French landings from VIa collected by Scotland was presented in the report from an EC FAIR project (ECFAIR, 1999) and are reproduced in Figure 9.4. A Norwegian length distribution from an experimental longline

fishery on the slope of the Hatton Bank (VIb) extracted from the Working Document of Langedal and Hareide (2000) is shown in Figure 9.5.

9.5 Biological Parameters

No new information on biological parameters was presented. As noted in the 1998 report (ICES C.M. 1998/ACFM:12), considerable information on growth, maturity etc. from many parts of the distribution area were presented in two project reports, i.e., Bergstad and Hareide (1996) and Magnússon *et al.* (1997a). In the Nordic project (Magnússon *et al.* 1997a) considerable effort was devoted to intercalibrate age readings (Bergstad *et al.*, 1998). Although tusk ageing is still considered rather difficult, there is now a somewhat higher degree of confidence in the age distributions and age-related population parameters being presented.

Russia reported from an experimental longline fishery in IIa and b in 1999 (Working document by Vinnichenko, 2000), and biological data from previous investigations off Rockall (Working document by Vinnichenko, 2000 referring to article by Zaferman and Shaestopal, 1996).

9.6 Assessment, CPUE Analyses And Mortality Estimates

The catch per unit of effort analyses of the Norwegian longliners operating primarily in Divisions IIa, IVa, Vb, VIa, and VIb presented to the Study Group in 1996 and 1998 indicated an overall downward trend since the early 1970s (Hareide and Godø, 1996; Bergstad and Hareide 1996; Magnússon *et al.* 1997a). The same trend was indicated in an area-specific analysis and from analyses of Faroese CPUE data from trawlers and longliners from the period 1986–94. These observations suggested that a reduction in abundance had occurred in several areas. The Norwegian CPUE series was not updated after 1996. However, if it is the case that the Norwegian effort increased in the most recent years, increased Norwegian landings from IIa and Vb in 1998 and 1999 reflects enhanced effort rather than enhanced availability.

The Faroese CPUE series suggests a decline until about 1994 to a lower level in recent years (Figure 9.1 and Table 9.2).

No new CPUE data were available for Division Va after 1997. It was noted in the 1998 report (ICES C.M. 1998/ACFM:12) that the longlining effort decreased by about 50 % between 1993 and 1997. In the same period the CPUE more than doubled. A decrease was observed in both the abundance indices of fishable sizes and juveniles in the Icelandic groundfish survey, with a slight increase in 1997.

In 1994, the Northern Shelf Working Group undertook a production model analysis based on available CPUE data, but with limited success. Since the database had not changed significantly since then and the time series are still short, the Study Group did not pursue this option except for Division Vb.

An assessment of tusk was attempted for this Division using a modified DeLury constant recruitment model and a Schaefer surplus production model. The assessment used total international catch data from 1906 to 1999 and Faroese longline CPUE data from 1986 to 1999.

The fit of the DeLury model was poor for all error models and was unable to predict the marked variations in CPUE. The parameter estimates using a range of assumed initial stock sizes were very unstable and therefore the results are not presented here. The Schaefer surplus production model produced a much better fit to the CPUE data and the least squares error model was marginally the best error model tested. The time series remains too short to analyse effects of using alternative time-lags. As for other species, we therefore assume that growth rather than recruitment is the main contributor to biomass production and the time-lag in the Schaefer model is therefore set to zero. Testing the model with a number of values for the ratio of initial biomass to carrying capacity shows very good robustness of parameter estimates for values between 0.7 and 1.0 (Table 9.3). It is assumed that prior to 1906 (the beginning of the catch data series) that the stock was at a virgin level and the fit with this initial condition is shown in Figure 9.7. It is observed in this figure that due to the very low catches in the first half of the century the stock remains in this equilibrium of almost virgin biomass until the 1950s when catches increase. In fact for all initial ratios above about 0.6, the stock attains this same equilibrium size. The carrying capacity estimated from this assessment is approximately 23 000t (95% confidence limits : 20 000-25 000t) and the final population biomass is calculated as 4 200t which equates to 18% of carrying capacity (95% confidence limits : 16.5-20.5%).

In ICES C.M. 1996/ Assess:8, estimates were given of total mortality, Z, from catch curves from Divisions IIa, IVa, Vb, VIa and VIb in the years 1993–1995 (and 1988 for IVa) based on age distributions of the Norwegian longline catches. The average Z was 0.6 (S.D.=0.2, n=12). These estimates were also presented in Bergstad and Hareide (1996) and Magnússon (1997a).

In 1998, estimates of Z by catch curves based on commercial longliner data for each of the years 1994–1997 were computed for Division Va (ICES C.M. 1998/ACFM:12). A corresponding estimate was obtained for Vb for 1996. The Va estimates were high, and some were higher than the previous values from other areas. The Vb estimate was 0.4 which by comparison was rather low. For this area a revised catch curve for 1996 and a new for 1997 are given in Figure 9.6. The mortality estimates obtained were around 0.3. It should be stressed that curves representing data for many cohorts depend to a strong degree on the variation in recruitment and on the sampling level.

In 1998 estimates were presented from the fishery conducted on what appeared to be a virgin stock at the Reykjanes Ridge in 1996 (Sub-area XII) (Magnússon *et al.* 1997a), indicating a very low mortality rate, Z=0.1. A corresponding estimate from 1997 was 0.2 (Langedal and Hareide 1997). These estimates suggest that the natural mortality coefficient, M, of tusk may be in the range 0.1 - 0.2.

9.7 Comments On Assessment

It is not possible to make age-based assessments for the tusk due to lack of good time series of age-structured data. With the present level of sampling, at least in Division Vb, this situation may improve somewhat in the future. It is a serious problem that the effort series from the Norwegian longline fishery could not be extended beyond 1996. The Study Group is of the opinion that further improvement in the recording of effort and catch data should be encouraged, since CPUE is used as an index of abundance and as the basis of production analyses.

The Schaefer model fits the CPUE data in Sub-area Vb relatively well (R^2=0.83), with parameter estimates which are stable over a range of initial conditions and have narrow confidence limits. However, it should be noted that a very high intrinsic growth rate is predicted.

9.8 Management Considerations

The Norwegian CPUE analyses presented to the Study Group in 1996 (Hareide and Godø, 1996) and in Bergstad and Hareide (1996), and further analyses discussed in Magnússon *et al.* (1997a), supported the conclusion drawn by the Northern Shelf Working Group in 1994 that there has been a downward trend in the stocks, probably with the exception of the tusk at Iceland (Division Va). However, the official Norwegian effort statistics for longliners are not given by species and since tusk is primarily a bycatch species, the effort directed at tusk could not readily be estimated. To get a species-specific CPUE, skipper's logbooks were used, but such detailed data were not updated after 1994. However, the Norwegian analyses of ling and tusk combined for 1996, suggest that the downward trend had continued. Since the CPUE series could not be extended beyond 1996, it is unclear whether there is a continued decline in the most recent years.

The revised Faroese CPUE data for Division Vb suggests a decline to a lower an apparently stable level after 1994.

In 1998, it was concluded that both the steadily declining CPUE in all areas, except Va, and the high mortality estimates strongly suggested that the availability/abundance of tusk had continued to decrease and that exploitation rate remained high. Except in Division Vb, the development after 1996 is unclear due to lack of information, but given that the fleet has rather increased than decreased and that the fishing areas and practices are the same, it is unlikely that the exploitation rate has decreased in recent years.

Although the Schaefer model assessment presented here would appear relatively stable, the results should be treated with extreme caution due to the very high estimate for the population growth rate. Based on these results, however, the exploitable stock biomass would appear to be below that of U_{lim} (20% of virgin biomass).

Based on available information, it is however difficult to determine at what level of abundance the tusk stocks are at present in relation to unexploited states.

Table 9.1. Tusk. Study Group estimates of landings

TUSK I

Year	Norway	**Total**
1996	587	**587**
1997	665	**665**
1998	805	**805**
1999*	907	**907**

TUSK IIa

Year	Faroes	France	FRGerman	Greenlan	Norway	UK (EW)	UK (Scot)	Russia	**Total**
1988	115	32	13	-	14,241	2	-		**14,403**
1989	75	55	10	-	19,206	4	-		**19,350**
1990	153	63	13	-	18,387	12	+		**18,628**
1991	38	32	6	-	18,227	3	+		**18,306**
1992	33	21	2	-	15,908	10	-		**15,974**
1993	-	23	2	11	17,545	3	+		**17,584**
1994	281	14	2	-	12,266	3	-		**12,566**
1995	77	16	3	20	11,271	1			**11,388**
1996	0	12	5		12,029	1			**12,047**
1997	1	21	1		8,642	2	+		**8,667**
1998		9	1		14,463	1	1	-	**14,475**
1999*		3	+		16,213		2	28	**16,246**

(1)Includes

TUSK IIb

Year	Norway	UK (EW)	Russia	**Total**
1988		-		**0**
1989		-		**0**
1990		-		**0**
1991		-		**0**
1992		-		**0**
1993		1		**1**
1994		-		**0**
1995	229	-		**229**
1996	161			**161**
1997	92	2		**94**
1998	73	+	-	**73**
1999*	26		4	**26**

TUSK III

Year	Denmar	Norway	Swede	**Total**
1988	8	51	2	**61**
1989	18	71	4	**93**
1990	9	45	6	**60**
1991	14	43	27	**84**
1992	22	46	15	**83**
1993	19	48	12	**79**
1994	6	33	12	**51**
1995	4	33	5	**42**
1996	6	32	6	**44**
1997	3	25	3	**31**
1998	2	19		**21**
1999*	6	25		**31**

TUSK IVa

Year	Denmar	Faroes	France	FRGerman	Norway	Sweden	UK (EW)	UK (NI)	UK (Scot)	Ireland	**Total**
1988	83	1	201	62	3,998	-	12	-	72		**4,429**
1989	86	1	148	53	6,050	+	18	+	62		**6,418**
1990	136	1	144	48	3,838	1	29	-	57		**4,254**
1991	142	12	212	47	4,008	1	26	-	89		**4,537**
1992	167	-	119	42	4,435	2	34	-	131		**4,930**
1993	102	4	82	29	4,768	+	9	-	147		**5,141**
1994	82	4	86	27	3,001	+	24	-	151		**3,375**
1995	81	6	68	24	2,988		10		171		**3,348**
1996	120	8	49	47	2970		11		164		**3,369**
1997	137	0	47	19	1763	+	16		238	-	**2,220**
1998	99	3	38	12	2943		11		266	-	**3,372**
1999*	163	7	n.a.	10	1983		12		212	1	**2,387**

(1) Includes IVb 1988-

Table 9.1 (Continued)

TUSK IVb

Year	Denmark	France	Norway	FRGermany	U K (E & W)	UK (Scot)	**Total**
1988		n.a.		-	-		
1989		3		-	1		**4**
1990		5		-	-		**5**
1991		2		-	-		**2**
1992		1		-	1		**2**
1993		1		-	-		**1**
1994		1		-	2		**3**
1995	4	-	5	1	3	2	**15**
1996	4	-	21	4	3	1	**33**
1997	6	1	24	2	2	3	**38**
1998	4	0	55	1	3	3	**66**
1999*	8	-	21	1	1	3	**34**

TUSK Va

Year	Faroes	Germany	Iceland	Norway	UK (Scot)	**Total**
1988	3,757	-	3,078	20		**6,855**
1989	3,908	-	3,143	10		**7,061**
1990	2,475	-	4,816	-		**7,291**
1991	2,286	-	6,446	-		**8,732**
1992	1,567	-	6,442	-		**8,009**
1993	1,329	-	4,746	-		**6,075**
1994	1,212	-	4,612	-		**5,824**
1995	979	1	5,245	-		**6,225**
1996	872	1	5,226	3		**6,102**
1997	575		4,819			**5,394**
1998	1,052	1	4,118	0		**5,171**
1999*	1,075	2	5,820	391	+	**7,288**

TUSK Vb1

Year	Denmark	Faroes	France	FRGermany	Norway	UK (EW)	UK (Scot) (1)	**Total**
1988	+	2,827	81	8	1,143	-		**4,059**
1989	-	1,828	64	2	1,828	-		**3,722**
1990	-	3,065	66	26	2,045	-		**5,202**
1991	-	3,829	19	1	1,321	-		**5,170**
1992	-	2,796	11	2	1,590	-		**4,399**
1993	-	1,647	9	2	1,202	2		**2,862**
1994	-	2,649	8	1 (2)	747	2		**3,406**
1995		3,059	16	1 (2)	270	1		**3,346**
1996		1,636	8	1	1,083			**2,728**
1997		1,849	11	+	869		13	**2,742**
1998		1,272	20	-	753	1	27	**2,073**
1999*		1,956	21	1	1,522		5	**3,505**

(1)Included in Vb2 until 1996. (2)Includes Vb2. (3)Reported as Vb.

TUSK Vb2

Year	Faroe Isl	Norway	UK (EW)	UK (Scot) (1)	**Total**
1988	545	1,061	-	+	**1,606**
1989	163	1,237	-	+	**1,400**
1990	128	851	-	+	**979**
1991	375	721	-	+	**1,096**
1992	541	450	-	1	**992**
1993	292	285	-	+	**577**
1994	445	462	+	2	**909**
1995	225	404	(2)	2	**631**
1996	46	536			**582**
1997	157	420			**577**
1998	107	530			**637**
1999*	132	315			**447**

(1)Includes Vb1. (2)See Vb1. (3)Included in Vb1.

Table 9.1 (Continued)

TUSK VIa

Year	Denmark	Faroe Isl	France (1)	FRGermany	Ireland	Norway	UK (EW)	UK (NI)	UK (Scot)	Spain	**Total**
1988	-	-	766	1	-	1,310	30	-	13		**2,120**
1989	+	6	694	3	2	1,583	3	-	6		**2,297**
1990	-	9	723	+	-	1,506	7	+	11		**2,256**
1991	-	5	514	+	-	998	9	+	17		**1,543**
1992	-	-	532	+	-	1,124	5	-	21		**1,682**
1993	-	-	400	4	3	783	2	+	31		**1,223**
1994	+		345	6	1	865	5	-	40		**1,262**
1995		0	332	+	33	990	1		79		**1,435**
1996		0	368	1	5	890	1		126		**1,391**
1997		0	359	+	3	750	1		137	11	**1,261**
1998			395	+		715	-		163	8	**1,281**
1999*			383	+	4	113	1		161	39	**701**

(1) Not allocated by divisions before 1993.

TUSK VIb

Year	Faroes	France	FRGermany	Ireland	Iceland	Norway	UK (EW)	UK (NI)	UK (Scot)	**Total**
1988	217		-	-		601	8	-	34	**860**
1989	41	1	-	-		1,537	2	-	12	**1,593**
1990	6	3	-	-		738	2	+	19	**768**
1991	-	7	+	5		1,068	3	-	25	**1,108**
1992	63	2	+	5		763	3	1	30	**867**
1993	12	3	+	32		899	3	+	54	**1,003**
1994	70	1	+	30		1,673	6	-	66	**1,846**
1995	79	1	+	33		1,415	1		35	**1,564**
1996	0	1		30		836	3		69	**939**
1997	1	1		23		359	2		90	**476**
1998		1		24	18	630	9		233	**915**
1999*				26	-	591	5		296	**918**

TUSK VIIa

Country	France	UK (EW)	UK (Scot)	**Total**
1988	n.a.	-	+	+
1989	2	-	+	**2**
1990	4	+	+	**4**
1991	1	-	1	**2**
1992	1	+	2	**3**
1993	-	+	+	+
1994	-	-	+	+
1995	-	-	1	**1**
1996	-	-		
1997	-	-	1	**1**
1998	-	-	1	**1**
1999*	-	-	+	

TUSK VIIb,c

Year	France	Ireland	Norway	UK (EW)	UK (NI)	UK (Scot)	**Total**
1988	n.a.	-	12	5	-	+	**17**
1989	17	-	91	-	-	-	**108**
1990	11	3	138	1	-	2	**155**
1991	11	7	30	2	1	1	**52**
1992	6	8	167	33	1	3	**218**
1993	6	15	70	17	+	12	**120**
1994	5	9	63	9	-	8	**94**
1995	3	20	18	6		1	**48**
1996	4	11	38	4		1	**58**
1997	4	8	61	1		1	**75**
1998	3		28	-		2	**33**
1999*	-	15	130	-		1	**146**

Table 9.1 (Continued)
TUSK VIIg-k

Year	France	FRGermany	Ireland	Norway	UK (EW)	UK (Scot)	**Total**
1988	n.a.		-	-	5	-	**5**
1989	3		-	82	1	-	**86**
1990	6		-	27	0	+	**33**
1991	4		-	-	8	2	**14**
1992	9		-	-	38	-	**47**
1993	5		17	-	7	3	**32**
1994	4		12	-	12	3	**31**
1995	3		8	-	18	8	**37**
1996	3		20	-	3	3	**29**
1997	4	4	11	-		+	**19**
1998	2	3	4	-		1	**10**
1999*	8	1	-	-		1	**10**

TUSK VIIIa

Year	U K (EW)	France	**Total**
1988	1	n.a.	**1**
1989	-	-	**-**
1990	-	-	**-**
1991	-	-	**-**
1992	-	-	**-**
1993	-	-	**-**
1994	-	-	**-**
1995	-	-	**-**
1996	-	-	**-**
1997	+	+	**+**
1998	-	1	**1**
1999*	-	-	**0**

TUSK XII

Year	Faroes	France	Iceland	Norway	UK(Scot)	**Total**
1988		1				**1**
1989		1				**1**
1990		0				**0**
1991		1				**1**
1992		1				**1**
1993		12	+			**12**
1994		1	+			**1**
1995	8	-	10			**18**
1996	7	-	9	142		**158**
1997	11	-	+	19		**30**
1998		1		-		**1**
1999*		1		+	1	**1**

TUSK XIVa

Year	FRGermany	Norway	**Total**
1988	2		**2**
1989	1		**1**
1990	2		**2**
1991	2		**2**
1992	+		+
1993	+		+
1994	-		+
1995	-		+
1996			+
1997		-	+
1998		-	+
1999*		+	+

Table 9.1 (Continued)
TUSK XIVb

Year	Faroes	Iceland	Norway	UK (EW)	**Total**
1988			-	-	
1989	19	3	-	-	**3**
1990	13	10	7	-	**17**
1991	-	64	68	1	**132**
1992	-	82	120	+	**202**
1993	-	27	53	+	**80**
1994	-	9	16	+	**25**
1995	-	57	30	+	**87**
1996	-	139	142		**281**
1997	-	10	108		**118**
1998	1	-	14		**14**
1999*	-	n.a.	9		**9**

Table 9.1 (CONTINUED)
TUSK, all area.

Year	I	IIa	IIb	III	IVa	IVb	Va	Vb1	Vb2	VIa	VIb	VIIa	VIIb,c	VIIg-k	VIIIa	XII	XIVa	XIVb	All areas
1988		14,403	0	61	4,429		6,855	4,059	1,606	2,120	860	+	17	5	1	1	2		34,419
1989		19,350	0	93	6,418	4	7,061	3,722	1,400	2,297	1,593	2	108	86	-	1	1	3	42,139
1990		18,628	0	60	4,254	5	7,291	5,202	979	2,256	768	4	155	33	-	0	2	17	39,654
1991		18,306	0	84	4,537	2	8,732	5,170	1,096	1,543	1,108	2	52	14	-	1	2	132	40,781
1992		15,974	0	83	4,930	2	8,009	4,399	992	1,682	867	3	218	47	-	1	+	202	37,409
1993		17,584	1	79	5,141	1	6,075	2,862	577	1,223	1,003	+	120	32	-	12	+	80	34,790
1994		12,566	0	51	3,375	3	5,824	3,406	909	1,262	1,846	+	94	31	-	1	+	25	29,393
1995		11,388	229	42	3,348	15	6,225	3,346	631	1,435	1,564	1	48	37	-	18	+	87	28,414
1996	587	12,047	161	44	3,369	33	6,102	2,728	582	1,391	939		58	29	-	158	+	281	28,509
1997	665	8,667	94	31	2,220	38	5,394	2,742	577	1,261	476	1	75	19	+	30	+	118	22,408
1998	805	14,475	73	21	3,372	66	5,171	2,073	637	1,281	915	1	33	10	1	1	+	14	28,949
1999*	907	16,246	26	31	2,387	34	7,288	3,505	447	701	918		146	10	0	1	+	9	32,656

Table 9.2. Total nominal landings in Vb and CPUE (kg/1000 hooks) for Faroese longliners >100 GRT.

Year	Landings, t	CPUE (kg/1000 hooks)
1986	5220	26.80
1987	6529	19.57
1988	5665	15.90
1989	5122	18.64
1990	6181	19.41
1991	6266	17.12
1992	5391	14.15
1993	3439	11.18
1994	4315	13.56
1995	3977	11.95
1996	3310	6.89
1997	3319	9.85
1998	2710	10.04
1999	3952	10.93

Table 9.3 Tusk in Sub-areas Vb. Output of Schaefer model runs.

Schaefer	Time lag =0					
Ratio	K (tonnes)	q	r	MSY	Pop (tonnes)	Pop/ K
1.0	22717	0.00243	0.9939	5645	4188	0.18
0.9	22717	0.00243	0.9939	5645	4188	0.18
0.8	22717	0.00243	0.9939	5645	4188	0.18
0.7	22717	0.00243	0.9939	5645	4188	0.18
0.6	41239	0.00014	0.5020	5171	6905	0.17

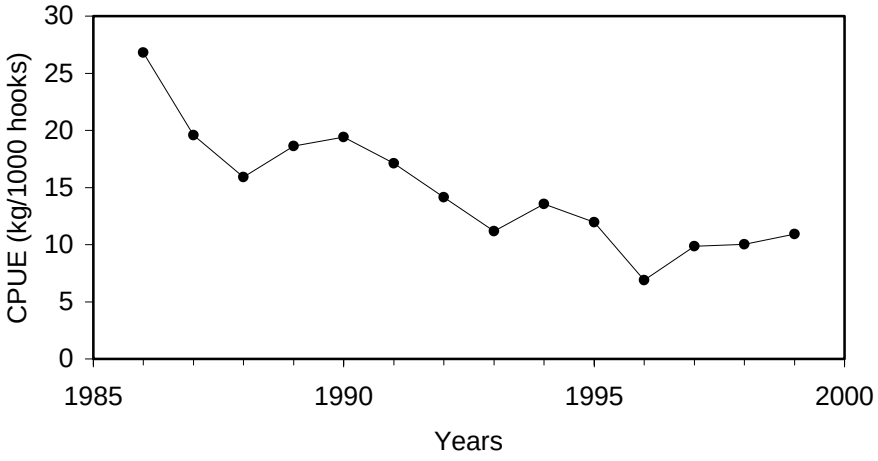


Figure 9.1 Tusk in ICES Division Vb. CPUE 1986-1999 for Longliners > 100 GRT.

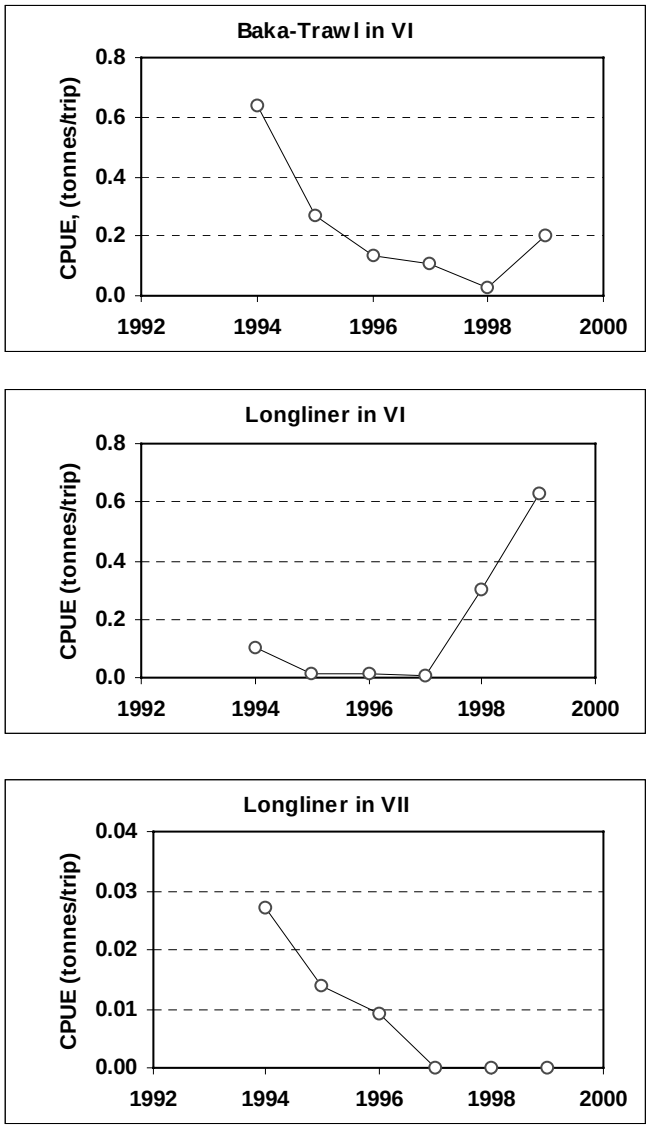


Figure 9.2. Tusk. Catch per unit of effort of Basque trawlers in Sub-area VI and longliners in Sub-areas VI and VII. Data extracted from Working Document by Lucio *et al.* For longliners, data for only 1-3 vessels were included.

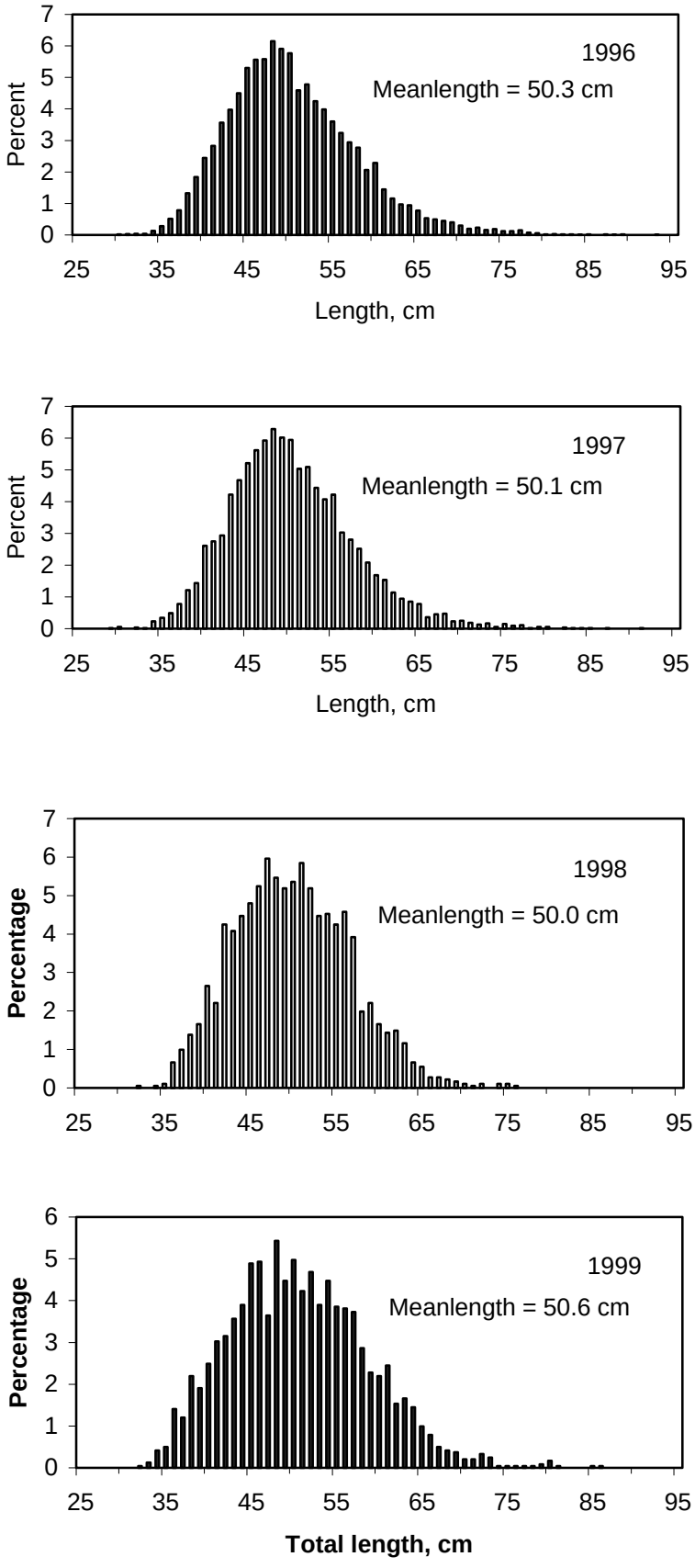


Figure 9.3 Tusk in Division Vb. Length distributions from Faroese longliners.

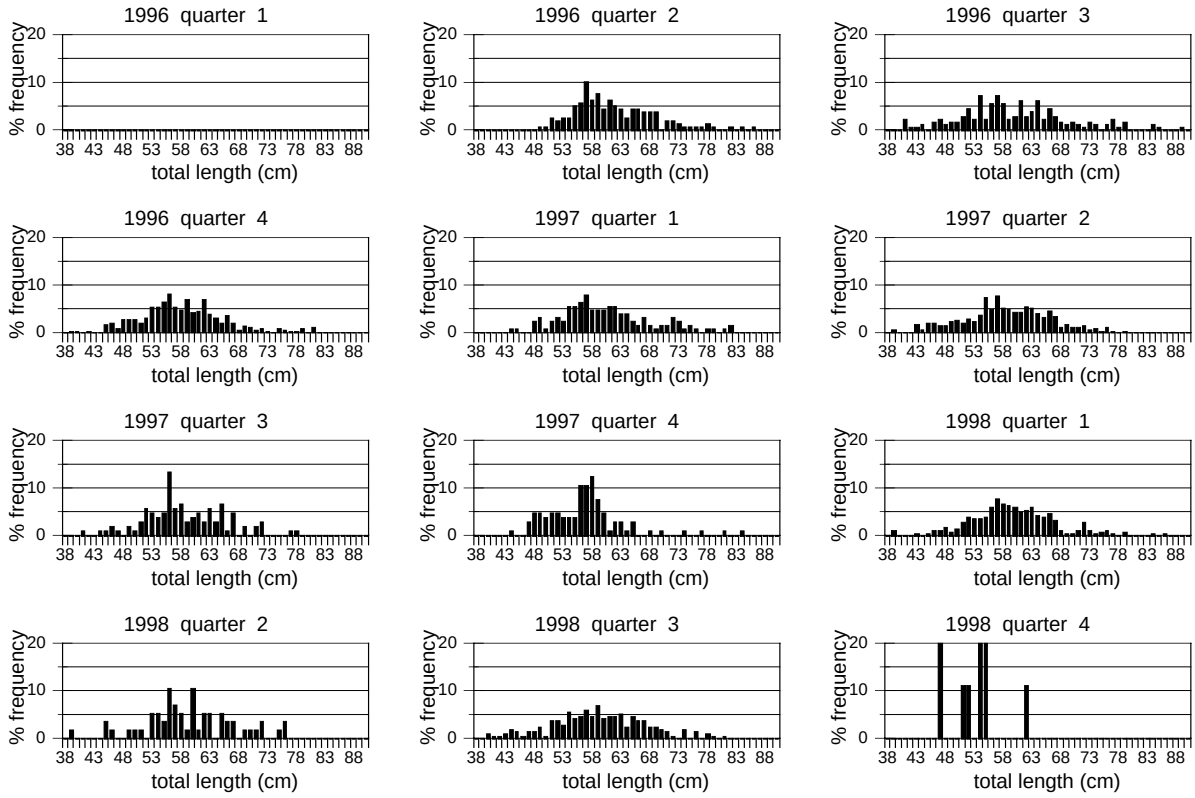


Figure 9.4 Tusk. Quarterly length distributions from French landings into Scotland, 1996-1998. Extracted from the report of an EC FAIR project (EC FAIR, 1999).

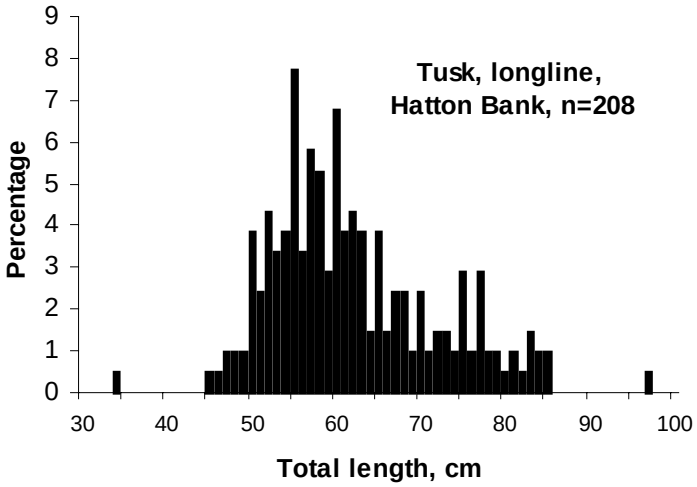


Figure 9.5 Tusk. Length distribution of Norwegian experimental longline catches on the northwestern Hatton Bank slope. Data extracted from Working Document by Langedal and Hareide, 2000. n= number of specimens measured.

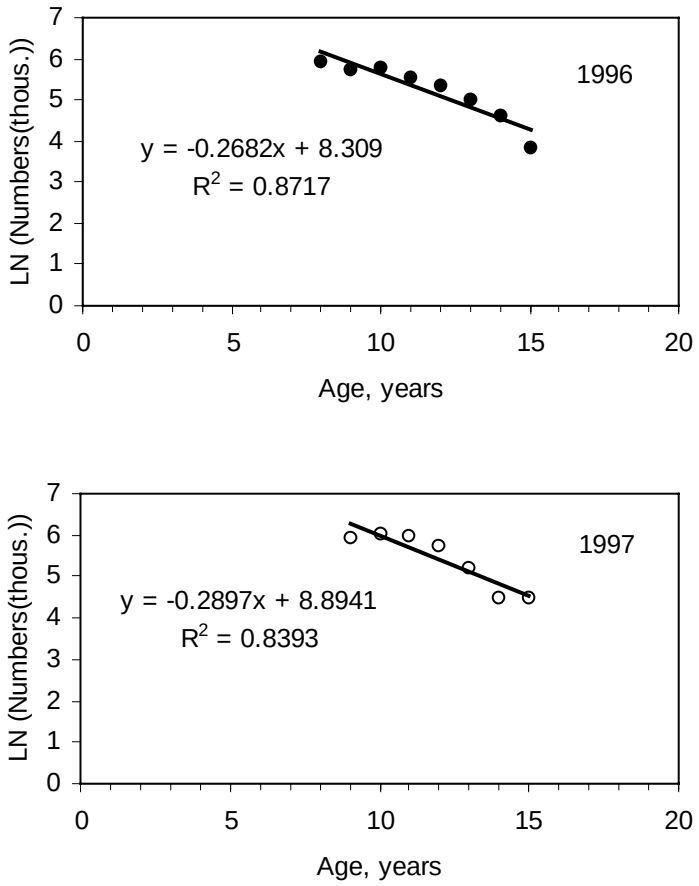


Figure 9.6 Tusk in Division Vb. Catch curves derived from Faroese age distributions, 1996 and 1997.

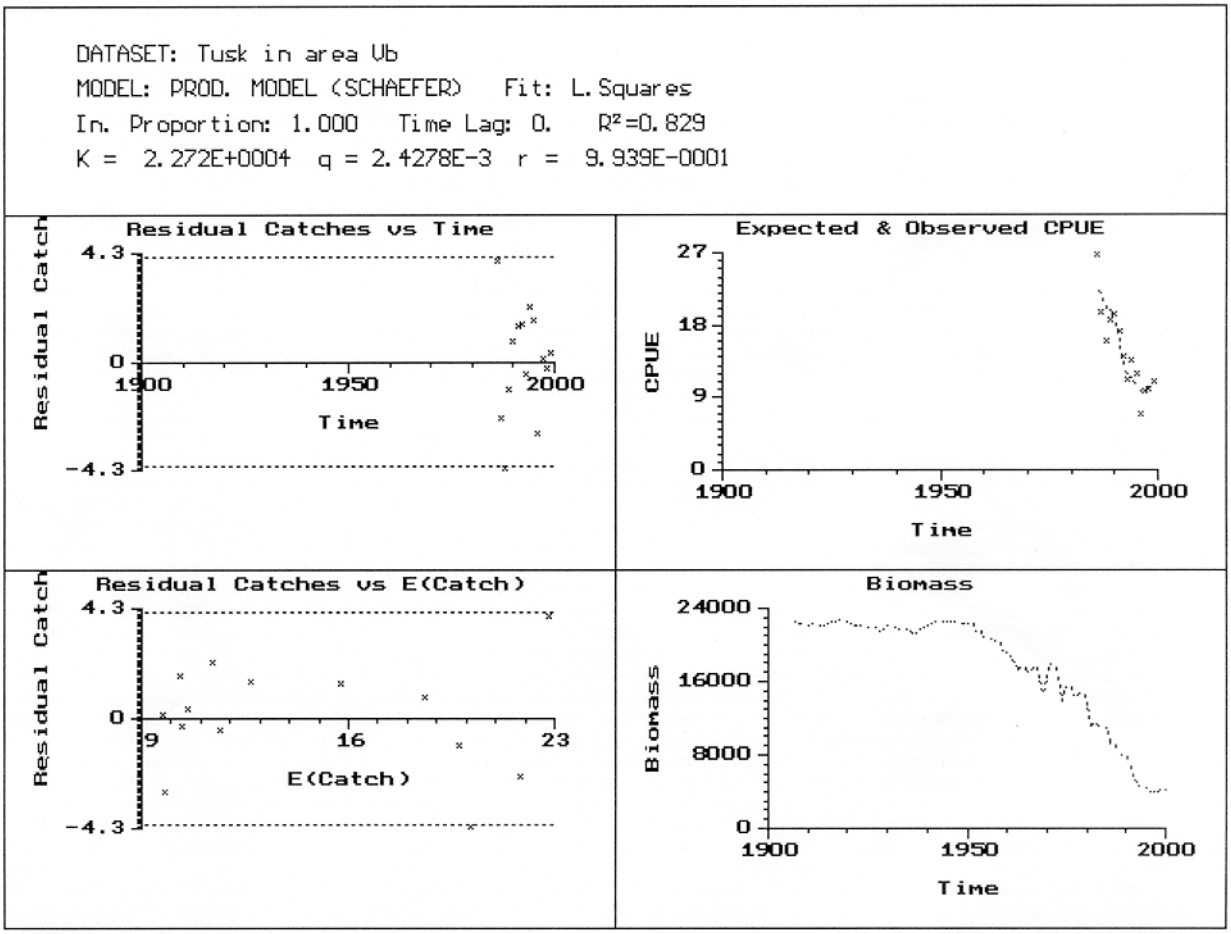


Figure 9.7. Tusk in Division Vb. Output of surplus production model run.

10 GREATER SILVER SMELT (*ARGENTINA SILUS*)

10.1 Catch trends

Table 10.1 shows the landings data for *Argentina silus* by ICES Sub-areas as reported to ICES or as reported to the Study Group.

Landings by Norway from Sub-areas I and II have declined from peak levels of 10 000 to 11 000 t to almost half that level in recent years. This probably represents a change in target species rather than a decline in abundance of *A.silus.*

Landings in Sub-areas III and IV are mainly by Denmark and Norway. The Danish landings have remained around the 1000 t mark except for 1992 and 1993 when they were higher. The Norwegian landings decreased from about 1000 to 2000 t to very low levels in the mid 1990s but have subsequently remained at low levels. The estimated Norwegian bycatch in the industrial fishery for Norway pout and blue whiting, based on sampling at fish meal factories, was 1342 t in 1998. There is probably a corresponding or even higher bycatch by the Danish industrial fleet. There is also an unknown bycatch of *A. silus* in the Danish, Norwegian and Swedish fishery for *Pandalus borealis* fishery.

The landings of *A. silus* in Divisions Va and Vb by Iceland and Faroe Islands respectively have increased considerably in recent years.

There has been a considerable decline in the landings of *A. silus* from Sub-areas VI and VII from a peak in the late 1980s Only the landings of the Netherlands remained reasonably consistent between 1989 and 1998. The Irish catch was high in the late 1980s but subsequently declined and has remained at a low level since then.

10.2 Stock structure

The limited and hypothetical information on possible stocks was reported in the 1998 Study Group report (CM 1998/ACFM:12).

10.3 Commercial catch-effort and research vessel surveys

No new information was available to the Study Group.

10.4 Length and Age compositions and mean weights at age

No new information was available to the Study Group.

10.5 Biological parameters

10.6 Assessment

The Norwegian acoustic surveys of the 1980s and early 1990s for Sub-area II were presented in the 1998 report (ICES C.M. 1998/ACFM :12).

The 1998 attempt to assess the argentines in Va was unsuccessful and because of the lack of any data no new assessment was attempted.

Table 10.1 Argentines. Study Group estimates of landings (tonnes).

ARGENTINES (Argentina silus) I and II

Year	Germany	Netherlands	Norway	Poland	Portugal	Russia/USSR	UK (Scot)	**TOTAL**
1988			11332	5		14		**11351**
1989			8367			23		**8390**
1990		5	9115					**9120**
1991			7741					**7741**
1992			8234					**8234**
1993			7913					**7913**
1994			6217				590	**6807**
1995	357		6418					**6775**
1996			6604					**6604**
1997			4463					**4463**
1998	40		7425					**7465**
1999*			7057					**7057**

ARGENTINES (Argentina silus) III and IV

Year	Denmark	Faroes	France	Germany	Netherlands	Norway	UK (Scot)	Sweden	Ireland	**TOTAL**
1988	1062			1		1655				**2718**
1989	1322				335	2128	1			**3786**
1990	737			13		1571				**2321**
1991	1421		1	0	3	1123	6			**2554**
1992	3565			1	70	698	101			**4435**
1993	2353				298	568	56			**3275**
1994	1118					4	24			**1146**
1995	1061					1	20			**1082**
1996	1446	370				213	22			**2051**
1997	1455			1		704	19	542		**2721**
1998	748			128	277	434				**1587**
1999*						5			2	**7**

ARGENTINES (Argentina silus) Va

Year	Iceland	UK (E+W)	**TOTAL**
1988	206		**206**
1989	8		**8**
1990	112		**112**
1991	247		**247**
1992	657		**657**
1993	1255		**1255**
1994	613		**613**
1995	492		**492**
1996	808		**808**
1997	3367		**3367**
1998	13387		**13387**
1999*	7220	23	**7243**

Table 10.1 (CONTINUED)

ARGENTINES (Argentina silus) Vb

Year	Faroes	Russia/USSR	UK (Scot)	**TOTAL**
1988	287			**287**
1989	111	116		**227**
1990	2885	3		**2888**
1991	59		1	**60**
1992	1439	4		**1443**
1993	1063			**1063**
1994	960			**960**
1995	5534	6752		**12286**
1996	9495		3	**9498**
1997	8433			**8433**
1998	17570			**17570**
1999*				

ARGENTINES (Argentina silus) VI and VII

Year	Faroes	France	Germany	Ireland	Netherlands	Norway	UK (EW)	UK (Scot)	UK (NI)	Russia	**TOTAL**
1988				5454		4984					**10438**
1989	188			6103	3715	12184	198	3171			**25559**
1990	689		37	585	5871			112			**7294**
1991		7		453	4723			10	4		**5197**
1992		1		320	5118			467			**5906**
1993					1168			409			**1577**
1994			43	150	4137			1377			**5707**
1995	1597		357	6	5440			146			**7546**
1996			1394	295	3953			221			**5863**
1997			1496	1089	4696			20			**7301**
1998			463	405	4687						**5555**
1999*		14	24	227						**5**	**270**

ARGENTINES (Argentina silus) XII

Year	Faroes	**TOTAL**
1988		
1989		
1990		
1991		
1992		
1993	6	**6**
1994		
1995		
1996	1	**1**
1997		
1999		

ARGENTINES (Argentina silus) XIV

Year	Norway	**TOTAL**
1988		
1989		
1990	6	**6**
1991		
1992		
1993		
1994		
1995		
1996		
1997		
1998		
1999		

Table 10.1 (CONTINUED)

Argentina silus (all areas)

	I + II	III + IV	Va	Vb	VI + VII	XII	XIV	Total
1988	11351	2718	206	287	10438			**25000**
1989	8390	3786	8	227	25559			**37970**
1990	9120	2321	112	2888	7294		6	**21741**
1991	7741	2554	247	60	5197			**15799**
1992	8234	4435	657	1443	5906			**20675**
1993	7913	3275	1255	1063	1577	6		**15089**
1994	6807	1146	613	960	5707			**15233**
1995	6775	1082	492	12286	7546			**28181**
1996	6604	2051	808	9498	5863	1		**24825**
1997	4463	2721	3367	8433	7301			**26285**
1998	7465	1587	13387	17570	5555			**45564**
1999*	7057	7	7243		270			**14577**

11 ORANGE ROUGHY (*HOPLOSTETHUS ATLANTICUS)*

11.1 Catch trends

Table 11.1shows the landings data for orange roughy for the ICES area as reported to ICES or as reported to the Study Group.

There are currently three fisheries for orange roughy in the North East Atlantic. The main fishery is by French trawlers in ICES Sub-areas VI & VII. There is also a Faroese fishery which has now extended to International waters (Hatton Bank and mid-Atlantic ridge) and a small Icelandic fishery which has now almost ceased. The French fishery in Sub-area VI started in 1991, and after an initial peak (3502 t) landings quickly declined to less than 200 t per annum. French landings from Sub-area VII peaked in 1992 at around 3100 t and in recent years have stabilised at around 1000 t per annum.

11.2 Stocks

The fishing grounds so far discovered in the North Atlantic have appeared to support relatively small aggregations of fish, usually associated with seamounts and other topographical features. Whether or not these are independent populations is not known. However, with time, the probability of finding, in the northern Atlantic, stocks comparable in size to the stocks exploited in the south Pacific is decreasing.

11.3 Commercial CPUE

French CPUE data have been computed for the period 1992–1998 (Table 11.2 and Figures 11.3 & 11.4). The CPUE calculated for the whole deep-sea fleet is not accurate because the fishery for this species is on concentrations which are targeted by a limited part of the fleet. The CPUE was calculated for a fleet of strictly deep-water trawlers which is better related to fish abundance (Lorance and Dupouy, 1998). The directed catch and effort data during 1989-98 were analyzed using a multiplicative model taking into account month and area effects. The annual standardized CPUE index derived from this model (Table 11.2, Fig. 11.3 to 11.6) was then used as input data for the subsequent surplus production model assessment. From 1992 to 1998, the number of vessels targeting orange roughy has declined. It is the CPUE of these vessels which has been used in the assessment.

In Sub-area VI CPUE declined quite quickly after the fishery commenced and by 1994 was 25% of initial catch-rates. In recent years CPUE has increased slightly and stabilised. CPUE in Sub-area VII shows a similar trend but with a stronger recovery in recent years. This recovery may simply reflect the discovery and subsequent fishing of previously unexploited aggregations.

11.4 Length and age composition

The length composition of the French landings in 1994, 1996 and 1998 is shown in Figure 11.1. The differences in length composition between years, the presence of juvenile fish in 1994 for example, are considered to be due to changes in the geographical distribution of fishing rather than changes in stock structure. No age composition is given for the species as no complete ALK is available. Otoliths of small fish (up to 25cm) can be read whole. For large fish, thin slice methods are used. Ages from thin slices suggest that orange roughy can be up to 100 years old. However, these ages are as yet unvalidated. On the large stocks exploited in the south west Pacific, only the ages of juvenile fish have been validated. According to the size at age of these juveniles and the numbers of rings see on larger fish, ages of up to 125 years are considered likely and the stocks are managed under an assumed natural mortality of 0.04 (Annala and Sullivan, 1996). Age validation is currently under investigation in France.

The quarterly length-frequency distributions of orange roughy landed by French vessels in Scottish ports are shown in Figure 11.2 (EC FAIR 1999).

Data on the length frequency distributions of orange roughy from Faroese exploratory cruises around the Faroe Islands, Hatton bank, Reykjanes Ridge and north of the Azores are given by Thomsen, 1998.

No length samples are available from the Icelandic landings, but a concentration of orange roughy was discovered during a survey in June-July 1997 on a seamount at about 800 m depth west of the Reykjanes Ridge, not far from the continental shelf. The length of these fishes ranged from 46 to 65 cm total length. The mean length of males was 55.9 cm and 57.6 for females.

11.5 Biological parameters

An analysis of the German deep-water survey data from 1974 to 1986 was completed as a contribution to the EC FAIR Deep-fisheries Project (EC FAIR, 1999). The length of males and females ranged from 30 – 64 and 30 – 69 cm respectively. The distribution and abundance by length, sex and depth for have been analysed for sub-areas of the Rockall Trough. Information on maturity and the length-weight relationship are given.

A description of an attempt to validate age estimates by *in situ* tagging was described by the French partner. Investigations were carried out on maturity, length at maturity, gonadosomatic index and fecundity (EC FAIR 1999).

The combined data from Icelandic surveys have been used to define the distribution in Icelandic water. The data have been analysed in terms of length frequency and mean length by depth. Information is also given on length distribution by sex and maturity stages by season. Length-weight relationships have been calculated for both sexes (EC FAIR 1999).

11.6 Assessment

Data for assessment of this species in the north Atlantic are poor in comparison to orange roughy stocks in the Pacific Ocean. It should be noted that the important stocks exploited in the South West Pacific are not assessed by analytical models. These assessments mainly rely on survey data in term of estimates of the biomass from acoustic and trawling surveys or the two combined. Eggs surveys are also carried out to back calculate SSB. These data are not available for the North Atlantic.

For this present assessment, a modified DeLury constant recruitment model and a Schaefer production model were attempted using total international catch data for VI and VII from 1992 to 1998, and French directed CPUE data for otter trawlers over the same seven year period. Sub-areas VI and VII were analysed separately on the assumption that separate aggregations occur in each area.

Sub-area VI

The fit from DeLury was good for a range of error models, with least squares error giving a marginally better fit (R^2=0.913) (in ICES files). The results were robust for a range of values of ratio of initial stock to virgin stock (Table 11.4). This fishery started on a virgin stock and it therefore seems reasonable to accept the results using an initial ratio of 1.0 (Figure 11.3). Virgin stock biomass is estimated to be 6000t (95% confidence limits : 5400-6300t). Population biomass in 1998 is estimated to be 1600t, 27% of virgin biomass (95% confidence limits : 25-29%). All confidence limits were calculated by bootstrapping (included in ICES files).

The fit from Schaefer was good for a range of error models, with least squares error giving a marginally better fit (R^2=0.908) (in ICES files). The results from Schaefer for range of values of ratio of initial stock to virgin stock and time lags were fairly robust (Table 11.5). An initial ratio of 1.0 was selected for the reasons described for the DeLury model. A time-lag of zero was used as the data-series are too short to explore the effect of time-lag over a range of years commensurate to age of recruitment (around 30yrs). It was assumed, therefore, that growth rather than recruitment is the main contributor to biomass production. The results (Table 11.5 and Figure 11.4) indicate that carrying capacity is estimated to be about 6000t (95% confidence limits : 5500-7300t). Population biomass in 1998 is estimated to be about 1800t, 29% of carrying capacity (95% confidence limits : 24 -32%). All confidence limits were calculated by bootstrapping (included in ICES files). MSY is estimated to be about 300t (95% confidence limits : 100–480t). This equates to around 5% of carrying capacity.

Sub-area VII

The fit from DeLury was very poor (R^2 >0.1) (Figure 11.5) for a range of error models and input ratios of initial stock to virgin stock (in ICES files).

The fit from Schaefer was good for a range of error models, with log error giving a marginally better fit (R^2=0.902) (Figure 11.6) (in ICES files). The results from Schaefer for range of values of ratio of initial stock to virgin stock and time lags are given in Table 11.6. For all options, the intrinsic rate of growth (r) is estimated to be high and this is unlikely for such a slow growing species. MSY is estimated to be around 40% of carrying capacity and is clearly not well estimated.

11.7 Comments on assessment

The results for orange roughy in VI from DeLury and Schaefer are fairly similar for K and population size in 1998. Estimates of MSY from Schaefer are also quite believable. Stock in 1998 is estimated to be between 24 and 32% of virgin biomass.

The results for orange roughy in VII are clearly unreliable and should not be used.

11.8 Management considerations

The results presented in this assessment should be treated with caution because they are based on short time-series and little is known about the general distribution of orange roughy in these areas. However, our analyses indicate that current exploitable biomass (U) at the end of 1998 was below U_{pa} (50% of virgin biomass) in Sub-area VI and may be close to U_{lim} (20% of virgin biomass) . The situation in Sub-area VII is less clear. Although catch-rates in 1998 are similar to those obtained when the fishery started, these may simply reflect the sequential discovery and subsequent fishing of previously unexploited aggregations.

Table 11.1 Orange roughy . Study group estimates of landings (tonnes)

ORANGE ROUGHY (Hoplostethus atlanticus) Va

Year	Iceland	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991	65	**65**
1992	382	**382**
1993	717	**717**
1994	158	**158**
1995	64	**64**
1996	40	**40**
1997	79	**79**
1998	28	**28**
1999*		**0**

*provisional

ORANGE ROUGHY (Hoplostethus atlanticus) Vb

Year	Faroes	France	**TOTAL**
1988		-	**0**
1989		-	**0**
1990		22	**22**
1991		48	**48**
1992	1	12	**13**
1993	36	1	**37**
1994	170	+	**170**
1995	419	1	**420**
1996	77	2	**79**
1997	17	1	**18**
1998		3	**3**
1999*		4	**4**

*provisional

ORANGE ROUGHY (Hoplostethus atlanticus) VI

Year	Faroes	France	UK (EW)	UK (Scot)	Ireland	Spain	**TOTAL**
1988							**0**
1989		5					**5**
1990		15					**15**
1991		3502					**3502**
1992		1422					**1422**
1993		429					**429**
1994		179					**179**
1995	40	74		2			**116**
1996	0	116		0			**116**
1997	29	116	1				**146**
1998		100				2	**102**
1999*		130			65	1	**196**

*provisional

Table 11.1 (Continued)

ORANGE ROUGHY (Hoplostethus atlanticus) VII

Year	France	Spain	**TOTAL**
1988			**0**
1989	3		**3**
1990	2		**2**
1991	1406		**1406**
1992	3101		**3101**
1993	1668		**1668**
1994	1722		**1722**
1995	831		**831**
1996	879		**879**
1997	893		**893**
1998	963	6	**969**
1999*	1201	4	**1205**

*provisional

ORANGE ROUGHY (Hoplostethus atlanticus) VIII

Year	France	Spain VIII+IX	**TOTAL**
1988			**0**
1989	0		**0**
1990	0		**0**
1991	0		**0**
1992	83		**83**
1993	68		**68**
1994	31		**31**
1995	7		**7**
1996	22		**22**
1997	1	26	**27**
1998	4	11	**15**
1999*	3	7	**10**

*provisional

ORANGE ROUGHY (Hoplostethus atlanticus) X

Year	Faroes	France	Norway	**TOTAL**
1988				**0**
1989		-		**0**
1990		-		**0**
1991		-		**0**
1992		-		**0**
1993		-	1	**1**
1994		-		**0**
1995		-		**0**
1996	470	1		**471**
1997	6	-		**6**
1998	177	-		**177**
1999*		-		**0**

*provisional

Table 11.1 (Continued)

ORANGE ROUGHY (Hoplostethus atlanticus) XII

Year	Faroes	France	Iceland	Spain	**TOTAL**
1988					**0**
1989		0			**0**
1990		0			**0**
1991		0			**0**
1992		8			**8**
1993	24	8			**32**
1994	89	4			**93**
1995	580	96			**676**
1996	779	36	3		**818**
1997	802	6			**808**
1998	570	59			**629**
1999*		27		43	**70**

*provisional

ORANGE ROUGHY (Hoplostethus atlanticus), all sea areas

Year	Va	Vb	VI	VII	VIII	X	XII
1988	0	0	0	0	0	0	0
1989	0	0	5	3	0	0	0
1990	0	22	15	2	0	0	0
1991	65	48	3502	1406	0	0	0
1992	382	13	1422	3101	83	0	8
1993	717	37	429	1668	68	1	32
1994	158	170	179	1722	31	0	93
1995	64	420	116	831	7	0	676
1996	40	79	116	879	22	471	818
1997	79	18	146	893	27	6	808
1998	28	3	102	969	15	177	629
1999*	0	4	196	1205	10	0	70

Table 11.2. Orange roughy, directed catch and effort and standardised CPUE of trawlers in ICES Division Vb and Sub-areas VI and VII

ICES sub-area	Year	Total international catch (t)	Data for the reference fleet		
			Directed Catch (t)	Directed effort (hours)	Standardised cpue (kg/h)
Vb	89	0	0	0	
Vb	90	22	4	88	
Vb	91	48	30	138	
Vb	92	13	3	31	97
Vb	93	37	0	0	63
Vb	94	170	0	0	
Vb	95	420	0	0	
Vb	96	79	0	0	
Vb	97	18	0	0	
Vb	98	3	0	0	
VI	89	5	0	0	
VI	90	15	0	0	
VI	91	3502	1688	2643	403
VI	92	1422	707	2200	248
VI	93	429	187	1395	118
VI	94	179	56	529	87
VI	95	116	20	166	105
VI	96	116	11	84	169
VI	97	146	31	172	175
VI	98	102	31	162	150
VII	89	3			
VII	90	2	0	0	
VII	91	1406	1120	3010	414
VII	92	3101	2185	7876	246
VII	93	1668	669	3933	151
VII	94	1722	944	5454	159
VII	95	831	614	4065	130
VII	96	879	642	2346	231
VII	97	893	741	1723	400
VII	98	969	734	2041	321
Combined	89	8	0	0	
Combined	90	39	4	88	
Combined	91	4956	2838	5791	408
Combined	92	4536	2895	10107	235
Combined	93	2134	856	5328	135
Combined	94	2071	1000	5983	140
Combined	95	1367	634	4231	119
Combined	96	1074	653	2430	212
Combined	97	1057	772	1895	347
Combined	98	1074	765	2203	283

Table 11.3. Orange roughy: mean length at first maturity.

	Mean length of first maturity	Range
Males	49	42-54
Females	52	45-62

Table 11.4 . Orange roughy in Sub-area VI. DeLury model

Ratio	K (nos)	Q	Pop (nos)	K(tonnes)	Pop(tonnes)	Pop/K
1.0	1850529	0.0000966	495564	5922	1586	0.27
0.9	1989081	0.0001	500784	6365	1603	0.25
0.8	2152944	0.000104	509347	6889	1630	0.24

Note Popns are for the final year 1998

Table 11.5 Orange roughy in Sub-area VI. Schaefer model

Schaefer	Time lag =0					
Ratio	K (tonnes)	Q	r	MSY	Pop (tonnes)	Pop/K
1.0	6118	0.0000952	0.204	312	1770	0.29
0.9	6594	0.000980	0.205	339	1733	0.26
0.8	7201	0.000101	0.206	372	1697	0.24

Schaefer	Ratio=1.0					
Time lag	K (tonnes)	Q	r	MSY	Pop (tonnes)	Pop/K
0	6118	0.0000952	0.204	312	1770	0.29
1	6463	0.0000881	0.193	311	1888	0.29
2	6600	0.0000857	0.230	379	2030	0.31
3	6694	0.0000842	0.295	494	2163	0.32

Note : Popn values are for the final year 1998

Table 11.6 Orange roughy in Sub-area VII. Schaefer model

Schaefer	Time lag=0					
Ratio	K (tonnes)	Q	r	MSY	Pop (tonnes)	Pop/ K
1.0	4394	0.000109	1.63	1795	3693	0.84
0.9	4221	0.000114	1.70	1798	3565	0.84
0.8	4176	0.000117	1.72	1795	3526	0.84

Schaefer	Ratio=1.0					
Time lag	K (tonnes)	Q	r	MSY	Pop (tonnes)	Pop/ K
0	4394	0.000109	1.63	1795	3693	0.84
1	6900	0.0000653	1.2	2071	6228	0.90
2	9596	0.0000404	1.16	2791	10580	1.10
3	11369	0.0000325	1.59	4531	14512	1.28

Note : Popn values are for the final year 1998

Table 11.7. Orange roughy - virgin biomass estimates derived from swept area method.

STRATUM	400 to 600	600 to 800	800 to 1000	1000 to 1200	1200 to 1400	TOTAL
Relative Density (*)	0	0	100	570	1710	
Virgin Biomass (t)	0	0	757	6384	11714	18856

(*) swept area method estimates of fish density from German surveys before exploitation (Ehrich, 1983).

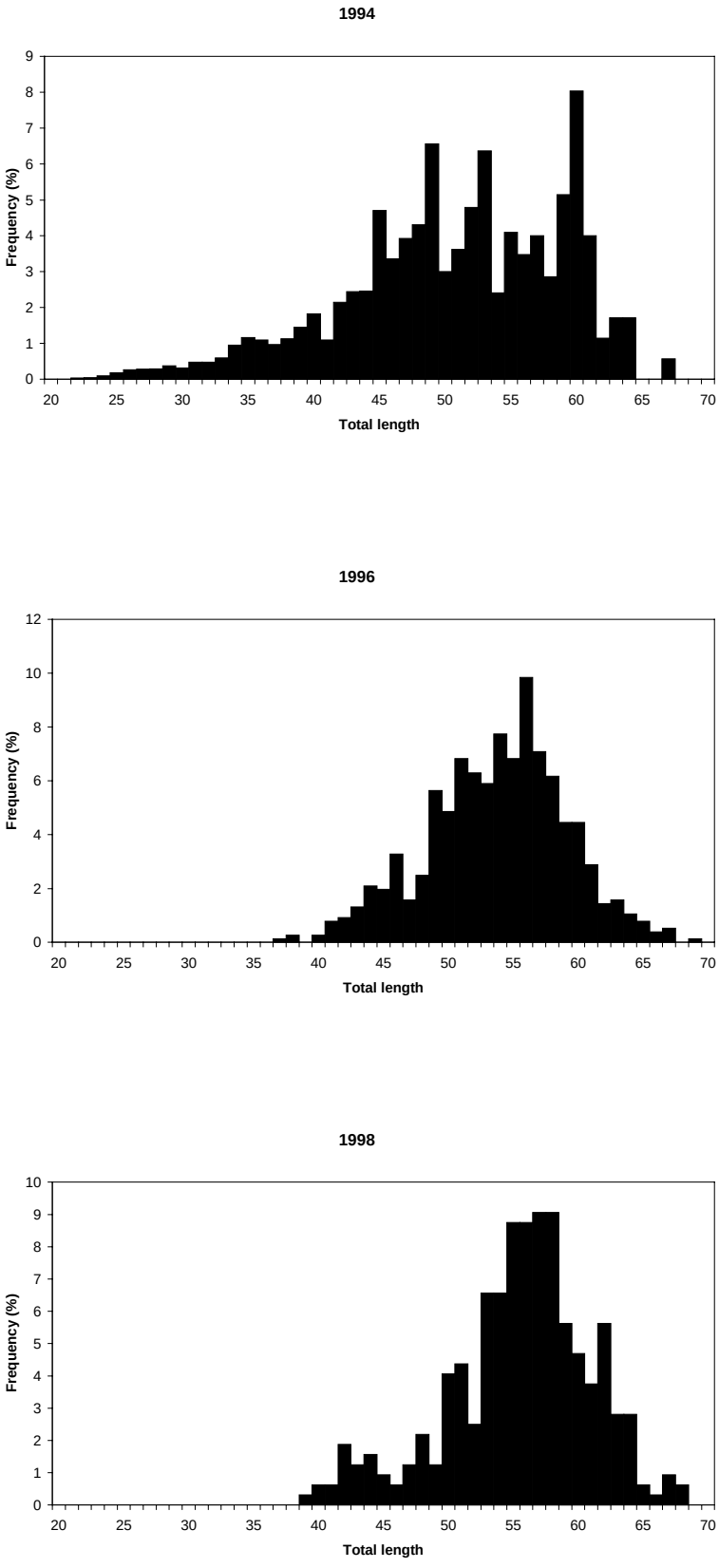


Figure 11.1. Length distribution of French landings of orange roughy from 1994 to 1998.

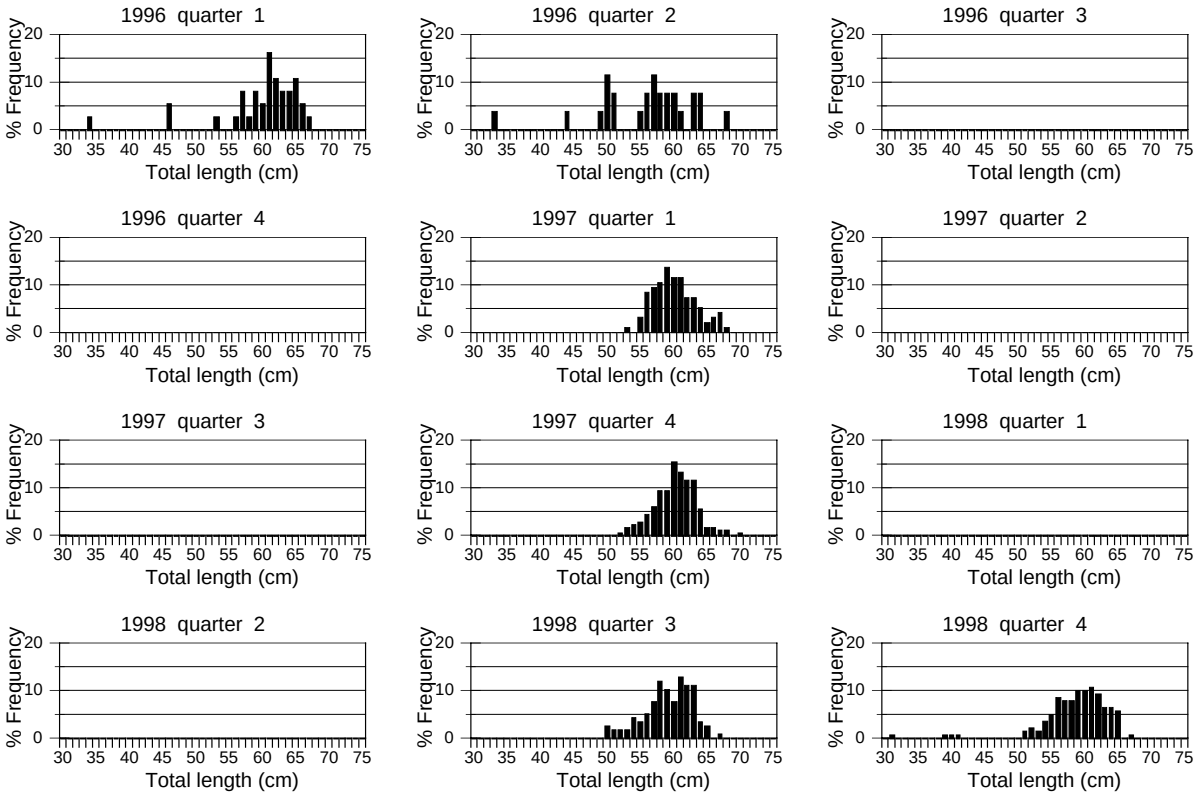


Figure 11.2 Orange roughy, quarterly landings from French vessels landing in Scotland (FRS data) (EC FAIR 1999)

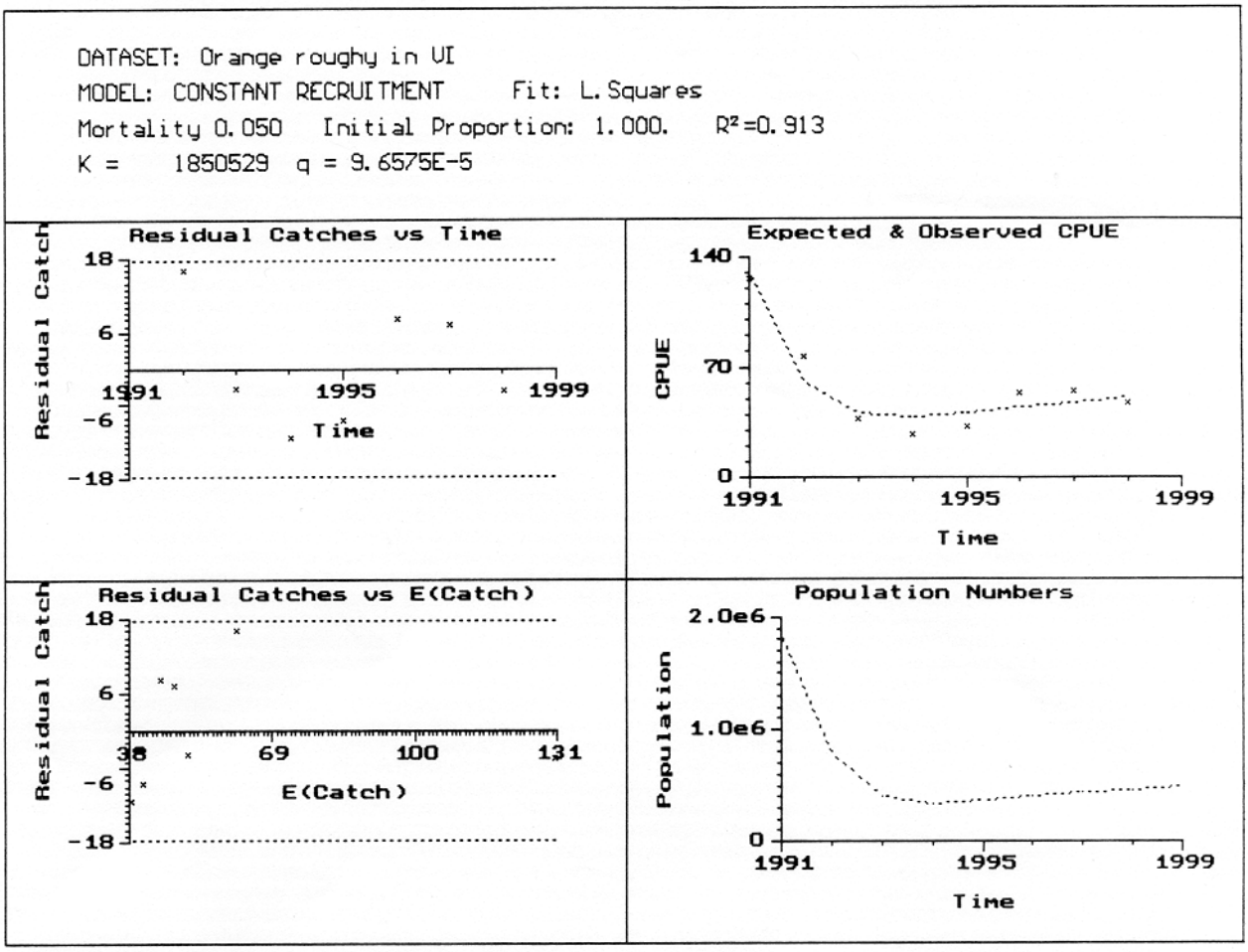

DATASET: Orange roughy in VI
MODEL: CONSTANT RECRUITMENT Fit: L.Squares
Mortality 0.050 Initial Proportion: 1.000. R²=0.913
K = 1850529 q = 9.6575E-5
Residual Catches vs Time
Residual Catch
18
6
-6
-18
1991
1995
1999
Time
Expected & Observed CPUE
CPUE
140
70
0
1991
1995
1999
Time
Residual Catches vs E(Catch)
Residual Catch
18
6
-6
-18
38
69
100
131
E(Catch)
Population Numbers
Population
2.0e6
1.0e6
0
1991
1995
1999
Time

Figure 11.3

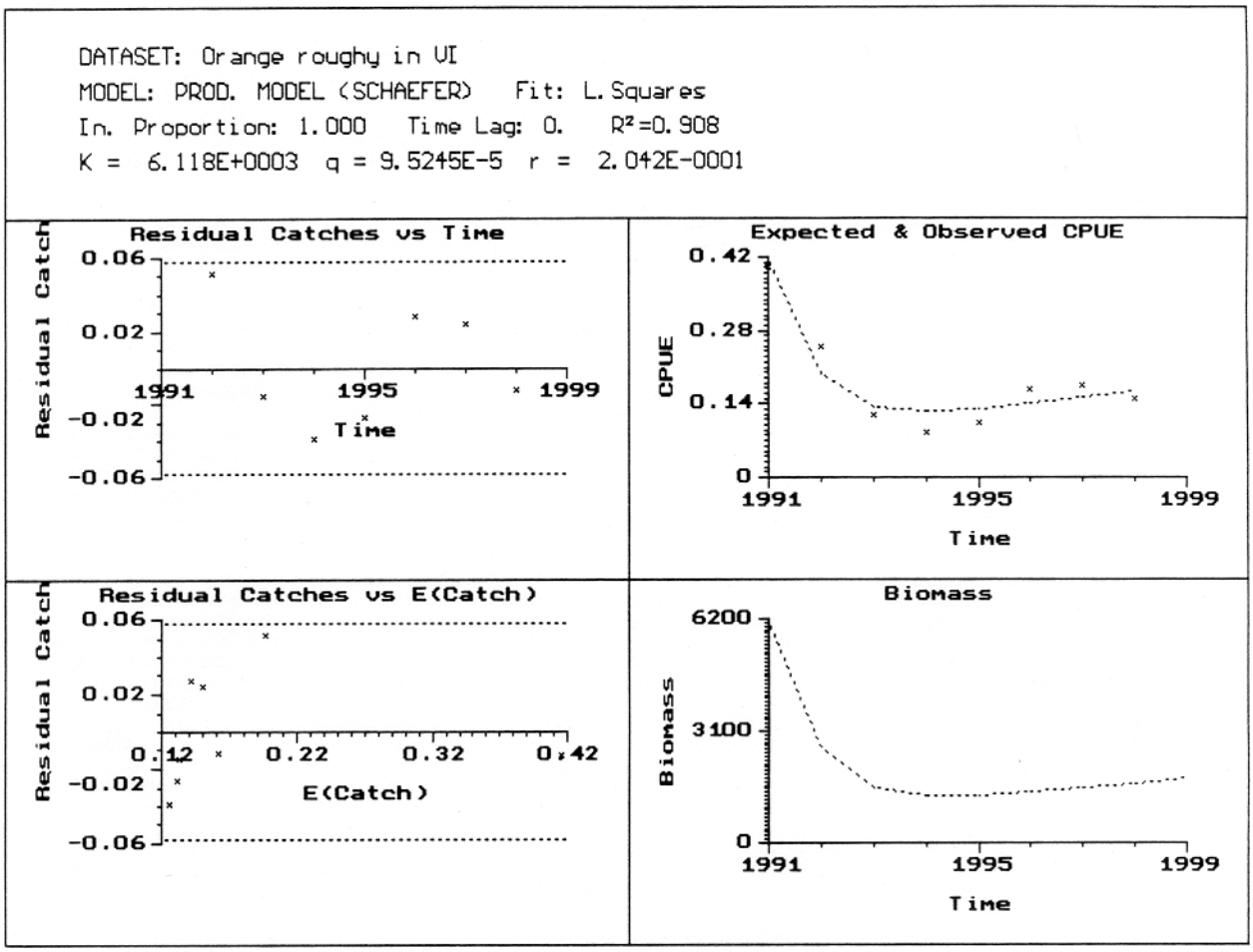

DATASET: Orange roughy in VI
MODEL: PROD. MODEL (SCHAEFER) Fit: L. Squares
In. Proportion: 1.000 Time Lag: 0. R²=0.908
K = 6.118E+0003 q = 9.5245E-5 r = 2.042E-0001
Residual Catches vs Time
Residual Catch
0.06
0.02
-0.02
-0.06
1991
1995
1999
Time
Expected & Observed CPUE
CPUE
0.42
0.28
0.14
0
1991
1995
1999
Time
Residual Catches vs E(Catch)
Residual Catch
0.06
0.02
-0.02
-0.06
0.12
0.22
0.32
0.42
E(Catch)
Biomass
Biomass
6200
3100
0
1991
1995
1999
Time

Figure 11.4

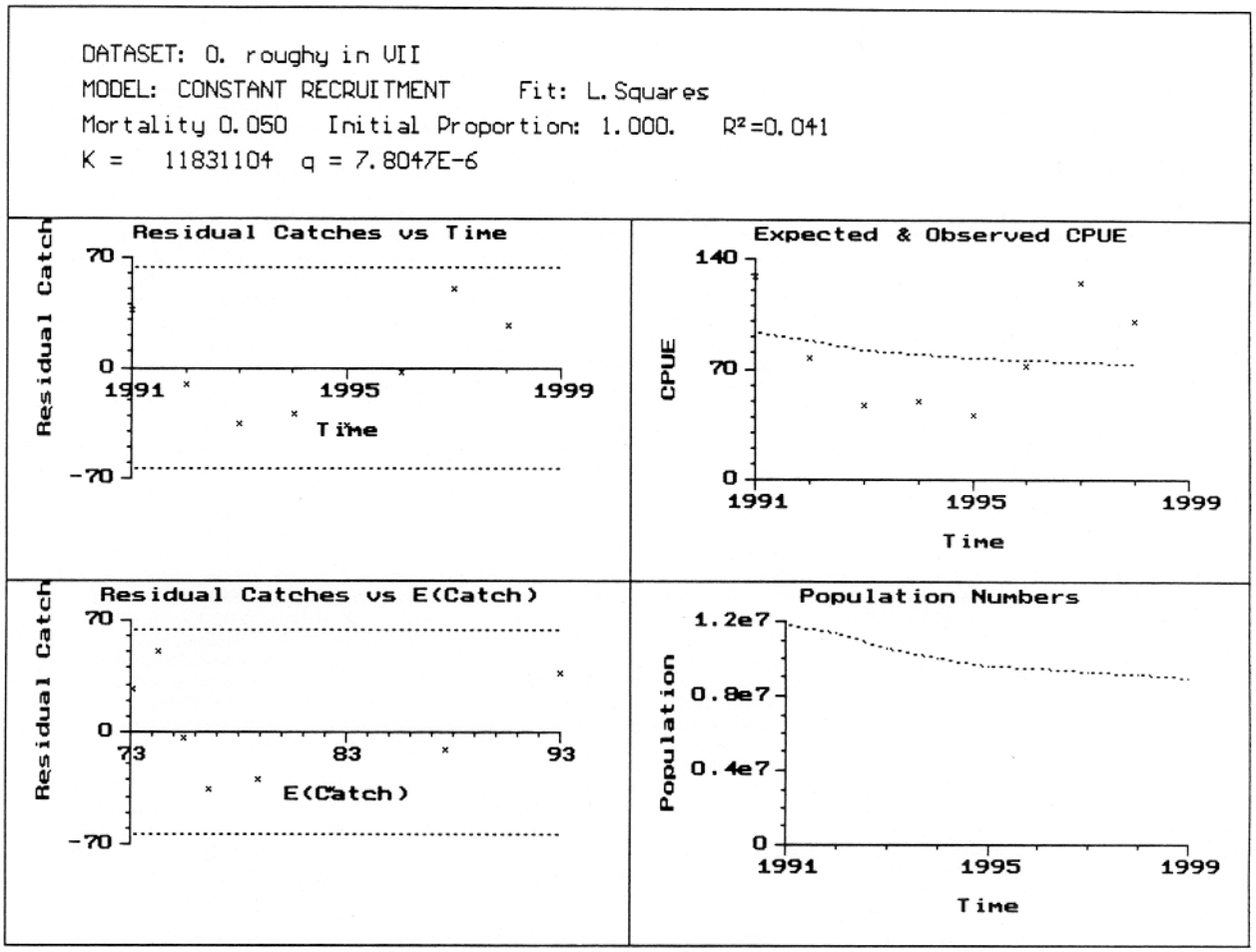

DATASET: O. roughy in VII
MODEL: CONSTANT RECRUITMENT Fit: L.Squares
Mortality 0.050 Initial Proportion: 1.000. R²=0.041
K = 11831104 q = 7.8047E-6
Residual Catches vs Time
Residual Catch
70
0
-70
1991
1995
1999
Time
Expected & Observed CPUE
CPUE
140
70
0
1991
1995
1999
Time
Residual Catches vs E(Catch)
Residual Catch
70
0
-70
73
83
93
E(Catch)
Population Numbers
Population
1.2e7
0.8e7
0.4e7
0
1991
1995
1999
Time

Figure 11.5

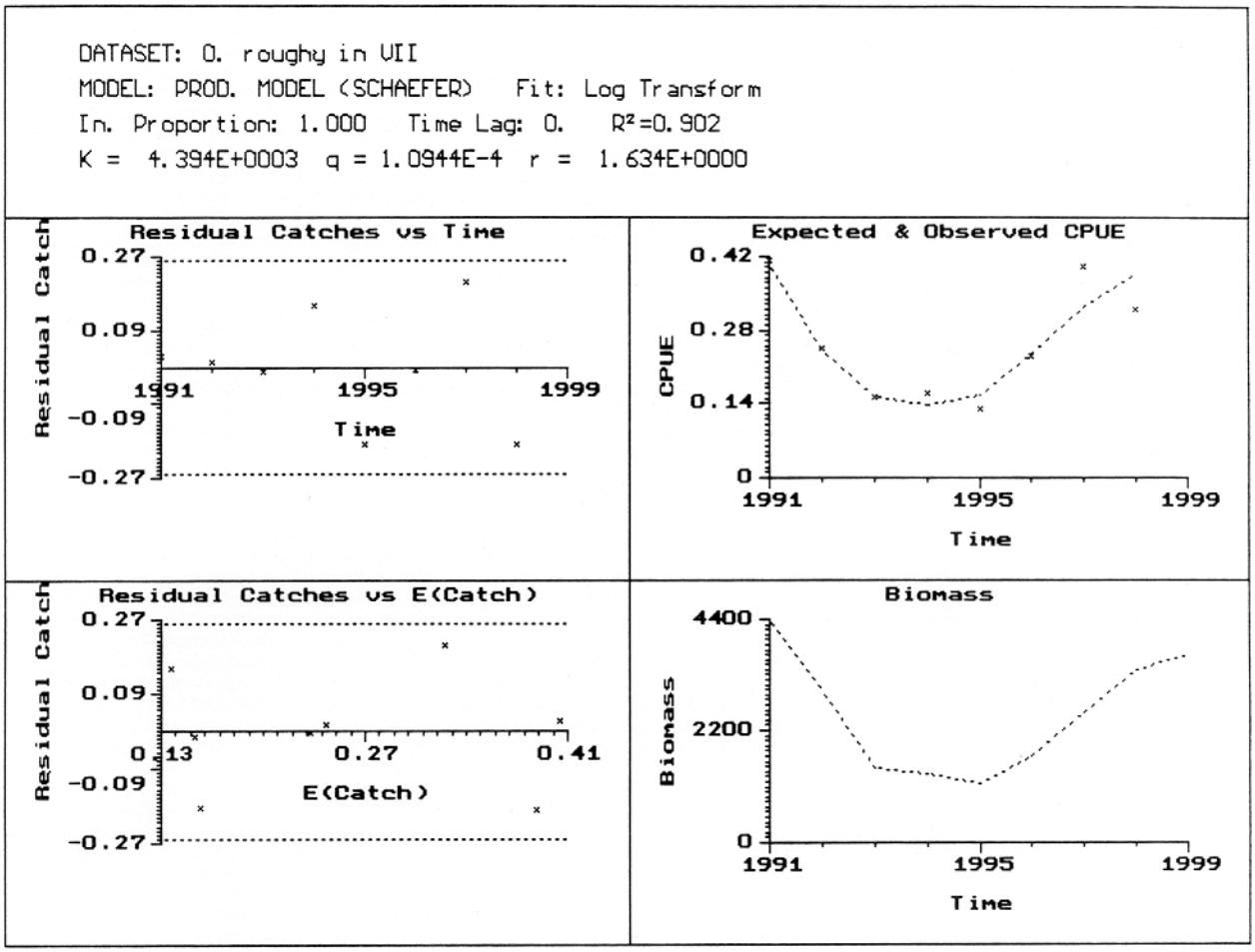

DATASET: O. roughy in VII
MODEL: PROD. MODEL (SCHAEFER) Fit: Log Transform
In. Proportion: 1.000 Time Lag: 0. R²=0.902
K = 4.394E+0003 q = 1.0944E-4 r = 1.634E+0000
Residual Catches vs Time
Residual Catch
0.27
0.09
-0.09
-0.27
1991
1995
1999
Time
Expected & Observed CPUE
CPUE
0.42
0.28
0.14
0
1991
1995
1999
Time
Residual Catches vs E(Catch)
Residual Catch
0.27
0.09
-0.09
-0.27
0.13
0.27
0.41
E(Catch)
Biomass
Biomass
4400
2200
0
1991
1995
1999
Time

Figure 11.6

12 ROUNDNOSE GRENADIER (*CORYPHAENOIDES RUPESTRIS)*

12.1 Catch trends

Table 12.1 shows the landings data for *Coryphaenoides rupestris* by ICES Sub-areas as reported to ICES or as reported to the Study Group.

Small catches are reported from Sub-areas I and II. There is an active fishery in Sub-area III. This fishery is mainly Danish with some Norwegian and Swedish catches. The catches increased to more than 4700 tonnes in 1998 which is a large quantity given the small size of the area. In the same area, roundnose grenadier is also a discard of the shrimp fishery. The quantity involved may be over 1000 t.

The fishery is Sub-areas VI and VII and Division Vb is mainly a French trawl fishery. In Division Vb, the catches from Faroe Islands are important in some years. Over recent years, the total catch is rather stable. However, there appears to be a change in the distribution of French catches between Sub-areas V and VI but the figures for 1999 are preliminary. Part of the catch is actually landed in other countries (Scotland and Ireland) but all the landings are sold and recorded in France.

Catches are rapidly increasing in Sub-area XII. After a continued decrease since the late 1980s, the total catches have increased from 1996 due to new fisheries from Spain and Poland and resumption of the Russian catch. The catches peaked at close to 12000 tonnes in 1998 and the reported catch may be well below the actual catch as fleets from countries whose catch statistics were not available are thought to have being fishing in that area.

12.2 Stock identity

The issue of roundnose grenadier stocks was discussed in the 1994 Study Group Report (ICES C.M. 1995/Assess:4) and there are no new data on this topic.

Roundnose grenadier in Sub-areas II (Norwegian fjords) and III (Skagerrak) may represent separate stock(s) due to the physical boundary of the Wyville Thomson Ridge and fjord sills. For other populations, the stock structure remains unclear.

The Study Group carried out assessment for Division Vb and Sub areas VI and VII combined implicitly considering these areas as a stock unit for this species. Sub-area XII was not included because catches in that area include catches from the Mid-Atlantic ridge and from the Western part of Hatton Bank. They cannot be re-allocated properly to each of these areas which are likely to support rather separated stocks units. Moreover, catch in Sub-area XII are likely to be significantly under-reported (see above).

12.3 Commercial CPUE

Commercial CPUE are available from the French fleet for ICES Sub-areas VI, VII and Division Vb. The deep-water French fleet is composed of high sea trawlers. In 1999 there were 14 large high sea trawlers (50 to 55 meters long) and 31 medium size trawlers (32 to 39 meters). Due to the differing sizes of the vessels of these fleets, as well as their power and activity (some vessels fishing on both the shelf and the slope while others have been almost entirely deep-water trawlers since the early 90s), the CPUE was calculated for a fleet of strictly deep-water trawlers which is better related to fish abundance (Lorance and Dupouy, 1998). The directed catch and effort data during 1989-98 were analyzed using a multiplicative model taking into account month and area effects. The annual standardized CPUE index derived from this model (Table 12.2, Fig. 12.8) was then used as input data for the subsequent surplus production model assessment (see below). During each fishing trip of an individual trawler, the catch in each statistical rectangle visited is considered as a directed catch if it represents more than 10% of the total catch. CPUE data show a gradual decline across the time series.

12.4 Age and length composition.

Length composition from the French catch is available from 1990 to 1999 (Table 12.3 and Fig 12.1). A decrease in size of the fish landed is evident.

Length distribution data, from observers onboard commercial fishing vessels, of the catch (landings + discards) in Sub-area XII was available for 1998 and 1999 from Spain (Fig. 12.2).These length distribution, include small size fish which are discarded. The larger size observed in Sub-area XII are similar to that observed in Sub-area V, VI and VII (French trawl fishery) at the start of the fishery, 10 years ago. Now the sizes in V, VI and VII are much lower than in XII.

Scientific survey data confirm the changes in length distribution. Data available are from German surveys in the late 1970s and early 1980s (Ehrich, 1983) and English surveys in 1973/1974 (Bridger, 1978) compared to data from a French cruise in 1999. German and English survey data apply to the Rockall Trough area (VI and VII). The French survey provides length distribution in the same area and to the west of Brittany, by 47 to 48°N, (Fig. 12.3). Although the length distribution of this species depends on depth, it is clear that the modal length of adult fish, observed for the pooled catch of the English (Fig. 12.4) and German surveys (Fig. 12.5), of around 17 cm or more, has decreased since exploitation. Length distribution on Hatton bank and Faraday Seamount (Mid-Atlantic Ridge, 50°N) from Spanish survey in 1999 (Durán Muñoz *et al.*, WORKING DOCUMENT), also show a higher proportion of large fish and a larger modal size than in the Rockall Trough area (Fig. 12.6).

Quarterly length frequency distributions of landings in Scotland by French trawlers during 1996-98 are shown in Fig. 12.7. Little variation was apparent among the length compositions provided.

The age interpretations for this species do not create particular concern since readers generally agree on age readings. Moreover, age estimates have been validated for juvenile fish (Gordon and Swan, 1996). Due to the high number of exploited age groups and wide overlaps of the range of ages by length classes a large sample of otoliths is necessary to obtain a meaningful age-length key. However, age-length keys have been constructed by France (Lorance *et al.*, 1998) and Ireland (Kelly *et al.*, 1997a) for the Rockall trough area and Norway (Bergstad, 1990) for the Skaggerak. The data for the former area were used for assessment purposes during the 1998 meeting.

No new age data were available to the study group. The study group considered that an age based assessment would be much more informative for this species and therefore should be encouraged.

12.5 Discards

Discards were estimates in the course of the EC FAIR project CT- 95-0655.

Due to the size distribution observed on fishing grounds (adult and juveniles are most often found together), a high discarding rate occur for this species. In the French fishery, discards have been estimated as 30% of the landings in weight and 60 % in numbers from on-board observations in 1996/1997. The mean weight of discarded roundnose grenadier was estimated as about 400 g (Dupouy *et al.*, 1998).

Spanish discards, estimated from on board observers, in Sub area XII amounted to 433 t (10% of the landings) in 1998 and to 2782 t (34 % of the landing) in 1999.

12.6 Biological data

The available data were comprehensively reviewed by the Study Group in 1998 (ICES CM 1998/ACFM:12).

New data documented in EC FAIR, 1999 are as follows. In the analysis of the historical, German survey data information is available on the abundance of male and female maturity stages by depth and the mean length by sex and depth horizon. Differences in relative abundance by depth in various sectors of the Rockall Trough and a length-weight relationship are also given. Length weight relationships and the relationship between total and gutted weight are available from Scottish market sampling of the landings by French vessels into Scotland. A comprehensive evaluation of all the Icelandic survey data was carried out. This included overall geographical distribution, length and depth distribution, length distribution by sex, the length-weight relationship and maturity data.

Spanish data for the Hatton bank and Mid-Atlantic ridge including length weight relationship, and percentage maturity by length were provided to the study group (Durán Muñoz *et al.*, Working Document).

12.7 Assessment

A combined assessment of areas Vb, VI and VII was conducted using total international catch data from 1990 to 1998 and French directed CPUE data for the same period. The total international catch data includes discards which are estimated as 30% of landed biomass. A Schaefer surplus production model was used in the assessment. A DeLury constant recruitment model could not be tried in this assessment due to difficulties converting numbers to biomass when discards are included in the catch data.

The fit from the Schaefer surplus production model to the CPUE data is very similar for a range of error models. The log transform error model was chosen as this gave more realistic estimates of the intrinsic growth rate parameter r (approximately 0.12 compared to 0.5 for the least squares error model). The estimated parameter values were quite robust to the ratio of initial stock biomass to population carrying capacity (Table 12.4). It is believed that this resource was initially only slightly depleted and we therefore assume an initial biomass of 90% of carrying capacity (Figure 12.8). In this case the carrying capacity is estimated to be about 130000t (95% confidence limits : 54 000-230 000t). The final population biomass is estimated at about 40 000 t which corresponds to 30% carrying capacity (95% confidence limits : 17-72%).

The fit of the model to the CPUE data shows no improvement when using different time lags and some of the parameter values become quite unrealistic with increased time lag. Since the data-series are too short to investigate the effect of a time lag which is comparable to the age of recruitment (approximately 15 years), it is assumed that growth rather than recruitment is the main contributor to biomass production and a time lag of zero is maintained.

12.8 Comments on the assessment

The data fit the Schaefer model relatively well (R^2=0.86). The estimates of MSY do not appear unrealistic and the final stock biomass is estimated to be between 24 and 34% of carrying capacity. However, it should be noted that the confidence intervals for carrying capacity and final biomass are very large.

At the previous meeting, 3 working papers on assessment based upon (i) estimated virgin biomass from the swept area method applied to surveys carried out before exploitation; (ii) pseudo-cohort analysis; (iii) estimates of biomass from surveys in 1997. In addition to these Working Documents, catch curves were computed using age data provided from both Irish research surveys and the French commercial fishery (ICES C.M. 1998/ACFM:12). These assessments methods suggested that catches over the recent period had generated low levels of F possibly as low as, or lower than M. The lack of contrast in the commercial CPUE series then used (1992-1996) was in agreement with this conclusion.

In the absence of new age data, no age-based assessment was possible at this meeting. On the other hand, the longer time series of CPUE data now available leads to a major revision of the previous assessment.

12.9 Management considerations

The results of this assessment should be treated with caution due to the relatively limited data available. However, the analysis conducted here indicates that $U_{current}$ is below U_{pa} for areas Vb, VI and VII combined and may be close to U_{lim}.

Table 12.1 Roundnose Grenadier. Study Group estimates of landings (tonnes).

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) I and II

Year	Faroe	Denmark	France	FRGermany	Norway	Russia/USSR	GDR	**TOTAL**
1988								
1989			1	2		16	3	**22**
1990			32	2		12	3	**49**
1991			41	3	28			**72**
1992		1	22	0	29			**52**
1993			13	0	2			**15**
1994			3	12				**15**
1995			7					**7**
1996			2					**2**
1997	1		5		100			**106**
1998			0		87	13		**100**
1999*			0		44			**44**

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) III

Year	Denmark	Norway	Sweden	**TOTAL**
1988	612		5	**617**
1989	884		1	**885**
1990	785	280	2	**1067**
1991	1214	304	10	**1528**
1992	2856	211	755	**3822**
1993	1591	55		**1646**
1994	1910		42	**1952**
1995	2227		1	**2228**
1996	1174			**1174**
1997	2124	124	42	**2290**
1998	4429	329		**4758**
1999*		13		**13**

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) IV

Year	France	FRGermany	Norway	UK (Scot)	**TOTAL**
1988		1			**1**
1989	167	1		2	**170**
1990	370	2			**372**
1991	521	4			**525**
1992	421			4	**425**
1993	279	4			**283**
1994	185	2			**187**
1995	68	1		15	**84**
1996	59			5	**64**
1997	1			10	**11**
1998	35		0		**35**
1999*	38		5		**43**

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) Va

Year	Faroes	Iceland***	Germany	**TOTAL**
1988		2		**2**
1989	2	2		**4**
1990		7		**7**
1991		48		**48**
1992		210		**210**
1993		276		**276**
1994		210		**210**
1995	0	398		**398**
1996	1	139		**140**
1997	0	198		**198**
1998		120	+	**120**
1999*				**0**

*** includes other grenadiers

Table 12.1 (Continued)

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) Vb

Year	Faroes	France	Norway	FRGermany	Russia/USSR	UK	**TOTAL**
1988				1			**1**
1989	20	181		5	52		**258**
1990	75	1470		4			**1549**
1991	22	2281	7	1			**2311**
1992	551	3259	1	6			**3817**
1993	339	1328		14			**1681**
1994	286	381		1			**668**
1995	405	818					**1223**
1996	93	983		2			**1078**
1997	53	1059					**1112**
1998	50	1617					**1667**
1999*	104	1919	2			29	**2054**

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) VI

Year	Faroes	France	FRGermany	Ireland	Norway	Spain	UK (EW)	UK (Scot)	**TOTAL**
1988	27		4				1		**32**
1989	2	2211	3					2	**2218**
1990	29	5484	2						**5515**
1991		7297	7						**7304**
1992	99	6422	142		5		2	112	**6782**
1993	263	7940	1					1	**8205**
1994		5898	15	14				11	**5938**
1995	0	6329	2	59				82	**6472**
1996	0	5888						156	**6044**
1997	15	5795		4	-			218	**6032**
1998	13	5170			21	3			**5207**
1999*		4445	-	50	-	1			**4496**

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) VII

Year	France	Ireland	Spain	**TOTAL**
1988				**0**
1989	222			**222**
1990	215			**215**
1991	489			**489**
1992	1556			**1556**
1993	1916			**1916**
1994	1922			**1922**
1995	1295			**1295**
1996	1051			**1051**
1997	1033		5	**1038**
1998	1146		11	**1157**
1999*	1247		4	**1251**

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) VIII and IX

Year	France	Spain	**TOTAL**
1988			**0**
1989	0		**0**
1990	5		**5**
1991	1		**1**
1992	12		**12**
1993	18		**18**
1994	5		**5**
1995	0		**0**
1996	1		**1**
1997	0		**0**
1998	1	19	**1**
1999*	0	7	**0**

Table 12.1 (Continued)

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) X

Year	Faroes	**TOTAL**
1988		
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995	0	**0**
1996	3	**3**
1997	1	**1**
1998	1	**1**
1999*		**1**

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) XII

Year	Faroes**	France	FRGermany	Iceland	Latvia	Russia/USSR	Poland	Spain	**TOTAL**
1988						10000			**10000**
1989		0				8000			**8000**
1990		0				2300			**2300**
1991		14			4296	3300			**7610**
1992		13			1684	700			**2397**
1993		26	39		2176	100			**2341**
1994	457	20	9		675				**1161**
1995	359	285							**285**
1996	136	179		77		200		1136	**1728**
1997	138	111				1300	5867	1800	**9216**
1998	19	116				812	6769	4262	**11978**
1999*		129				705		8251	**9085**

* provisional, indication of important catches from Latvia in 1999, without official report
** includes some from VIb in 1995

Table 1(continued)

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) XIV

Year	Faroes	FRGermany	Greenland	Iceland***	Norway	UK (EW)	UK (Scot)	**TOTAL**
1988		45	7					**52**
1989	3	42						**45**
1990		45	1			1		**47**
1991		23	4			2		**29**
1992		19	1	4	6		1	**31**
1993		4	18	4				**26**
1994		10	5					**15**
1995	0	13	14					**27**
1996	0	6	19					**25**
1997	6	34	12		7			**59**
1998	1	116	3		6			**126**
1999*		105	0		19			**124**

Roundnose Grenadier (Coryphaenoides rupestris). All areas

Year	I & II	III	IV	Va	Vb	VI	VII	VII & IX	X	XII	XIV	**TOTAL**
1988		617	1	2	1	32	0	0		10000	52	**10705**
1989	22	885	170	4	258	2218	222	0	0	8000	45	**11824**
1990	49	1067	372	7	1549	5515	215	5	0	2300	47	**11126**
1991	72	1528	525	48	2311	7304	489	1	0	7610	29	**19917**
1992	52	3822	425	210	3817	6782	1556	12	0	2397	31	**19104**
1993	15	1646	283	276	1681	8205	1916	18	0	2341	26	**16407**
1994	15	1952	187	210	668	5938	1922	5	0	1161	15	**12073**
1995	7	2228	84	398	1223	6472	1295	0	0	285	27	**12019**
1996	2	1174	64	140	1078	6044	1051	1	3	1728	25	**11310**
1997	106	2290	11	198	1112	6032	1038	0	1	9216	59	**20063**
1998	100	4758	35	120	1667	5207	1157	1	1	11978	126	**25150**
1999*	44	13	43	0	2054	4496	1251		1	9085	124	**17111**

Table 12.2. Roundnose grenadier. Directed catch and effort and standardised CPUE from a reference fleet of trawlers in ICES Divison Vb and sub-areas VI and VII

ICES sub-area	Year	Total international catch (t)	Data for the reference fleet		
			Directed Catch (t)	Directed effort (hours)	Standardised cpue (kg/h)
Vb	89	258	130	490	171
Vb	90	1549	998	3104	301
Vb	91	2311	1154	2850	430
Vb	92	3817	667	1889	332
Vb	93	1681	329	987	320
Vb	94	668	196	822	241
Vb	95	1223	450	1447	286
Vb	96	1078	476	1703	234
Vb	97	1112	497	2478	202
Vb	98	1667	791	4934	151
VI	89	2218	176	531	311
VI	90	5515	2104	3506	541
VI	91	7304	2934	6395	400
VI	92	6782	1357	5835	217
VI	93	8205	1732	6692	239
VI	94	5924	1291	6055	205
VI	95	6413	1787	7999	217
VI	96	6044	1538	9577	156
VI	97	6032	1426	8090	168
VI	98	5207	764	7064	101
VII	89	222	0	0	
VII	90	215	0	0	
VII	91	489	198	1908	91
VII	92	1556	990	7148	134
VII	93	1916	986	5077	195
VII	94	1936	969	5973	161
VII	95	1354	857	5269	159
VII	96	1051	548	3756	143
VII	97	1038	346	2254	151
VII	98	1157	280	2224	124
Combined	89	2698	306	1021	212
Combined	90	7279	3102	6610	365
Combined	91	10104	4286	11153	312
Combined	92	12155	3014	14872	201
Combined	93	11802	3047	12756	239
Combined	94	8528	2456	12850	202
Combined	95	8990	3094	14715	211
Combined	96	8173	2562	15036	162
Combined	97	8182	2269	12822	166
Combined	98	8031	1835	14222	113

Table 12.3 Roundnose grenadier
Length distribution (pre-anal length) per year of the French landings

Pre-anal Length cm	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
10										
11						0.20				
12						1.82	0.27	0.20		0.12
13				0.34	0.63	5.85	0.77	1.21	0.55	1.82
14		0.50		1.58	3.87	8.31	3.98	6.06	2.86	8.37
15	0.47	0.53	0.93	8.61	5.41	14.64	9.00	14.14	9.86	17.23
16	1.07	2.56	3.47	9.55	12.77	15.32	15.70	11.92	15.76	23.67
17	5.16	7.39	9.73	16.17	17.65	13.86	15.17	15.96	16.22	21.36
18	9.89	10.67	15.51	18.18	16.02	14.95	16.23	15.15	16.04	15.17
19	12.28	14.11	14.56	15.76	14.11	10.25	14.19	9.70	15.12	6.80
20	15.08	16.19	18.57	14.08	13.36	7.92	10.84	10.71	10.78	3.40
21	19.05	17.70	11.76	8.37	10.07	5.03	7.97	7.27	6.73	1.09
22	14.69	14.29	10.99	4.47	3.72	1.25	2.89	5.05	4.24	0.73
23	12.95	9.50	8.43	2.06	1.37	0.40	1.33	1.62	1.38	0.12
24	5.77	5.26	4.10	0.54	0.68	0.20	1.11	0.61	0.46	0.12
25	3.07	0.91	1.20	0.15	0.17		0.56	0.40		
26	0.29	0.39	0.58	0.15						
27	0.24		0.16		0.17					
28										
29										
30										

Table 12.4. Roundnose grenadier in Vb, VI & VII. Schaefer model.

Ratio	K (tonnes)	q	r	MSY	Pop (tonnes)	Pop/K
1.0	128751	0.0000027	0.1189	3827	42957	0.33
0.9	129010	0.0000030	0.1365	4402	39031	0.30
0.8	147953	0.0000028	0.1082	4002	41316	0.28
0.7	152736	0.0000031	0.1208	4613	37287	0.24

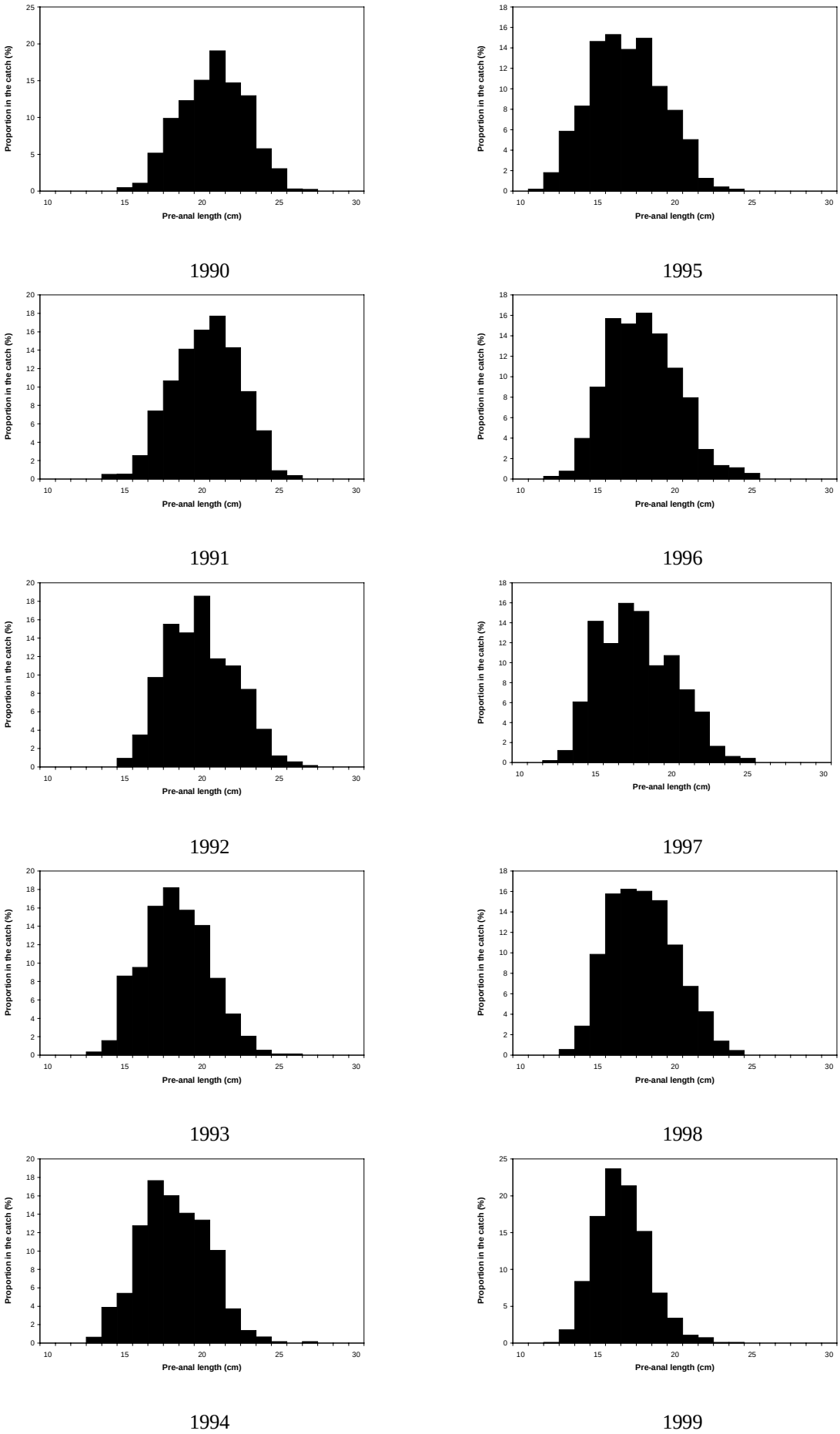
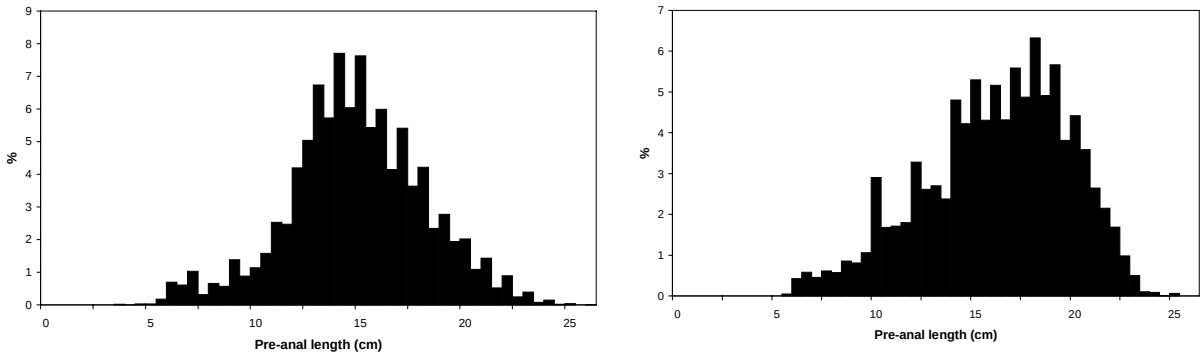
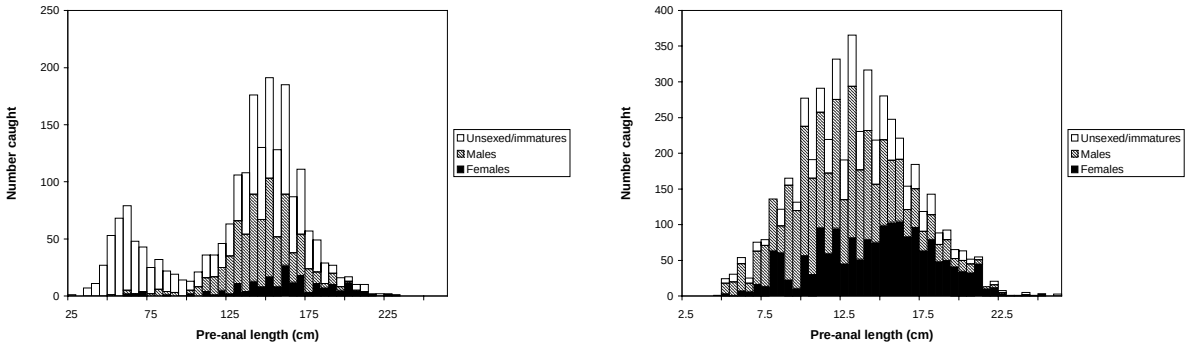


Figure 12. 1. Size distribution in the French landings from 1990 to 1999 (unsexed).

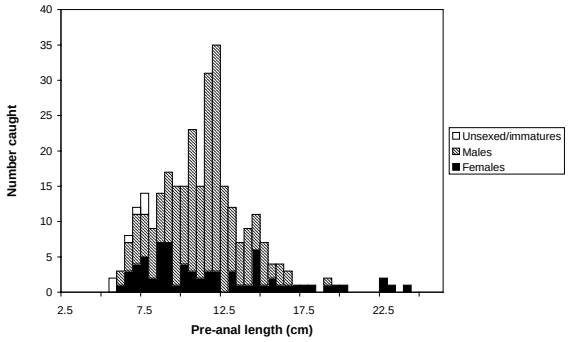


1998 1999

Figure 12.2. Roundnose grenadier. Length frequency distribution of the catch of Spanish commercial trawlers from on board observers in sub-area XII (unsexed).



VIa, 1000 m depth band VIa, 1250 m depth band



VIIIa, 1250 m depth band

Figure 12.3. Length distribution, by sex, of roundnose grenadier *Coryphaenoides rupestris*, observed during French cruise in 1999 by 250 m depth band (centered on the labelled depth).

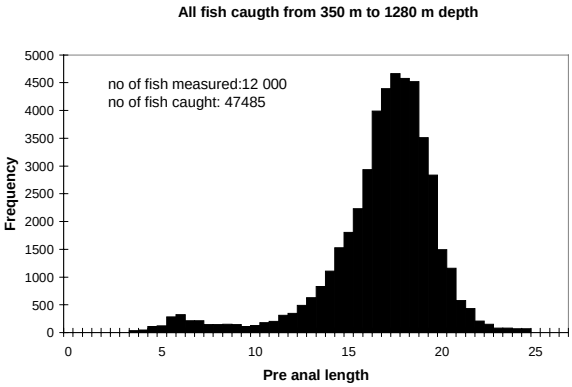
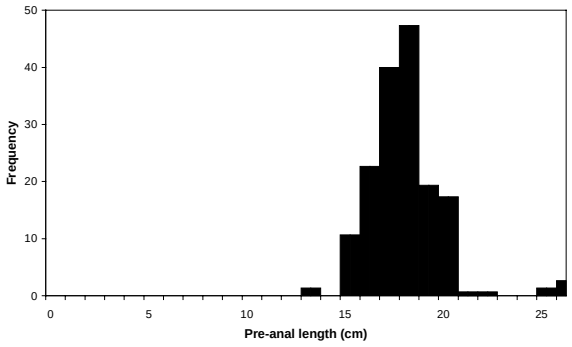
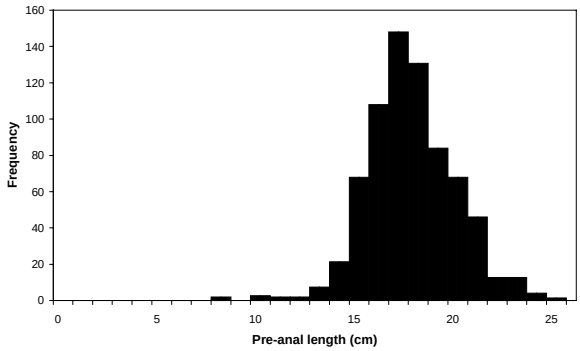


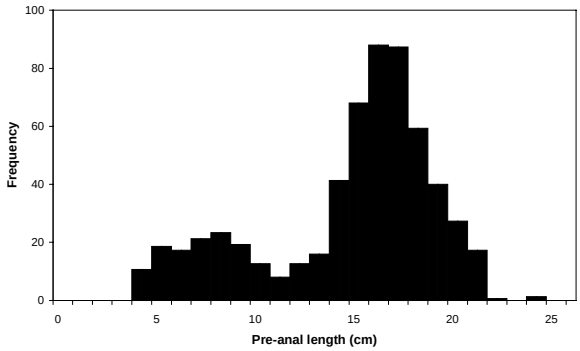
Figure 12.4 Length distribution of roundnose grenadier *Coryphaenoides rupestris*, observed during English cruises from 1974 to 1978, unsexed (modified from Bridger, 1978).



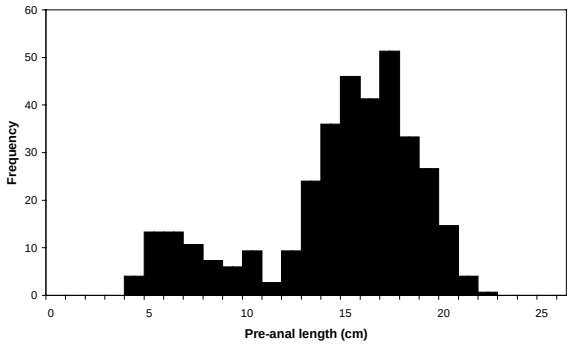
Depth range: 500 – 700 m



Depth range: 700 – 900 m



Depth range: 900 – 1100 m



Depth range: 1100 –1300 m

Figure 12.5. Roundnose grenadier Length frequency distribution of by depth during German suveys, unsexed (modified from Ehrich, 1983).

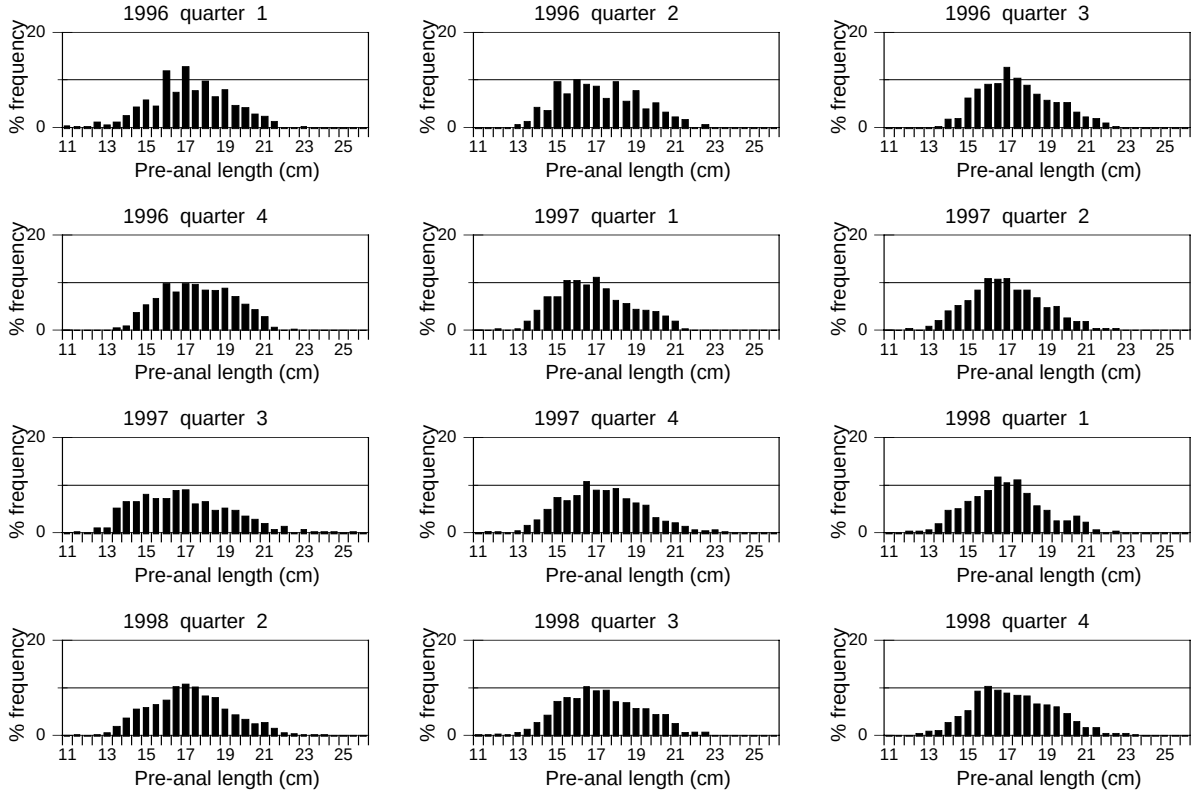


Fig. 12.6 Quarterly length-frequency distributions of landed roundnose grenadier (unsexed).

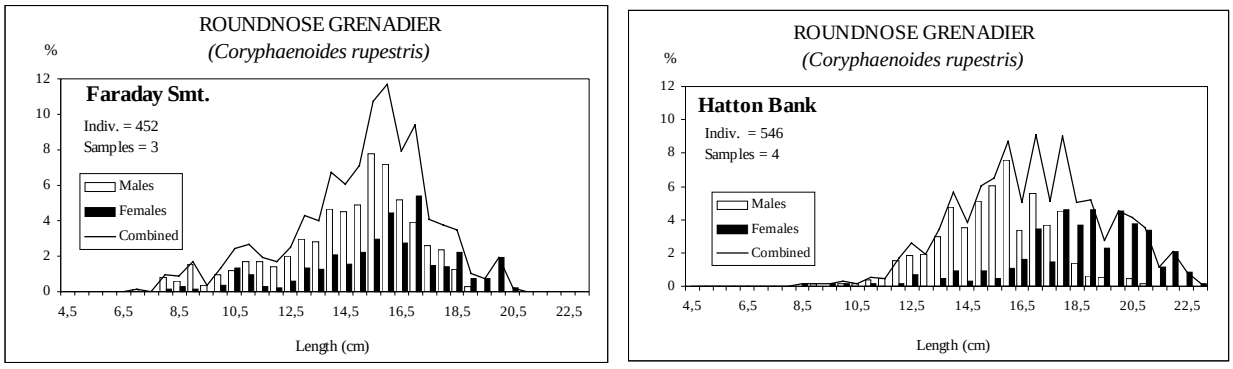


Figure 12.7. Length distribution of roundnose grenadier observed during Spanish experimental fishing on faraday seamount (Mid Atlantic Ridge) and Hatton bank.

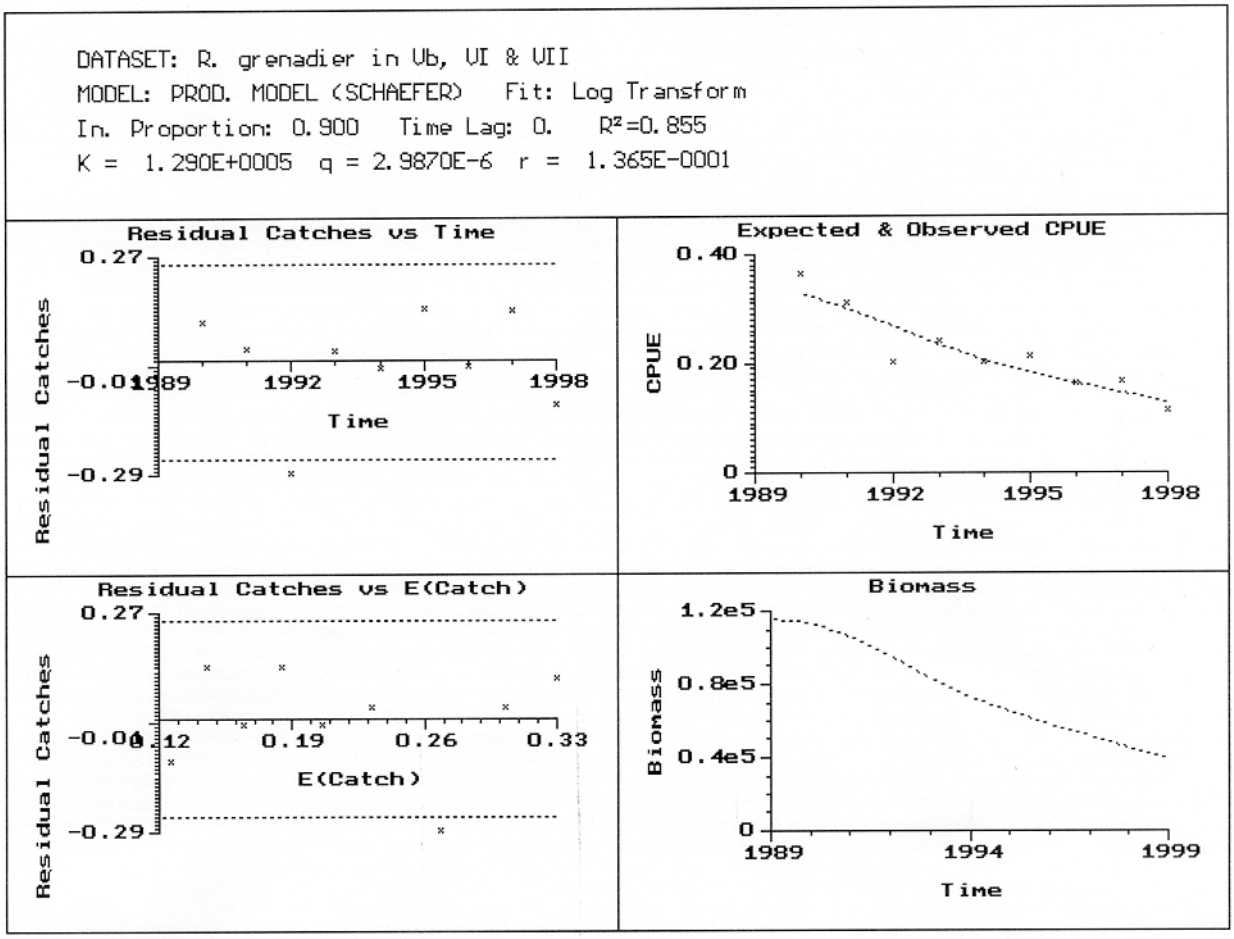

DATASET: R. grenadier in Vb, VI & VII
MODEL: PROD. MODEL (SCHAEFER) Fit: Log Transform
In. Proportion: 0.900 Time Lag: 0. R²=0.855
K = 1.290E+0005 q = 2.9870E-6 r = 1.365E-0001
Residual Catches vs Time
Residual Catches
0.27
-0.01
-0.29
1989
1992
1995
1998
Time
Expected & Observed CPUE
CPUE
0.40
0.20
0
1989
1992
1995
1998
Time
Residual Catches vs E(Catch)
Residual Catches
0.27
-0.01
-0.29
0.12
0.19
0.26
0.33
E(Catch)
Biomass
Biomass
1.2e5
0.8e5
0.4e5
0
1989
1994
1999
Time

Figure 12.8

13 BLACK SCABBARDFISH (*APHANOPUS CARBO*)

13.1 Catch trends

Table 13.1 shows the landings data for *Aphanopus carbo* by ICES Sub Areas as reported to ICES or as reported to the Study Group. This table includes landings for 1988 to 1999 from the long established fishery at Madeira which is outside the ICES area.

Only the landings of France in Sub-areas VI and VII, Portugal in Sub-area IXa and at Madeira reach more than 1000 t. Recently in Sub-area X Portuguese landings were 68 and 48 t in 1998 and 1999 respectively.

French landings increased until 1993, remained stable until 1996 and since then have shown a slight decline. Portuguese landings fluctuated around 3500 tons from Division IXa, showing a decreasing trend in recent years while at Madeira there was a slightly increasing trend over the last three years to about 4000 t. (Fig. 13.1.).

13.2 Stock structure

Research into stock discrimination is being carried out in the BASBLACK project (Section 2.4.2). These studies involve genetics (DNA), otolith micro-chemistry and morphometric analyses. The work on the first two is progressing but there are no results as yet. The analysis of morphometric data collected in three different regions of Northeast Atlantic: west of Scotland, off the Portuguese mainland (Sesimbra) and around Madeira, revealed that a significant component of among-group differences is assigned to length. Specimens from Scotland are considerably smaller in size than those from Madeira and Sesimbra (Carvalho, Figueiredo & Reis, in submission). These results should be treated with caution since the procedure used did not allow for an evaluation of discrimination among samples from regions where the specimens vary in size. This is intrinsically linked with the problem of the selection of shape discriminators independent of size in order to partition out the effects of growth (Humphries *et al.*, 1981).

The working hypothesis is that there is one stock extending from Faroe Islands to Madeira. However, there is as yet no strong evidence to support this hypothesis. Some of the results from BASBLACK, namely length distribution and reproductive behaviour, are suggestive of large or small-scale migratory processes of components of the population.

13.3 Commercial catch-effort

French trawl CPUE data for Vb, VI and VII were available for the period 1991–1998 (Table 13.2 and Figures 13.2). The CPUE time-series shows a gradual decline. A large proportion of the total international catch from Vb, VI, VII and XII is taken from Sub-area VI and French CPUE from this area shows a strong decline.

CPUE data, expressed as t/boat and kg/haul from the Portuguese mainland (Sesimbra) longline fishery for the years 1984 to 1992 in Division IXa were presented in the 1998 Study Group report (ICES CM 1998/ACFM:12). As a contribution to the BASBLACK Project an inquiry program was developed to obtain information on fishing effort using the total number of hooks as the unit. Based on this sampling program catch-effort data were obtained for 1990 to 1999 and a crude estimates of CPUE were determined based on the total number of landings and arithmetic mean of the number of hooks used in each haul (Table 13.3.Figure 13.4).

CPUE data, as kg/hook as well as total number of boats and total number of hooks by year are available for the Madeira longline fishery between 1988 and 1998 (Table 13.4). CPUE estimates were obtained for each year using the following expression for rotal effect:

$$\sum_{i=1}^{n} \bar{h}_i * \bar{s}_i * l_i ,$$

where $\bar{h}_i$ - mean number of hooks per haul used by the ith fishing vessel;

$\bar{s}_i$ - mean number of haul per landing of ith fishing vessel ;

l_i -. Total number of landings of ith fishing vessel;

i=1, …, n ; n total number of fishing vessels.

CPUE data, in kg/hook is available for the fishery recently developed in Sub-area X by Madeiran longliners (Table 13.5).

13.4 Length and Age compositions and mean weights at age

Length frequency distributions for different geographical areas, Portuguese mainland (information from longline commercial catches from 1988 to 1993), Reykjanes Ridge (information from Iceland research surveys held in 1995 and 1997) and Hebrides Terrace (based on 1996 French survey) were presented in the report of the 1998 Study Group. New data from landings at Madeira from 1988 to 1998, from Spanish trawl landings from ICES Subarea XII during 1998 and from Soviet research surveys on Outer-Bailey Bank, Hatton Bank and the Rockall Bank(Vinnichenko, Working Document) .

Length of black scabbardfish from Madeiran commercial catches ranged mainly from 100 to 135 cm, with 116 cm as mean length. During that period, annual length compositions follow similar gaussian distributions. (Sena-Carvalho, Reis and Afonso-Dias, in preparation) (Fig.13.5).

Length distribution of the Spanish trawl landings in ICES Subarea XII during 1998 is shown in Figure 13.6. In this area the total effort was 14001 of fishing hours.

The length range of black scabbardfish caught during the Soviet deep-water research surveys varied between 85 to 120 cm (which corresponded to ages between 3 and 13 years). Nevertheless 96 –105 cm (6-7 years) were the most common lengths found.

Length frequency distributions in Subarea X based on observational experiments made onboard Madeiran longliners in 1998 and 1999 as well as the geographical positions of the fishing hauls from which lengths were obtained are presented at Figure 13.7.

13.5 Biological parameters

Quarterly length frequency distributions of specimens caught by bottom trawl in the Rockall Trough and by longline off mainland Portugal and at Madeira are shown in Figures 13.8, 13.9 and 13.10. Despite the underlying confounding effect of the fishing gear between regions, the analysis of these figures shows that there are no important differences in length range between quarters in the same region. Only at the Rockall Trough was there a weak indication that small specimens enter into this region during the last quarter of the year. It thus appears that length structure remains almost the same and that in those areas the life cycle of the species is not complete. This indicates that either small or large scale migrations may occur. This hypothesis is to some extent corroborated by the reproductive behaviour of the species between those areas.

New information is available on the reproduction of the black scabbardfish. No specimens at an advanced stage of maturity or in spawning condition have ever been found in either the Rockall Trough or off mainland Portugal. However, such speciments are found at Madeira every year and have been reported at Outer Bailey Bank, Hatton Bank, Rockall Bank, at Iceland coast and on the Reykjanes Ridge. In these spawning areas there are temporal differences in time of peak spawning and in its duration. At Madeira spawning occurs September to December, with a peak in October-November. There is also a temporal delay in the maximum of the percentages of mature individual between sexes; September for males and October for females (Sena-Carvalho, Reis and Afonso-Dias, in prep.). At the Outer-Bailey Bank, Hatton Bank and Rockall Bank spawning lasts from November to April (Zilanov & Shepel, 1975; Pschenichny *et. al.* 1986) and at Iceland and the Reykjanes Ridge it occurs from January to September, with a peak in July (EC FAIR, 1999).

At Madeira the length of smallest mature individuals is 60 cm for males and 70 cm for females and the length at first maturity is 73.7 cm for males and 102.7 cm for females. This difference is probably due to different growth patterns between sexes (Sena-Carvalho, Reis & Afonso-Dias; in prep.). At the outer Bailey Bank, Hatton Bank and Rockall Bank black scabbardfish becomes mature at 80-85 cm of total length, which corresponds to 0.9-1.1 Kg in weight (Zilanov & Shepel, 1975; Pschenichny *et. al.* 1986). At Iceland and the Reykjanes Ridge the length at first maturity is at 84-88 cm for males and 92-97 for females. (EC FAIR, 1999).

Table 13.6 summarises the results of length weight data adjustment to the allometric length-weight model for several geographical areas. Length-weight relationships are available from German and Icelandic surveys and from Scottish discard trips. Age estimates based on sectioned otoliths collected from Irish surveys in VI and VII, ranged from 4 to 32 years, which is far beyond the age range found using the w hole otolith (0 to 8 years) (EC FAIR, 1999).

Growth parameters have been estimated both for an indirect method - length frequency analysis (Martins *et al.*, 1989) and for a direct method age estimates using otoliths (Morales-Nin and Sena–Carvalho, 1995). An otolith exchange and workshop was organised by the BASBLACK project. Growth studies are continuing within this project with emphasis on the standardisation of otolith preparation and the assignment criteria for age reading. The subsequent co-ordinated growth study based on an enlarged sample, with specimens from different geographical areas, should lead to new estimation of growth parameters for the species.

Growth studies based on specimens from the Outer Bailey Bank, Hatton Bank and Rockall Bank, showed that growth rate decreased with the age, and that in the first four years fish grow fast and uniformly. In terms of length this corresponds to an average annual length increment of 10.8 cm for males and 12.5 cm for females (Glebova *et al*., 1980).

All the 1974 to 1986 German survey data from the Rockall Trough has been re-analysed (EC FAIR, 1999). Data are available on the localised distribution within the area and the relative abundance by depth. Plots of the CPUE (numerical) by quarter and by depth horizon indicates that peak abundance occurs in the 2nd quarter.

13.6 Assessment

Stock structure is not clear for this species, and given the conflicting CPUE trends in Sub-area VI and Sub-area IX it seemed reasonable, as an interim measure, to assess the former as a 'Northern component' comprising V,VI,VII & XII and the latter as a 'southern component'.

Sub-areas V,VI,VII and XII

For this assessment, a modified DeLury constant recruitment model and a Schaefer production model were attempted using total international catch data for V,VI,VII,XII from 1989 to 98, and French directed CPUE data for otter trawlers for the years 1991-1998.

The fit from DeLury was good for a range of error models, with log error giving a marginally better fit (R^2=0.962) (in ICES files). The results were reasonably robust for a range of values of ratio of initial stock to virgin stock (Table 13.7). There was a large fishery for roundnose grenadier in XII in the 1960s and 1970s and it is probable that large quantities of black scabbard may have been caught as a by-catch and discarded. It seems reasonable therefore to select an initial ratio of less than 1. At ratios of less than 0.6 the estimated biomass trend from the model shows a marked increase in 1989 and 1990 and their is no evidence to corroborate this (the French CPUE series only goes back to 1991). Taking all factors into consideration, a ratio of 0.8 seemed a reasonable compromise and the results are presented in Table 13.7 and Figure 13.4. Virgin stock biomass is estimated to be around 22000t (95% confidence limits : 21 000-23 000t). Population biomass in 1998 is estimated to be around 4000t, 19% of virgin biomass (95% confidence limits : 18-20%). All confidence limits were calculated by bootstrapping (included in ICES files).

Choice of error model had little effect on the fit from Schaefer (In ICES files). All error models gave a good fit (R^2=0.98) and log error was used throughout. The results from Schaefer for range of values of ratio of initial stock to virgin stock and time lags were fairly robust (Table 13.8). An initial ratio of 0.8 was selected for the reasons described above for the DeLury model. A time-lag of zero was used as the data-series are too short to explore the effect of time-lag over a range of years commensurate to age of recruitment (the age of recruitment is uncertain). It was assumed, therefore, that growth rather than recruitment is the main contributor to biomass production. The estimated intrinsic rate of growth (r) is quite high (0.523) but there is some ageing evidence to suggest that black scabbardfish may not be as long-lived as other deep-water fish. The results (Table 13.8 and Figure 13.3) indicate that carrying capacity is estimated to be around 19 000t (95% confidence limits: 16 000-50 000t). Population biomass in 1998 is estimated to be around 5 000t, 24% of carrying capacity (95% confidence limits: 10-29%). MSY is estimated to be around 2500t (95% confidence limits: 47–2831t) This equates to around 13% of carrying capacity. All confidence limits were calculated by bootstrapping (included in ICES files).

Sub-area IX

This assessment was attempted with both a modified DeLury constant recruitment model and a Schaefer surplus production model. The data used in the assessment comprised of total international catch data for area IX from 1990 to 1999, and Portugese longline CPUE data for this area over the same period.

The fit of the DeLury model was poor for all error models and was unable to predict the marked variations in CPUE. The least squares error model appeared particularly unstable and therefore the results presented are those obtained from the log transform error model. A natural mortality rate of 0.17 was used in this analysis (Martins et al, 1994), due to the lack of other information this was the best estimate available. The stock in this area experienced some exploitation prior to 1990 and therefore we do not assume that the stock was initially in its virgin state. A number of initial stock sizes

were considered in this model (Table 13.9), but the parameter estimates proved very unstable and all R^2 values were less than 0.1. The results are not presented but included in ICES files.

The Schaefer model was fitted to the CPUE data with a variety of error models, the log transform model again proved slightly better. The fit of the Schaefer model did prove slightly better than that of DeLury, but the model could still not predict the apparent fluctuations in CPUE. A range of values of ratio of initial stock to virgin stock were tested (Table 13.10) and the parameter estimates did not prove robust to this analysis. All initial conditions provided equally poor fits to the data (R^2<0.4), but an initial ratio 0.8 was chosen following the reasoning above. The data-series are too short to explore the effect of time-lag over a range of years commensurate to age of recruitment (uncertain). It was assumed, therefore, that growth rather than recruitment is the main contributor to biomass production. The fit remained poor (Figure 13.4).

13.7 Comments on assessment

The results for black scabbardfish in V,VI,VII and XII from DeLury and Schaefer are fairly similar for K and population size in 1998. Stock in 1998 is estimated to be between 10 and 29% of virgin biomass. It should be noted that the 95% confidence limits about K and MSY from Schaefer are very wide.

For black scabbardfish in Sub-area IX the DeLury and Schaefer models gave a wide range of parameter estimates and neither model fitted the data well. It is possible that the problem may be associated with the crude CPUE estimates provided from the Portugese longline fishery which may be improved in future years. A further problem may be a lack of contrast in the data or that any of the principal model assumptions may not hold, for example constant catchability over time.

13.8 Management considerations

The results presented in this assessment should be treated with caution because they are based on short time-series and little is known about stock structure and migration of this species. However, our analyses indicate that current exploitable biomass (U) at the end of 1998 was below U_{pa} (50% of virgin biomass) in Sub-areas V,VI,VII and XII and may have been below U_{lim} (20% of virgin biomass).

The inability of either the DeLury or Schaefer models to correctly model the fluctuations in CPUE data observed in Sub-area IX implies that we cannot draw any firm conclusions about the state of the stock in this area from the assessment attempted here.

Table 13.1 Black Scabbardfish. Study Group estimates of landings (tonnes).

BLACK SCABBARDFISH (Aphanopus carbo) III and IV

Year	France	Germany	UK(Scot)	**TOTAL**
1988	2			**2**
1989	0			**0**
1990	57			**57**
1991	0			**0**
1992	0			**0**
1993	0			**0**
1994	13	3		**16**
1995			2	**2**
1996	3		1	**4**
1997	0		2	**2**
1998			9	**9**
1999				**0**

BLACK SCABBARDFISH (Aphanopus carbo) Va

Year	Iceland	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993	0	**0**
1994	1	**1**
1995	+	**+**
1996	0	**0**
1997	1	**1**
1998		
1999		

BLACK SCABBARDFISH (Aphanopus carbo) Vb

Year	Faroes	France	Germany	UK	**TOTAL**
1988					**0**
1989		166			**166**
1990	12	407			**419**
1991	1	151			**152**
1992	4	29			**33**
1993	202	76	9		**287**
1994	114	45	1		**160**
1995	249	175			**424**
1996	57	129			**186**
1997	18	50			**68**
1998	36	144			**180**
1999	31	127		7 *	**165**

* Reported to Faroese Coastal Guard Service

Table 13.1 (Continued)

BLACK SCABBARDFISH (Aphanopus carbo) VI and VII

Year	Faroes	France	Germany	Ireland	Spain	UK (Scot)	UK(EWNI)	**TOTAL**
1988								**0**
1989	46	108						**154**
1990		1060						**1060**
1991		2759						**2759**
1992	3	3433						**3436**
1993	62	3411	48	8				**3529**
1994		3050	46	3		2		**3101**
1995		3257	3			18		**3278**
1996		3650	2			36	1	**3689**
1997	3	2754		0	1	235	2	**2995**
1998		1815		0	3	148	1	**1967**
1999		1600		30	0	*	1	**1631**

* No landings

BLACK SCABBARDFISH (Aphanopus carbo) VIII and IX

Year	France	Portugal	Spain	**TOTAL**
1988		2602		**2602**
1989		3473		**3473**
1990	0	3274		**3274**
1991	1	3978		**3979**
1992	0	4389		**4389**
1993	0	4513		**4513**
1994	0	3429		**3429**
1995		4272		**4272**
1996	126	3686	3	**3815**
1997	2	3553	1	**3556**
1998	2	3147	3	**3152**
1999*	1	2510	0	**2511**

* preliminary

BLACK SCABBARDFISH (Aphanopus carbo) X

Country	Faroes	Portugal	**TOTAL**
1988			**0**
1989			**0**
1990			**0**
1991		166	**166**
1992	370		**370**
1993		2	**2**
1994			**0**
1995		3	**3**
1996	11	0	**11**
1997	3	0	**3**
1998	31	68	**99**
1999		46	**46**

Table 13.1 (Continued)

BLACK SCABBARDFISH (Aphanopus carbo) XII

Year	Faroes	France	Germany	Spain	**TOTAL**
1988					**0**
1989					**0**
1990					**0**
1991					**0**
1992		512			**512**
1993	1051		93		**1144**
1994	779		45		**824**
1995	301#				**301**
1996	187	4		253	**444**
1997	102			98	**200**
1998	20			134	**154**
1999				109	**109**

\# includes VIb Hatton Bank
* preliminary

BLACK SCABBARDFISH (Aphanopus carbo) in Madeira (Portugal)

Year	Portugal	**TOTAL**
1988	2724	**2724**
1989	2476	**2476**
1990	2500	**2500**
1991	2486	**2486**
1992	2812	**2812**
1993	3466	**3466**
1994	3132	**3132**
1995	3469	**3469**
1996	3279	**3279**
1997	4023	**4023**
1998	4430	**4430**
1999	4402	**4402**

BLACK SCABBARDFISH (Aphanopus carbo) XIV

Country	Faroes	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995		**0**
1996		**0**
1997		**0**
1998	2	**2**
1999		**0**

Table 13.1 (Continued)

Black Scabbardfish All ICES areas

Year	III + IV	Va	Vb	VI + VII	VIII + IX	X	XII	XIV	**TOTAL**
1988	2	**0**	0	0	2602	0	0	0	**2604**
1989	0	**0**	166	154	3473	0	0	0	**3793**
1990	57	**0**	419	1060	3274	0	0	0	**4810**
1991	0	**0**	152	2759	3979	166	0	0	**7056**
1992	0	**0**	33	3436	4389	370	512	0	**8740**
1993	0	**0**	287	3529	4513	2	1144	0	**9475**
1994	16	**1**	160	3101	3429	0	824	0	**7531**
1995	2	**+**	424	3278	4272	3	301	0	**8280**
1996	4	**0**	186	3689	3815	11	444	0	**8149**
1997	2	**1**	68	2995	3556	3	200	0	**6825**
1998	9		180	1967	3152	99	154	2	**5563**
1999	0		165	1631	2511	46	109	0	**4462**

Table 13.2. Black scabbardfish. Directed catch and effort and standardised CPUE from a reference fleet of trawlers in ICES Divison Vb and sub-areas VI and VII

ICES sub-area	Year	Total international catch (t)	Data for the reference fleet		
			Directed Catch (t)	Directed effort (hours)	Standardised cpue (kg/h)
Vb	89	166	108	1059	94
Vb	90	419	337	2154	145
Vb	91	152	115	444	238
Vb	92	105	86	458	155
Vb	93	287	62	311	218
Vb	94	160	36	294	82
Vb	95	424	146	549	221
Vb	96	186	114	984	114
Vb	97	68	26	346	68
Vb	98	180	62	780	85
VI	89	154	125	508	273
VI	90	1023	731	2728	249
VI	91	2290	1036	3385	293
VI	92	3111	1487	4808	280
VI	93	3045	1195	4679	239
VI	94	2427	1186	6049	196
VI	95	2633	608	5301	114
VI	96	3024	878	7686	99
VI	97	2532	488	4009	96
VI	98	1611	382	3895	74
VII	89	0	0	0	
VII	90	10	0	0	
VII	91	93	1	49	68
VII	92	322	74	879	53
VII	93	484	159	1296	84
VII	94	673	268	1952	103
VII	95	645	352	2924	90
VII	96	665	341	2973	91
VII	97	460	94	945	69
VII	98	356	88	1045	74
Combined	89	154	233	1567	128
Combined	90	1060	1068	4882	172
Combined	91	2759	1152	3878	227
Combined	92	3436	1647	6145	184
Combined	93	3529	1416	6286	169
Combined	94	3101	1490	8295	145
Combined	95	3278	1106	8774	102
Combined	96	3689	1333	11643	89
Combined	97	3716	608	5300	77
Combined	98	1967	532	5720	67

Table 13.3 - CPUE data for Portuguese longline fishery for black scabbardfish from 1988 to 1999 in Sub-area IXa .

Year	No hooks (x1000)	CPUE (Kg/hook)
1990	32393	0,10
1991	31301	0,13
1992	35989	0,12
1993	36139	0,12
1994	28736	0,12
1995	28453	0,15
1996	20570	0,18
1997	26129	0,14
1998	27648	0,11
1999	29476	0,09

Table 13.4.- Black scabbardfish fishing effort and CPUE off Madeira Island (1988-1998).

Year	No. vessels	No hooks (x1000)	CPUE (Kg/hook)
1988	90	18 421	0.15
1989	86	16 905	0.15
1990	84	15 742	0.16
1991	83	19 363	0.13
1992	71	19 480	0.14
1993	61	17 833	0.19
1994	46	17 805	0.18
1995	49	16 367	0.21
1996	43	14 553	0.23
1997	45	16 668	0.24
1998	42	16 679	0.27

Table 13.5. - Black scabbardfish fishing effort and CPUE in Subarea X by Portuguese longline fleet (1998-1999).

Year	No hooks	CPUE (Kg/hook)
1998	186069	0.366
1999	128062	0.356

Table 13.6 - Black scabbardfish length weight model ($W= a * L^b$) adjustments.

Parameters estimates	n	R	Length range	Geographical area	Source
a= 0.000376 b=3.27	1042	0.702	66 – 132 cm	Sesimbra	(Martins,1989)
a= 0.0000597 b=3.676	-	-	69 – 120 cm	Hebrides Terrace	(Lorance, pers. comm)
Males a= 0.0001 b=3.4964	117	0.9761	67 – 117 cm	Mid Atlantic Ridge (from North of Azores till Reikjanes Ridge)	(Munoz, Roman & Gonzalez, 2000)
Females a= 0.0001 b=3.5458	131	0.984	60 – 139 cm		
Both sexes a= 0.0001 b=3.5254	248	0.982	60 – 139 cm		

Table 13.7 . Black scabbardfish in Sub-areas Vb, VI, VII and XII. DeLury model

Ratio	K (nos)	q	Pop (nos)	K(tonnes)	Pop(tonnes)	Pop /K
1.0	15051586	.0000117	3393194	21524	4852	0.23
0.9	15098928	.0000126	3164725	21591	4526	0.21
0.8	15125302	.0000136	2915557	21629	4169	0.19
0.7	15175688	.0000148	2688081	21701	3844	0.18
0.6	15254332	.0000161	2483722	21814	3552	0.16

Note Popns are for the final year 1998

Table 13.8 . Black scabbardfish in Sub-areas Vb, VI, VII and XII. Schaefer model

Schaefer	Time lag =0					
Ratio	K (tonnes)	q	r	MSY	Pop (tonnes)	Pop /K
1.0	22148	0.0000123	0.395	2189	5683	0.26
0.9	22020	0.0000117	0.407	2240	5445	0.25
0.8	19375	0.0000138	0.523	2533	4718	0.24
0.7	17210	0.0000160	0.641	2759	4154	0.24

Note Popns are for the final year 1998

Table 13.9. Black scabbardfish in Sub-area IX. DeLury model

Ratio	K (nos)	q	Pop (nos)	K(tonnes)	Pop(tonnes)	Pop/K
1.0	11125370000	6.07×10^{-9}	11114439680	18690622	18672259	1.00
0.9	5277230080	1.34×10^{-8}	5170361344	8865747	8686207	0.98
0.8	483075136	1.56×10^{-7}	455384544	81156	765046	0.94
0.5	36107264	3.12×10^{-6}	22799010	60660	38302	0.63
0.2	19671510	1.09×10^{-5}	6782131	33048	11394	0.34

Note Popns are for the final year 1999

Table 13.10 . Black scabbardfish in Sub-areas IX. Schaefer model

Schaefer	Time lag =0					
Ratio	K (tonnes)	q	r	MSY	Pop (tonnes)	Pop/K
1.0	768864	1.72×10^{-7}	2.997	575979	761777	0.99
0.9	2637684	4.75×10^{-8}	0.6422	423504	2633288	1.00
0.8	1219765	1.04×10^{-7}	0.7329	223497	1216039	1.00
0.5	951786	1.48×10^{-7}	2.754	655408	316279	0.33

Note : Popn values are for the final year 1999

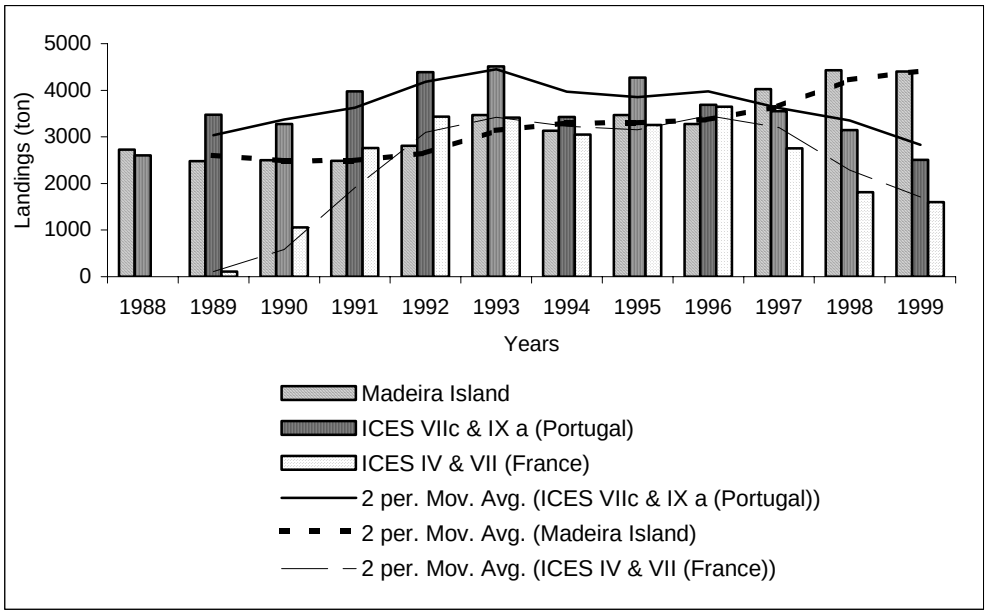


Figure 13.1 –Annual landings from Subareas VIIc and IX,IV and VII and off Madeira. from 1988 to 1999. Trend lines for each of these sub-groups are included.

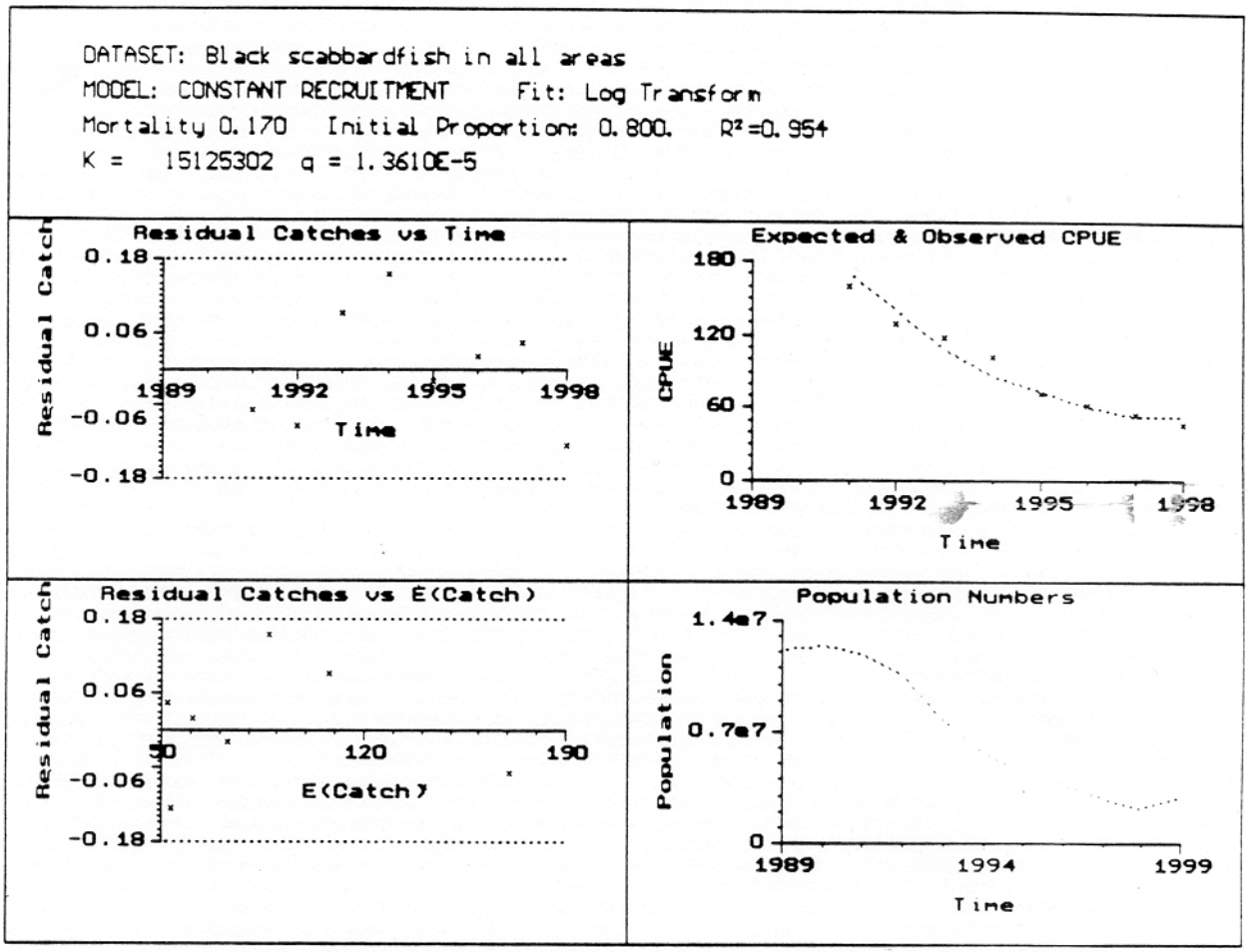


Figure 13.2 Black scabbardfish in areas V, VI, VII and XII**.**

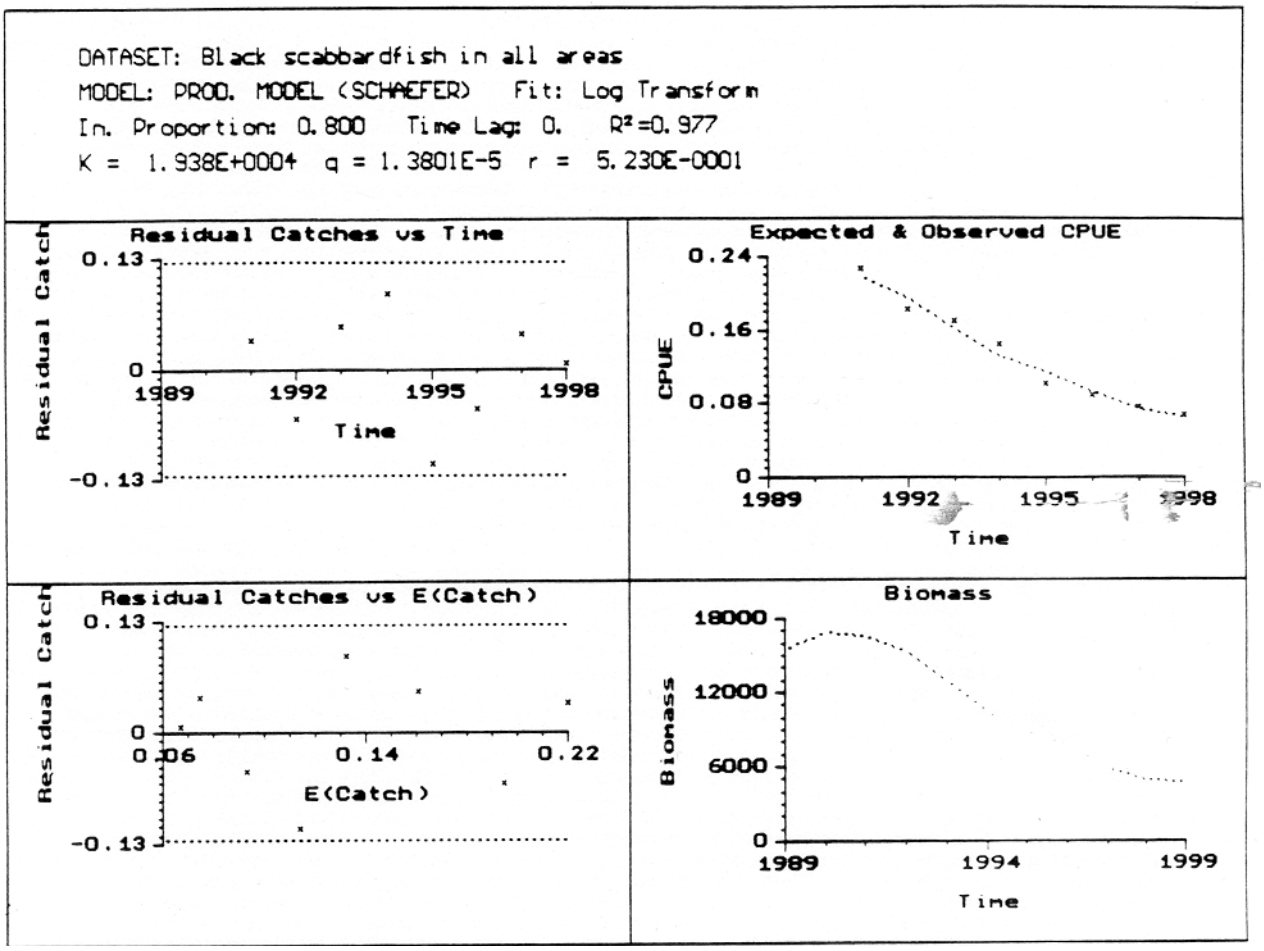


Figure 13.3 Black scabbardfish in areas V, VI, VII and XII**.**

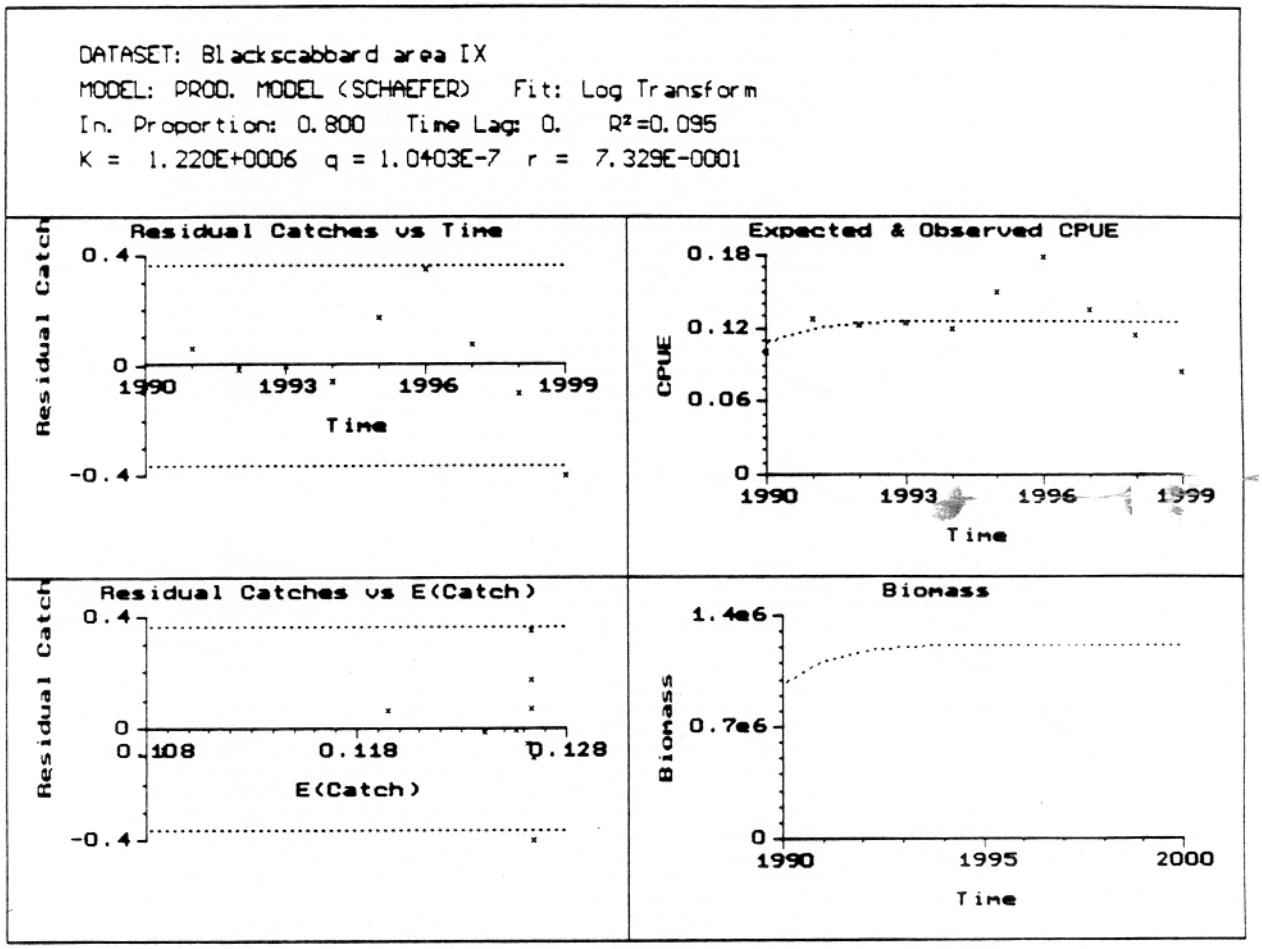

DATASET: Blackscabbard area IX
MODEL: PROD. MODEL (SCHAEFER) Fit: Log Transform
In. Proportion: 0.800 Time Lag: 0. R²=0.095
K = 1.220E+0006 q = 1.0403E-7 r = 7.329E-0001
Residual Catches vs Time
Residual Catch
0.4
0
-0.4
1990
1993
1996
1999
Time
Expected & Observed CPUE
CPUE
0.18
0.12
0.06
0
1990
1993
1996
1999
Time
Residual Catches vs E(Catch)
Residual Catch
0.4
0
-0.4
0.108
0.118
0.128
E(Catch)
Biomass
Biomass
1.4e6
0.7e6
0
1990
1995
2000
Time

Figure 13.4

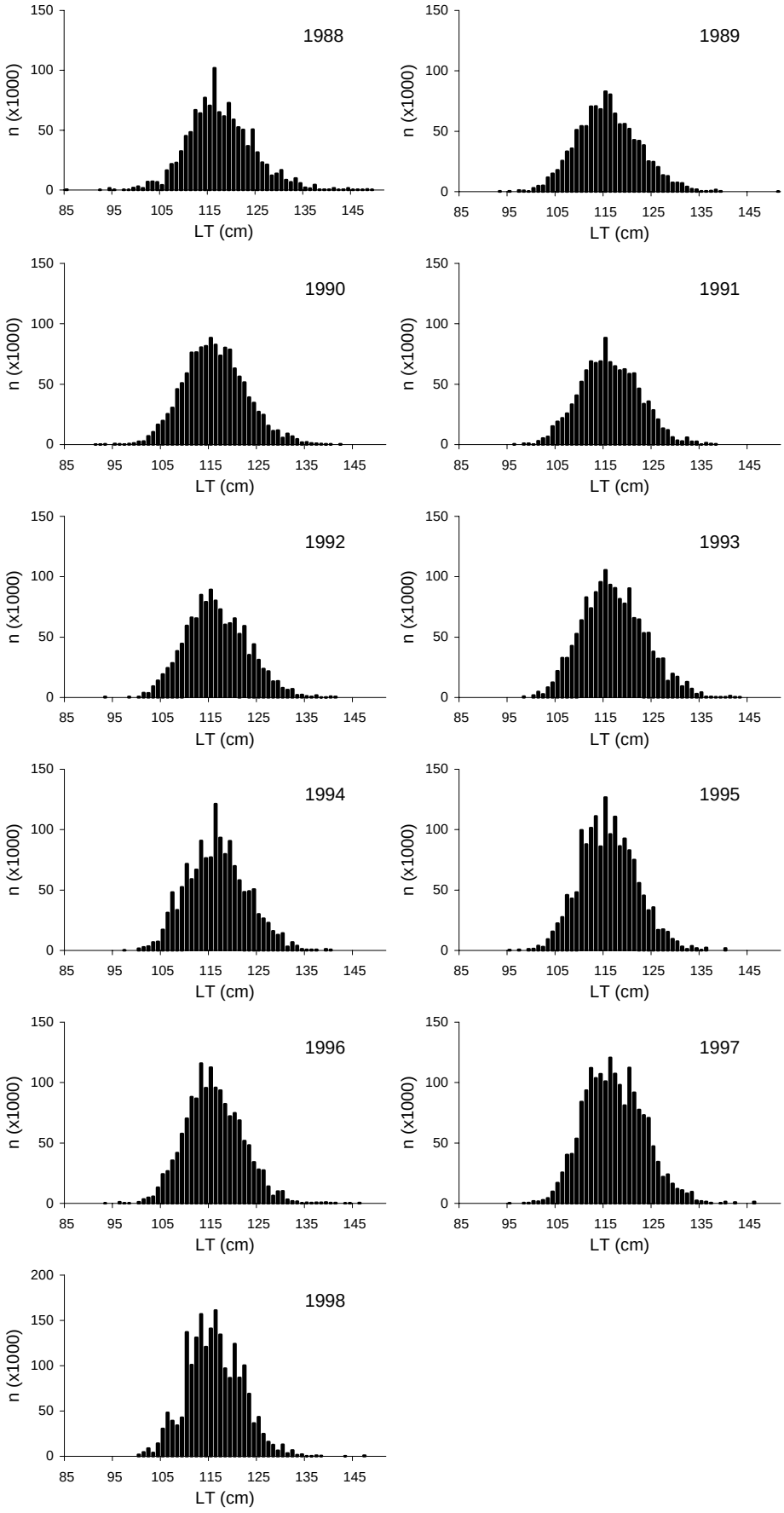


Figure 13.5 – Annual length frequency distributions of Madeiran landings from 1988 to 1998

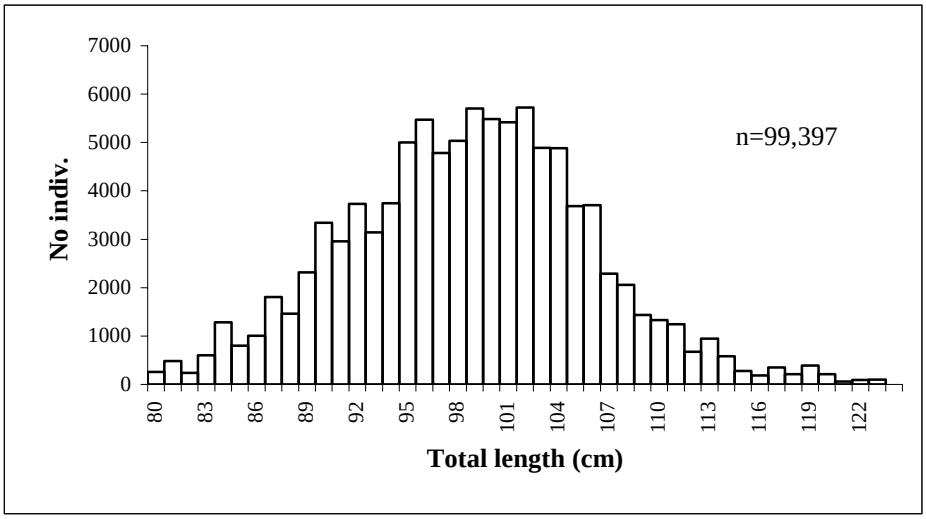


Figure 13.6. - Length frequency distribution of Spanish landings in 1998 (ICES XII)

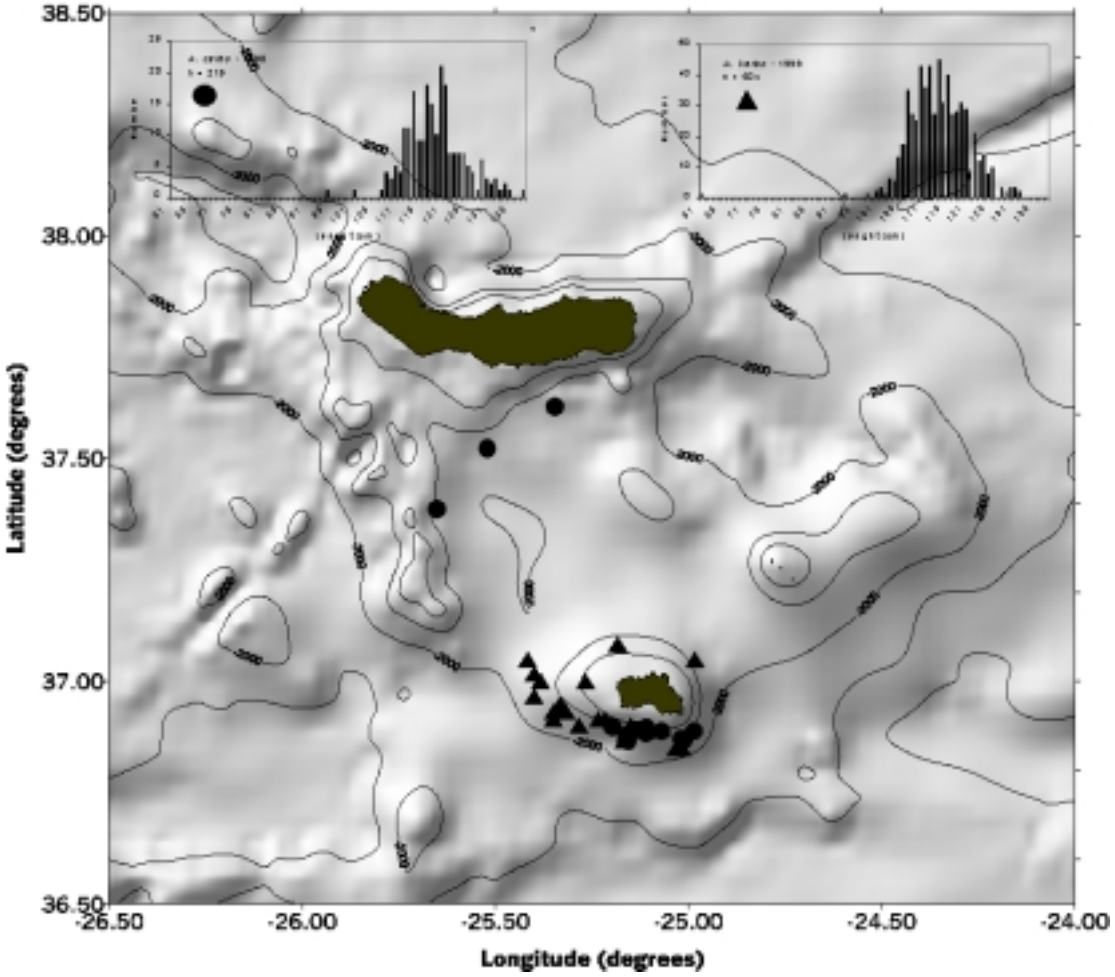


Figure 13.7 – Commercial exploratory sets towards *Aphanopus carbo* in the Azores in 1998 and 1999. Length frequencies for the two years are also presented.

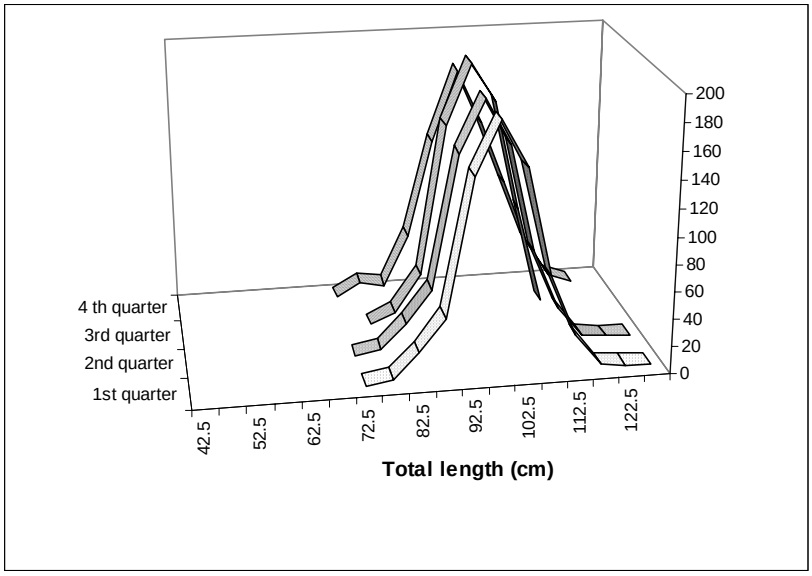


Figure 13.8. – Quarterly length frequency distributions of specimens caught by bottom trawl in the Rockall Trough

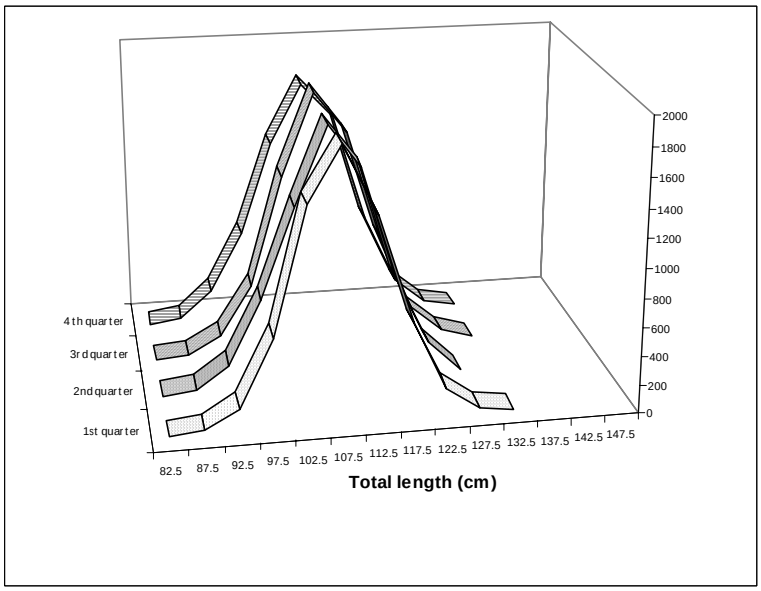


Figure 13.9. - Quarterly length frequency distributions of specimens caught by commercial longliners off Portugal Mainland .

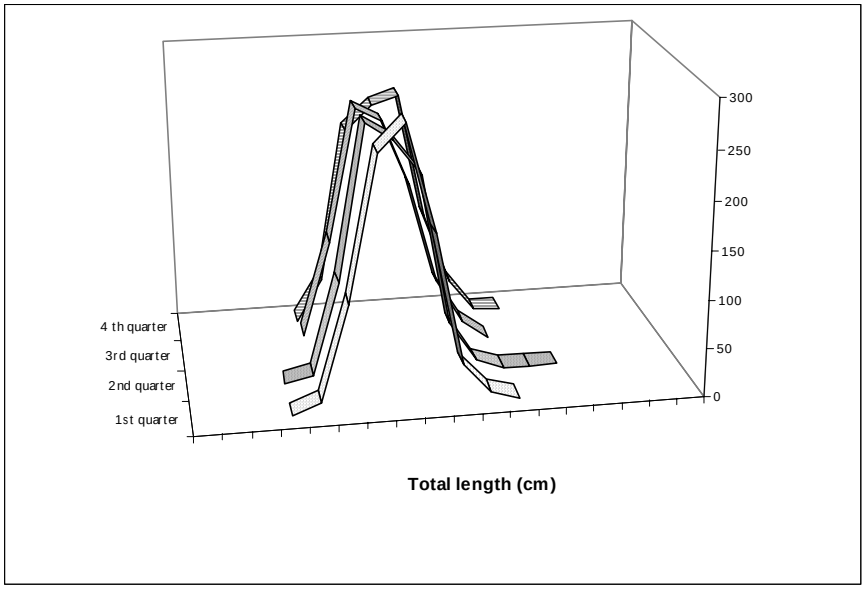


Figure 13.10. - Quarterly length frequency distributions of specimens caught by longline in Madeira (Portugal).

14 RED (=BLACKSPOT) SEABREAM (*PAGELLUS BOGARAVEO*)

14.1 Catch trends

Landings data for red (blackspot) seabream, *Pagellus bogaraveo*, by ICES Sub-areas as reported to ICES or to the Study Group are shown in Table 14.1. This table includes for the first time landings for 1990 to 1999 from the fishery at Madeira which is outside the ICES area. No data on discards have been presented to the Study Group.

Landings in the Sub-areas VI, VII and VIII, from France, Portugal, Spain and UK were very high in the past. They started to decline in the mid–1970s, after peaking at more than 24 000 t in 1974 (ICES C.M.1998/Assess:8), although some of those catches could be considered as misreported as they included some species of *Pagellus* and/or other *Sparidae*, i.e. "seabream" in general. A more detailed report of official international catches by country in Sub-area VI+VII+VIII indicated that about 7 000 t were landed in 1979 and then there was a decrease to 2 100 t in 1985 (ICES C.M.1996/Assess:8). In Table 14.1 landings in the Sub-areas VI, VII and VIII are available from 1988 onwards. They tend to decline more or less continuously year by year in all Sub-areas. In the recent years, they have fallen from more than 460 t in 1989 to 33 t in 1999 (preliminary data). Most of the catches are taken by the longliner fleet, but trawlers also occasionally land red seabream. In the three last years (1997-1999), catches of UK (England and Wales) in Sub-area VII and catches of France in Sub-area VIII have increased in relation to the previous years, but not the Irish and Spanish (excepting for 1998) catches in Sub-area VII or VIII. In case, when the present landings are compared with those obtained 20 and more years ago, the fishery seems to continue in a "quasi collapse" situation.

In Sub-area IX most of the catches are made by the longliner fleet. Spanish landings data in this sea area are available from 1983 and Portuguese ones since 1988 onwards. The maximum catch in this period has been obtained in1993-1994 and 1997 (about 1 000 t) and the minimum in 1991 and 1999 (about 530 t). Almost all Spanish catches in this Sub-area are taken in waters close to the Gibraltar Strait. They show an increasing trend from 1983 (100 t) until 1994 (854 t), then they remain in a rather high level but in the last two years (1998-1999) the catches have decreased reaching in 1999 the minimum (278 t) of the 1988-1999 period.

Landings data in Sub-area X (Azores) are available from 1982 onwards. Catches have ranged from 369 t (in 1982) to 1222 t (in 1999). Two periods can be identified in the historical series. One from 1988 to 1992 corresponding to the developed phase of the fishery, with a significant increase of fishing effort, and a second one from 1993 to 1999, characterised by a decrease of effort but significant increase of catches, corresponding probably to the specialisation period of the fishery. It is not clear whether this reduction on effort is effective or a multispecies effect on the dynamics of the fishery. The majority of the catches are made by the Azorean longline fleet.

In Sub-area XII, landings data are available from only one year (1994). They amount to 75 t.

14.2 Stocks

Information on red (blackspot) seabream, *P. bogaraveo*, has been split into three different components, as referred to in the 1996 and 1998 Reports (ICES C.M.1996/Assess:8; ICES C.M.1998/ACFM:12):

- *P. bogaraveo* in Sub-areas VI, VII and VIII
- *P. bogaraveo* in Sub-area IX
- *P. bogaraveo* in Sub-area X (Azores region)

This separation does not pre-suppose that there are three different stocks of *P. bogaraveo*, but it offers a better way of recording the available information. In fact, the inter-relationships of the red seabream from the Sub-areas VI, VII, VIII and the northern part of Division IXa, and their migratory movements within these sea areas have been confirmed in the past by tagging methods (Gueguen, 1974; ICES, C.M.1996/Assess:8). Studies on possible links between red seabream of the Azorean region with the southern Sub-area IX, Sahara Bank and Sub-areas VI-VII-VIII and the northern part of Division IXa have not yet been carried out and would be welcome.

Due to the very different present status of the red seabream fishery in the three sea areas and the current scientific contribution to each of them, it has been considered more convenient to present the following chapter split by sea area.

14.2.1 *P. bogaraveo* in Azores region (Sub-area X)

At present the fishing effort level since 1996 is considered high by the whole Azorean fishery community and concerns about the state of the *Pagellus bogaraveo* stock and the effects of this fishery on some other shallow species have arisen. Moreover the artisanal component of the fishery, using mainly hand lines, has suggested a closed area for the longliners

in the shallow waters around the Islands coasts (3 miles zone). Facing these concerns, the Azorean Government has set up some technical measures in January 2000 related with the demersal and deep-water fishery activities inside the 12 mile zone. These include hook size limits and fishing area restrictions by vessel size and gear type. Thus it is expected that there will be some future effects on the blackspot seabream longline catches mostly near the islands shores.

14.2.1.1 Commercial CPUE and Research Surveys

Results on red seabream abundance, length frequency distributions and demersal and deep-sea communities by geographical area and depth were presented to the Study Group (ICES, 1996). All these data have been updated elsewhere (Menezes *et al.*, 1998).

Longline survey CPUE for the period 1995 to 1999 and the commercial CPUE for the period 1988 to 1998 are plotted in Figure 14.2.1.1. It can be observed that there is a decreasing trend in the period 1988 until 1994, and a slight increase in the catch rates from 1995 to 1998. The survey CPUE from 1995 to 1999 seems to show similar trends.

14.2.1.2 Length and Age compositions

Length composition is available for the period 1982-1998. Age reading has been updated annually since 1995, using data from surveys and the fishery. Age composition from commercial fishery and surveys are presented in Figures 14.2.1.2. and 14.2.1.3. The commercial age composition seems to maintain the distribution along the period with modes in the ages 2 and 3. Age composition from surveys seems also similar in the three years presented. If compared with the commercial age composition, the survey age modes are older and around 4-5 years.

14.2.1.3 Biological parameters

Available biological parameters (growth parameters, maturity ogive, length-weight relationship) have been presented to the study group since 1996 and have been annually updated. Growth parameters are estimated annually since 1995 from fishery and survey data (Krug *et al.* 2000 WORKING DOCUMENT).

14.2.1.4 Assessment

For this assessment, a modified DeLury constant recruitment model and a Schaefer production model were attempted using total international catch data for area X from 1986 to 1998, and Portuguese longline CPUE data for this period.

The fit of the DeLury model was poor for all error models and was unable to predict the marked variations in CPUE. The parameter estimates using a range of assumed initial stock sizes were very unstable and therefore the results are not presented here.

The Schaefer model proved even less successful than the DeLury model in predicting the variations in the CPUE data series. Red seabream recruit to the fishery at age 1 and therefore a time-lag of 1 year was used in this model. Again varying the ratio of initial biomass to carrying capacity gave a wide range of estimated parameter values and the results are not presented.

14.2.1.5 Biological reference points

As the Study Group carried out no assessment, no biological reference points have been considered.

14.2.1.6 Comments on the assessment

The DeLury and Schaefer models gave a wide range of parameter estimates and neither model predicted the Sub-area X data well. The models fail due to the sudden fluctuations in the data (Figure 14.2.1.1) which may just be noise masking some underlying trend or there may be important processes occurring which these simple models are unable to deal with.

Compilation of more detailed information on catch and effort by area and depth from the Azorean longline fishery is encouraged by the Study Group to get better abundance's indices from the fishery.

14.2.1.7 Management considerations

The inability of either the DeLury or Schaefer models to correctly model the fluctuations in CPUE data observed in Sub-area X implies that we cannot draw any firm conclusions about the state of the stock in this area from these methods of stock assessment at the current time.

14.2.2 *P. bogaraveo* in Sub-area IX

A comprehensive description of the Spanish fishery in the southern part of the Sub-area IX area, i.e., close to the Strait of Gibraltar has been presented this year by first time to the Study Group by Gil *et al.* (WORKING DOCUMENT). In relation to the Portuguese fishery, only information on their catches has been reported.

Description of the Spanish fishery

Since the earlies 1980s an artisanal longline fishery targeted to red seabream (*Pagellus bogaraveo*, "voraz") has been developed close to the Gibraltar area (Figure 14.2.2.1). The "*voracera*", a particular mechanised hook line baited with sardine, is the gear used by the fleet. The base ports of the boats involved in this fishery are only two: Algeciras and mainly Tarifa. The fishing is carried out taking advantage of the turnover of the tides in bottoms from 200 to 400 fathoms. Usually landings are distributed in categories due to the wide range of sizes and to market reasons. These categories have varied along the time.

In the beginning of the 1980s, there were 25 small boats focused in this fishery. Thereafter the fleet has increased to more than a hundred since the 1990s. The mean technical characteristics of this fleet by port, in 1999, are as below:

Port	Length (m)	G.T.R. (t)	N
Tarifa	8.95	5.84	79
Algeciras	6.52	4.00	28

The marked decrease of the landings in the last years caused a serious concern in the fishermen and in the authorities and an study project was started by the *Instituto Español de Oceanografía* (IEO) at the request of the Fishermen Corporations. At present, this study is in the monitoring phase and the discussion of the preliminary results has just begun. Moreover, some technical measures have been set up by the Spanish Government, in 1998, in order to regulate the fishing activity. In 1999, the Regional Government of Andalucía has worked out a fishing plan for the resource recuperation including a series of measures to be accomplished by the fleet since March 1999. Among the technical measures adopted there are: close season of two months (February - March), maximum number of lines per boat (30), hook size and maximum number per line (100), maximum number of automatic machines for hauling per boat (3), minimum size of fish retained or landed (25 cm total length).

14.2.2.1 Commercial CPUE and Research Surveys

A preliminary approach to estimate the commercial landings per unit effort (LPUE) has been used. All information was gathered for the period 1983-1999 from the sale sheets: monthly landings, monthly number of sales, number of days where sales were carried out and number of fishing boats that at least once per month landed fish.

The number of sales was chosen as unit of effort because it represents the number of daily trips for fishing (without consideration that boats could have made catches or not in that day). Hence, the LPUE is estimated as:

$$LPUE = \sum Landings(kg) / \sum Sales$$

The preliminary results on the LPUEs evolution in the period 1983-1999 are presented in Figure 14.2.2.2. A continuous and simultaneous increase of landings and fishing effort was observed since 1983 until 1994. The fishing effort increased so much in number of fishing units as in technological improvements (automatic machines for hauling the gear, sounding for bottom register, GPS, etc.). This simultaneous increase of landings and effort up to 1994 caused rather similar LPUEs values along this period. But it could be better explained as an improvement in the effectiveness of the fishing gear rather than by a real increase in the fish abundance. In 1995, and due to causes can not be explained by the available information, the fishery shows an important decrease in the landings and a drop in the mean length of the catches. Finally, the landings and effort low values observed in 1999 can be at least partially explained by the agreed stop of the fishing activity during three months (March, April and September) of this year. On the other hand, from 1995

onwards, the exploitation pattern of the fishery suffers an important change. There is a more intensive use of the fishing areas located between Algeciras and Tarifa, as well as a shift of the Algeciras boats to land their catches at their own port. In the recent years (1998-1999), it appears that there is a trend towards a stabilisation but at a lower level. However, as the estimated pattern on the LPUE trend evolution could be affected by the effort unit preliminary chosen, further investigations are needed to check it.

14.2.2.2 Length and Age compositions

From the beginning of the IEO monitoring study, in June 1997, a monthly length sampling on the different commercial sizes is being carried out to estimate the length composition of the landings. Annual length compositions of landings for the period 1984-1996 were estimated by applying the standard length distribution obtained from each of the commercial categories in the monitored years (1997-1999) to the annual landings split by categories of that period.

The annual length composition of the Spanish landings in the years 1983-1999 is presented in Figure 14.2.2.3. The annual mean length evolution in this period presents a decreasing tendency (Figure 14.2.2.4). On the other hand, in the last three years, different annual mean lengths have been observed in the Tarifa and Algeciras landings (Figure 14.2.2.4). It might be explained because both fleets work in different fishing areas and the resource according to the length probably does not have a similar geographic and bathymetric distribution.

14.2.2.3 Biological parameters

For the biological characterisation of the fishery, a monthly sampling program was carried out on commercial landings in two periods: from June 1997 to June 1998 and from November 1998 to February 1999. The last one was especially targeted to smaller fish. In addition, two tagging surveys were implemented in summer 1997 and 1998. The main results are presented below:

Length-weight relationship

The relationship between total length (cm) and weight (g) of *Pagellus bogaraveo* in this sea area can be described by the following equation:

$$\text{Weight} = 0.0142215 * L^{3.005} \qquad (n= 1042;\ r^2 = 0.99)$$

Age and growth

Sagittae otoliths (302) have been collected and read for age determination and a preliminary age-length key was obtained, but it has not been presented.

Reproduction

In the sampling period 1997-1999, 1042 fish were analysed.

Sex	Number	Length range (cm)
Unsexed	160	11-30
Males	318	24-50
Females	282	24-53
Hermaphrodites	282	20-54
Total	1042	11-54

The GSI monthly evolution seems to indicate that the spawning season of Red seabream in this area takes place during the first quarter of the year (Figure 14.2.2.5). Length at 50% of maturity of males was calculated at 29.3 cm and at 33.6 cm for females.

14.2.2.4 Assessment

The Study Group attempted no assessment on the Red seabream of this area because a part of the information presented, namely the fishing effort unit chosen, was considered preliminary.

14.2.2.5 Biological reference points

No biological reference points have been considered, because no assessment was carried out by the Study Group.

14.2.2.6 Comments on assessment

No comments because no assessment.

14.2.2.7 Management considerations

Although no assessment has been carried out, the decreasing trend observed in the landings and in their mean lengths might justify, from a precautionary point of view, the local technical measures adopted.

14.2.3 *P. bogaraveo* in Sub-areas VI, VII and VIII

14.2.3.1 Commercial CPUE and Research Surveys

No data were available to the Study Group.

14.2.3.2 Length and Age compositions

No data were available to the Study Group.

14.2.3.3 Biological parameters

No new biological parameters were available to the Study Group since the 1996 (ICES, C.M.1996/Assess:8).

14.2.3.4 Assessment

The Study Group due to the lack of basic data attempted no assessment.

14.2.3.5 Biological reference points

As the Study Group carried out no assessment, no biological reference points have been considered.

14.2.3.6 Comments on assessment

No comments because no assessment.

14.2.3.7 Management considerations

In the Sub-areas VI, VII and VIII, there have for many years been no directed fisheries on *Pagellus bogaraveo* due to the very low yields obtained since the 1980s. Therefore most of the catches must be considered as very occasional bycatches of the fleets, mainly longliners, targeting on other demersal species. For this reason, in spite of the obvious "collapse" of this traditional fishery, no special management considerations can be suggested.

Table 14.1 Study Group estimates of landings (tonnes).

RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo) VI and VII

Year	France	Ireland	Spain	UK (EW)	UK (C. Isle	**TOTAL**
1988	52	0	47	153	0	**252**
1989	44	0	69	76	0	**189**
1990	22	3	73	36	0	**134**
1991	13	10	30	56	14	**123**
1992	6	16	18	0	0	**40**
1993	5	7	10	0	0	**22**
1994	0	0	9	0	1	**10**
1995	0	3	5	0	0	**8**
1996	0	8	24	1	0	**33**
1997	0	0	0	36		**36**
1998	0	0	7	6		**13**
1999*	0	0	0	15		**15**

* Preliminary

RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo) VIII

Year	France	Spain	K (England	**TOTAL**
1988	37	91	9	**137**
1989	31	234	7	**272**
1990	15	280	17	**312**
1991	10	124	0	**134**
1992	5	119	0	**124**
1993	3	172	0	**175**
1994	0	131	0	**131**
1995	0	110	0	**110**
1996	0	23	0	**23**
1997	18	7	0	**25**
1998	18	86	0	**104**
1999* (1)	17	1	0	**18**

* Preliminary. (1) French landings probably from VII+VIII

RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo) IX

Year	Portugal	Spain	**TOTAL**
1988	370	319	**689**
1989	260	416	**676**
1990	166	428	**594**
1991	109	423	**532**
1992	166	631	**797**
1993	235	765	**1000**
1994	150	854	**1004**
1995	204	625	**829**
1996	209	769	**978**
1997	203	808	**1011**
1998	207	520	**727**
1999*	258	278	**536**

* Preliminary

RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo) X

Year	Portugal	**TOTAL**
1988	637	**637**
1989	924	**924**
1990	889	**889**
1991	874	**874**
1992	1110	**1110**
1993	829	**829**
1994	983	**983**
1995	1096	**1096**
1996	1036	**1036**
1997	1012	**1012**
1998	1114	**1114**
1999	1222	**1222**

Table 14.1(continued)

RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo) XII

Year	Latvia	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994	75	**75**
1995		**0**
1996		**0**
1997		**0**
1998		**0**
1999*		**0**

* Preliminary

RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo) in Madeira (Portugal)

Year	Portugal	**TOTAL**
1988		**0**
1989		**0**
1990	6	**6**
1991	8	**8**
1992	7	**7**
1993	8	**8**
1994	7	**7**
1995	8	**8**
1996	4	**4**
1997	5	**5**
1998	14	**14**
1999*	13	**13**

RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo) All ICES sea areas

Year	VI+VII	VIII	IX	X	XII	**TOTAL**
1988	252	137	689	637	0	**1715**
1989	189	272	676	924	0	**2061**
1990	134	312	594	889	0	**1929**
1991	123	134	532	874	0	**1663**
1992	40	124	797	1110	0	**2071**
1993	22	175	1000	829	0	**2026**
1994	10	131	1004	983	75	**2203**
1995	8	110	829	1096	0	**2043**
1996	33	23	978	1036	0	**2070**
1997	36	25	1011	1012	0	**2084**
1998	13	104	727	1114	0	**1958**
1999*	15	18	536	1222	0	**1791**

* Preliminary

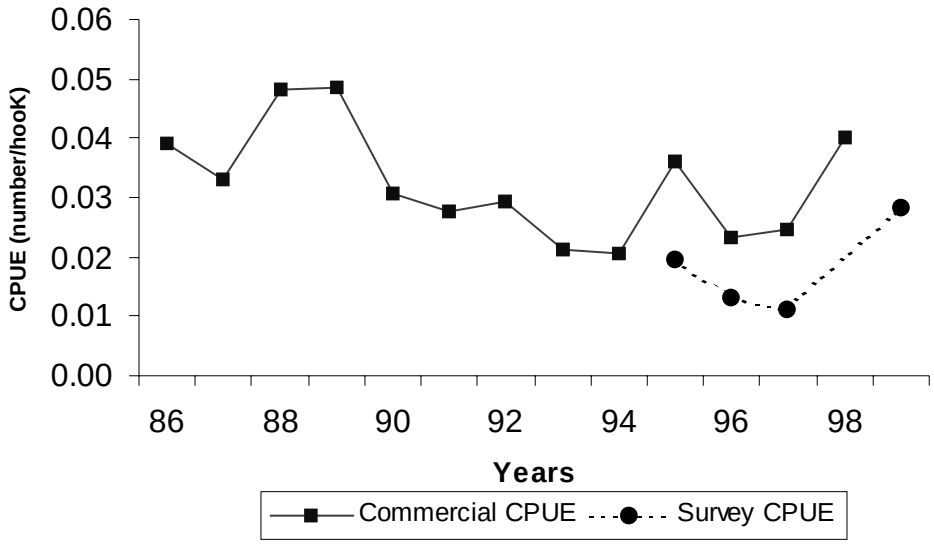


Figure 14.2.1.1 Commercial and survey CPUE (nº/hook) for *Pagellus bogaraveo* of the Azores, in the period 1998-1999.

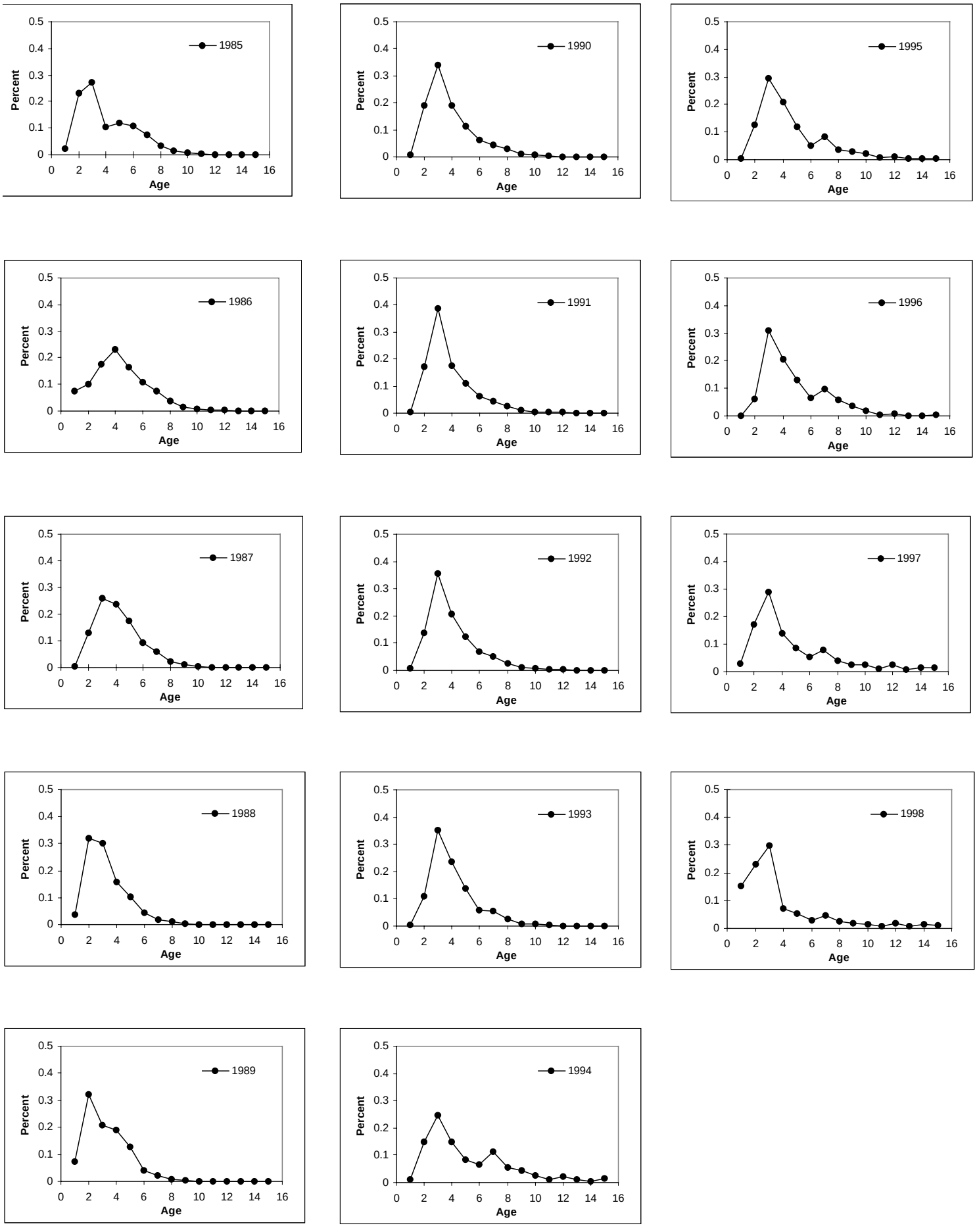


Figure 14.2.1.2 Age composition for *Pagellus bogaraveo* from Azorean commercial longline catches.

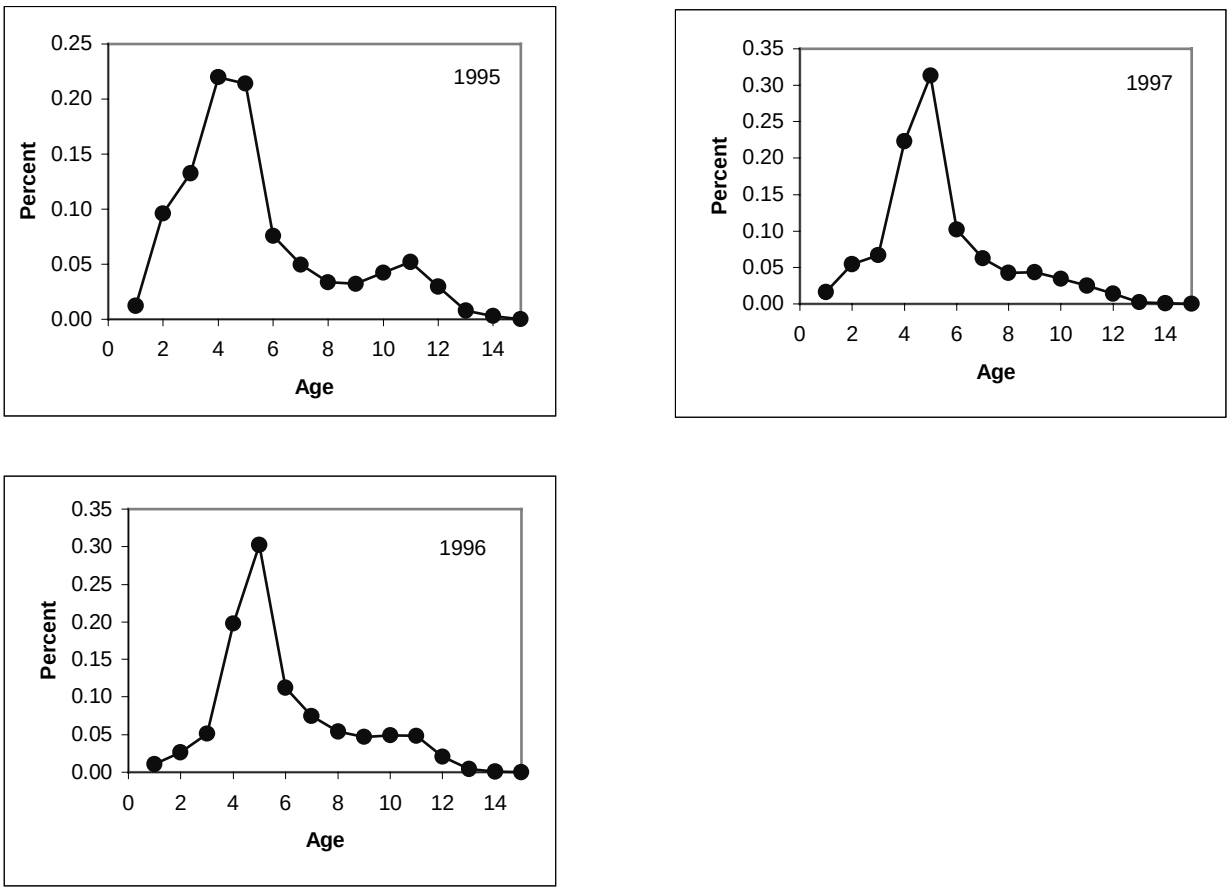


Figure 14.2.1.3 Age composition for *Pagellus bogaraveo* from longline cruise survey in Azores.

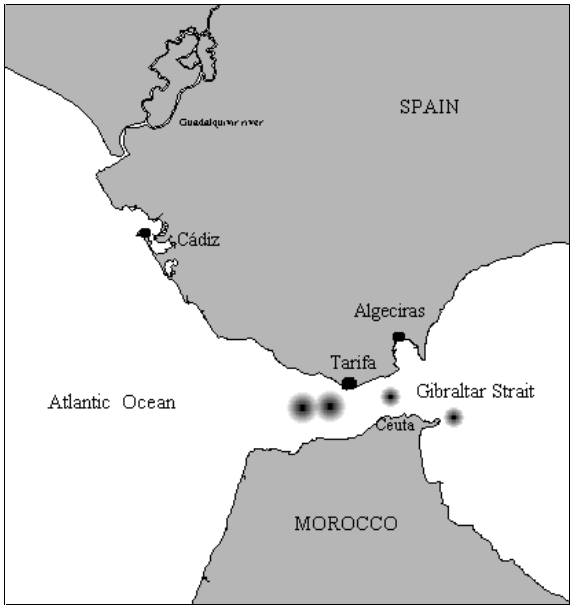


Figure 14.2.2.1 Main landing ports and fishing areas of the artisanal longline ("voracera") fishery on *Pagellus bogaraveo*, in the Strait of Gibraltar.

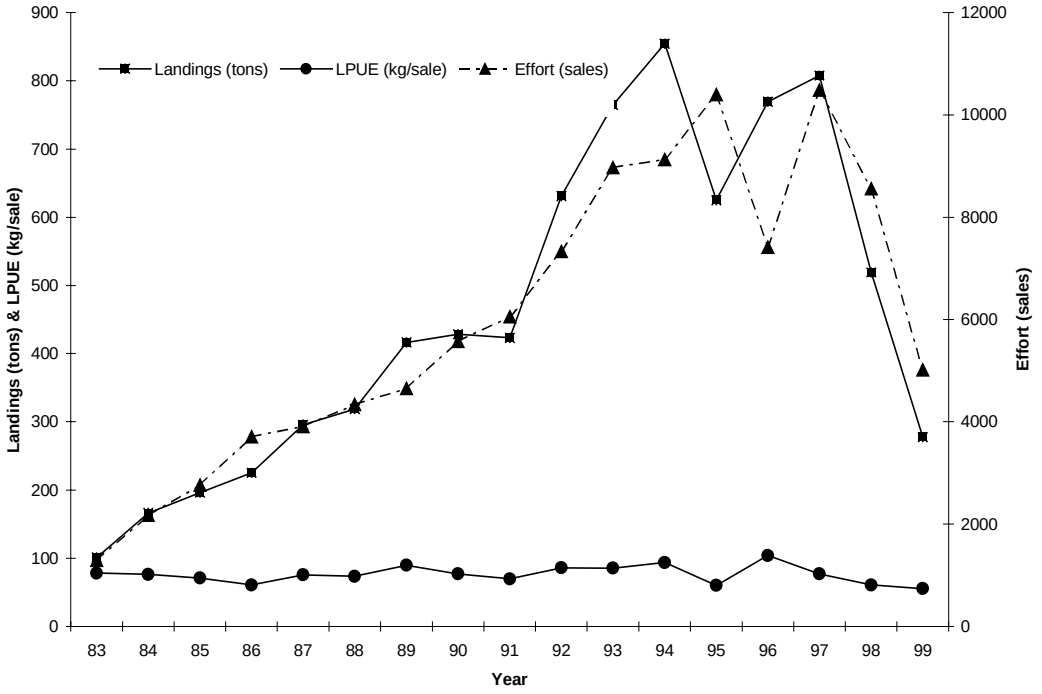


Figure 14.2.2.2. Evolution of landings, effort and LPUE of the artisanal longline ("voracera") fishery on *Pagellus bogaraveo*, in the period 1983 to 1999.

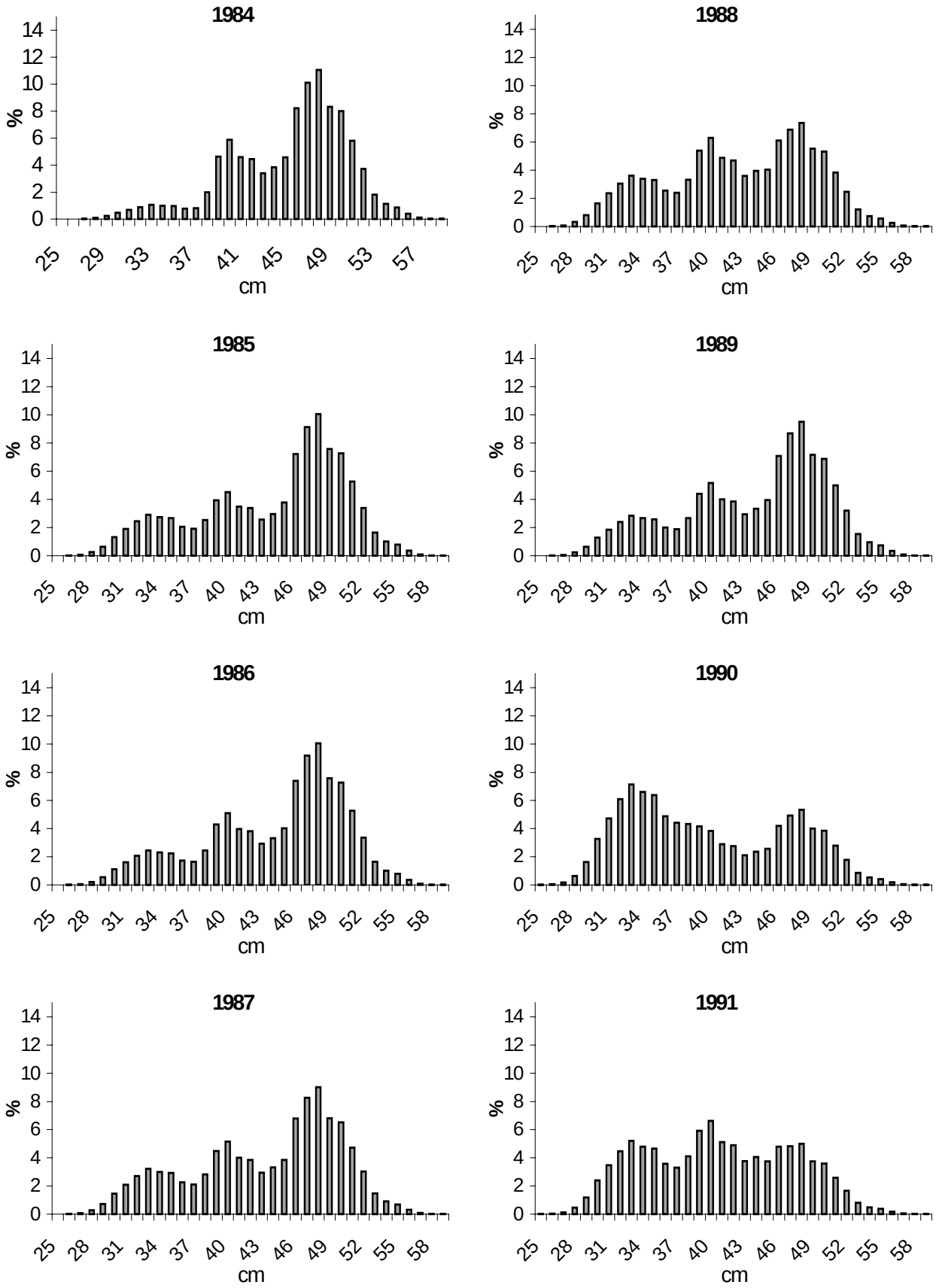


Figure 14.2.2.3 Annual landings length distribution of *P. bogaraveo* from the artisanal longline ("voracera") fleet in the Strait of Gibraltar, in the period 1984-1999.

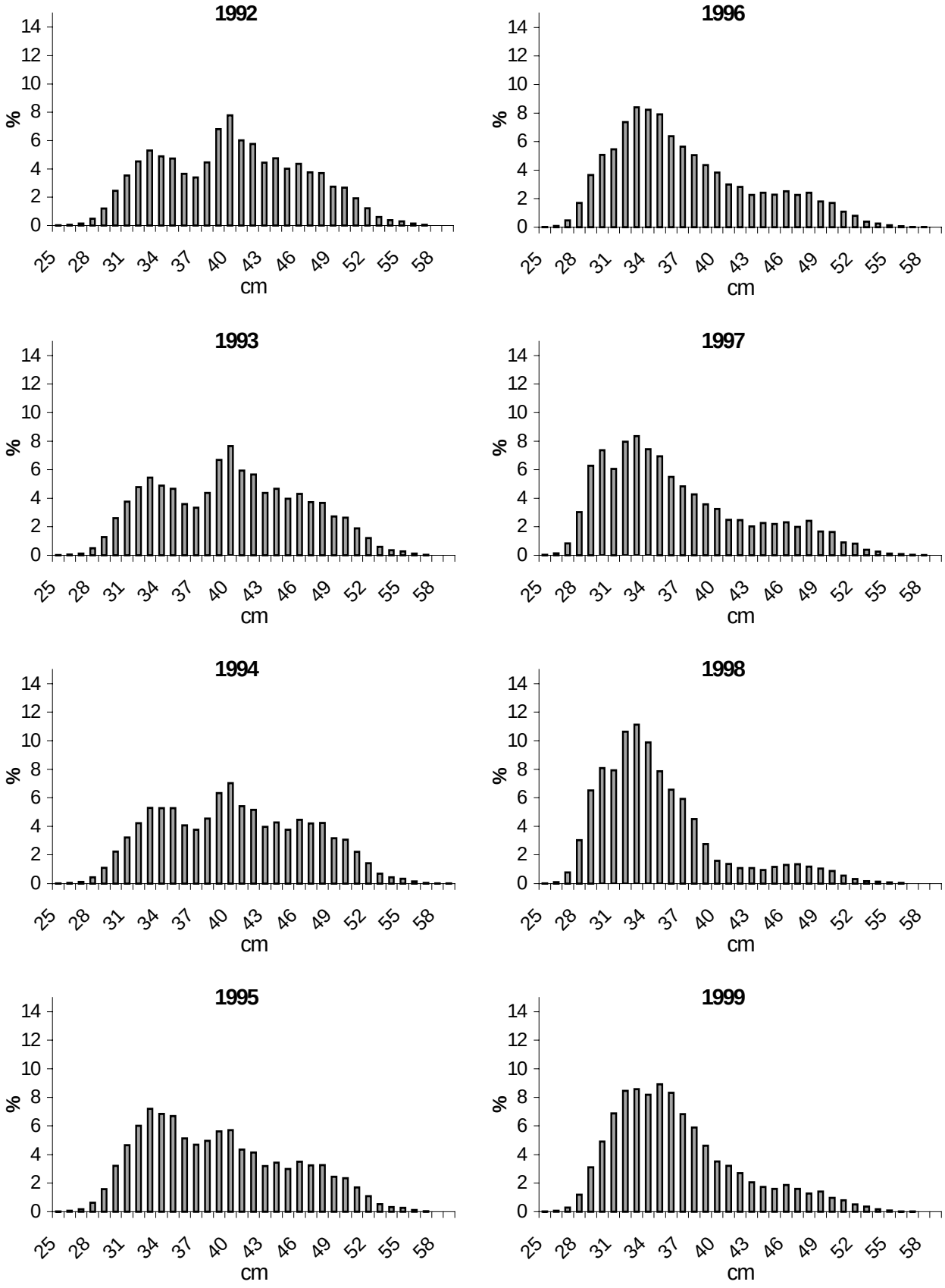


Figure 14.2.2.3 (continued). Annual landings length distribution of *P. bogaraveo* from the artisanal longline ("voracera") fleet in the Strait of Gibraltar, in the period 1984-1999.

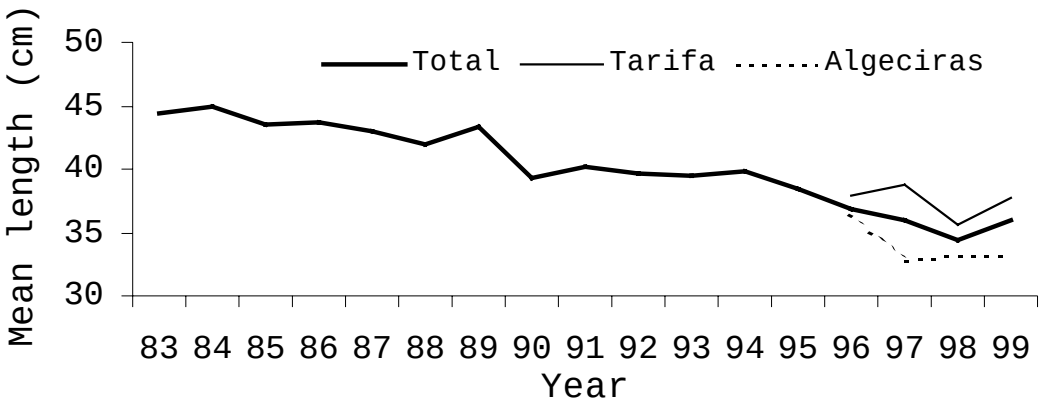


Figure 14.2.2.4 Evolution of landings mean length of the artisanal longline ("voracera") fishery on *Pagellus bogaraveo*, by port, in the period 1983-1999.

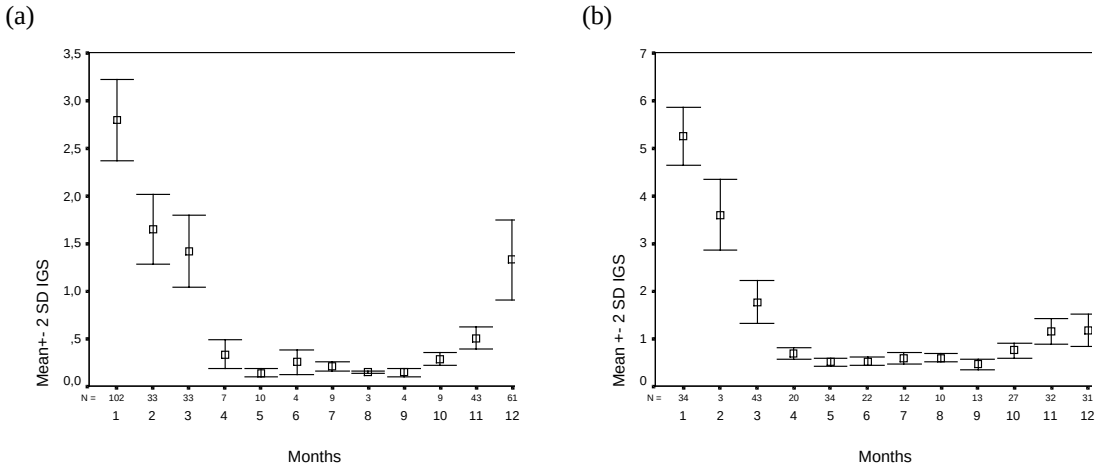


Figure 14.2.2.5 Gonadosomatic Index (GSI) monthly evolution of *Pagellus bogaraveo* in the Strait of Gibraltar. (a) Males; (b) Females.

15 GREATER FORKBEARD (*PHYCIS BLENNOIDES*)

15.1 Introduction

The greater forkbeard (*Phycis blennoides* Brunnich, 1768) is a gadoid fish which is widely distributed in the north-eastern Atlantic from Norway and Iceland to Cape Blanc in West Africa and the Mediterranean (Svetovidov, 1986; Cohen *et al.*, 1990). It is distributed along the continental shelf and slope in depths ranging between 60m and 800m, but recent observations on board of commercial longliners and research surveys extend the depth range to below 1000 m (Stefanescu *et al*, 1992).

Phycis blennoides may be considered as a bycatch species in the traditional demersal trawl and longline fisheries for different target species (hake, megrim, monkfish, ling, blue ling etc.).

The information has been split into four different components according to the importance of the catches and the geographical distribution:

- Greater forkbeard in Sub-areas I, II, III, IV, and V.
- Greater forkbeard in Sub-areas VI, VII and XII (Hatton Bank).
- Greater forkbeard in Sub-areas VIII and IX.
- Greater forkbeard in Sub-areas X (Azorean region)

This separation does not presume the existence of four different stocks of *P. blennoides.*

15.2 Catch trends

Table 15.1 shows the landings of *Phycis blennoides* by ICES Sub-areas as reported to ICES or as reported to the Study Group.

In Sub-areas I, II, III, and IV the small landings registered mainly by Norway have declined since 1993. In Sub-area V the landings in 1999 increased to 33 tonnes. The Norwegian fleet of longliners which fish in these areas catch *Phycis blennoides* as a bycatch in the ling fishery. The quantity of this bycatch that is landed depends on market price.

In Sub-areas VI and VII the landings range between 2000 and 3000 t from 1995 until 1999, mainly due to the increase in the UK and Spanish landings. The change in the landings probably represents a change in target species rather than variations in the abundance of *P. blennoides.* From Sub-area XII the only French landings are available because Spanish vessels do not differentiate between *Lepidion eques* and *Phycis spp*. Almost the whole of these Spanish catches are discarded.

In Sub-areas VIII and IX the bulk of the landings are Spanish and have increased from 81 t in 1988 to 665 t in 1998. This is probably because of the start of a longline directed deep-water fishery from Asturias and Cantabria ports.

In the Sub-area X (Azorean region) landings by Portugal have declined from peak levels of 135 t in 1994 to less than 50 tonnes in 1996-1999 period.

15.3 Commercial CPUE and Research surveys

In addition to what was presented in the 1998 Report the only new CPUE data available is from Irish trawl and long-line surveys in Sub-areas VI and VII (Clarke, *et al.* 1999; Clarke, 1999). See Section 18 for more details. Table 15.2 updates the CPUE from Irish Surveys.

15.4 Length and Age composition

In Sub-area VI the first analysis from the sampling program carried out at Scottish ports indicated that the variations observed in quarterly length frequencies were probably a function of movements of fishing effort up or down the slopes as well as seasonal movements of fish stocks (EC FAIR,1999). More recently there are indications that the trend in recent years has been towards fishing at greater depths and thus it would seem unlikely that the change in fishing depth has been the cause of the observed changes. It appears most likely that a change in market conditions has led to small fish, which would previously have been discarded, being retained and landed (EC FAIR, 1999)

To study the growth of greater forkbeard in the North and Northwest of Spain (ICES Sub-areas VIII and IX) a study of their otoliths and length frequency distributions was carried out (EC FAIR, 1999). The mean lengths at age derived from otolith readings by sex were calculated. Growth parameters were estimated using FISHPARM (Saila *et al.*, 1988). The Von Bertalanffy function was fitted to model the growth pattern and the equations by sex are given below:

$$\text{Males: } L_t = 54.9(1-e^{-0.217(t-(-0.663))})$$

$$\text{Females: } L_t = 110(1-e^{-0.0937(t-(-0.484))})$$

The growth pattern of greater forkbeard by sex is similar up to age three. After age three, females grow larger and faster than males. Male specimens larger than 45 cm are very scarce. The female curve shows higher growth, reaching sizes greater than 80 cm.

Also, this growth and age estimation of greater forkbeard for ICES Divisions VIIIc and IXa will be available (Casas, *et al.* in press).

Portuguese deep-water surveys carried out in Sub-area IXa showed that the species is evenly distributed over continental slope at depths ranging from 200 to 900 m with no apparent preference for a particular substrate type. Mean yields of more than 10 Kg/h are usually obtained at depths greater than 600 m where large individuals are more frequent. In 1997/1998 surveys the total mean length was 38.6 and 28.9 cm for females and males respectively (EC FAIR, 1999).

Length frequency distributions from Irish Surveys are given in Figure 15.1 and Figure 15.2 for Sub area VI and Sub-areas VI and VII, respectively.

15.5 Discards

The Norwegian sampling discard sampling program mainly carried out in Sub-area IVa under the EC FAIR Deep-fisheries project indicated that all the greater forkbeard were discarded. The total length ranged from 32 to 64 cm (EC FAIR, 1999).

However in the years 1990 to 1993 this species was landed as by-catch at Norwegian ports, the total landings amounted 440 t. This fact may be due to the scarcity of cod quota in the Barents Sea during that period which caused a temporary increase in the price (EC FAIR, 1999).

15.6 Biological parameters

In Sub-area VII, length weight relationships were obtained from Irish survey data (Clarke, *et al.* in prep).

$$W_{total} = 0.00005*L^{2.85}$$

Also, there are new maturity data available for Sub Areas VI and VII from Irish survey data (Kelly (1997b); Clarke *et al.* 1999).

15.7 Assessment

No assessment was attempted by the Study Group due to the lack of the suitable data in all sub-areas.

15.8 Biological reference points

As no assessment was carried out by the study group, no biological reference points have been considered.

15.9 Comments on Assessment

No comment because no assessment.

15.10 Management considerations

No special management considerations can be suggested because there is no assessment. Also, the general character of this fishery as a bycatch means that CPUE data are unreliable. The greater forkbeard are mainly a bycatch species and maybe this fact makes it not manageable according to a single species regulation.

Table 15.1 Study Group estimates of landings (tonnes)

GREATER FORKBEARD (Phycis blennoides) I and II

Year	Norway	**TOTAL**
1988	0	**0**
1989	0	**0**
1990	23	**23**
1991	39	**39**
1992	33	**33**
1993	1	**1**
1994	0	**0**
1995	0	**0**
1996	0	**0**
1997	0	**0**
1998	0	**0**
1999*	0	**0**

* Preliminary data

GREATER FORKBEARD (Phycis blennoides) III and IV

Year	France	Norway	UK (EWNI)	UK (Scot)(1)	**TOTAL**
1988	12	0	3	0	**15**
1989	12	0	0	0	**12**
1990	18	92	5	0	**115**
1991	20	161	0	0	**181**
1992	13	130	0	2	**145**
1993	6	28	0	0	**34**
1994	11			1	**12**
1995	2			1	**3**
1996	2	10		6	**18**
1997	2			5	**7**
1998	1		0	11	**12**
1999*	2		5		**7**

* Preliminary data
(1) Includes Moridae

GREATER FORKBEARD (Phycis blennoides) Vb

Year	France	Norway	**TOTAL**
1988	2	0	**2**
1989	1	0	**1**
1990	10	28	**38**
1991	9	44	**53**
1992	16	33	**49**
1993	5	22	**27**
1994	4		**4**
1995	9		**9**
1996	7		**7**
1997	7	0	**7**
1998	4	4	**8**
1999*	5	28	**33**

* Preliminary data

Table 15.1. (CONTINUED)

GREATER FORKBEARD (Phycis blennoides) VI and VII

Year	France	Ireland	Norway	Spain	UK (EWNI)	UK (Scot)(1)	FRGermany	**TOTAL**
1988	252	0	0	1584	62	0		**1898**
1989	342	14	0	1446	13	0		**1815**
1990	454	0	88	1372	6	1		**1921**
1991	476	1	126	953	13	5		**1574**
1992	646	4	244	745	0	1		**1640**
1993	582	0	53	824	0	3		**1462**
1994	451	111		1002	0	7		**1571**
1995	430	163		722	808	15		**2138**
1996	519	154		1428	1434	55		**3590**
1997	512	130.6	5	46	1460	181		**2335**
1998	357	530	162	530	1364	97		**3040**
1999*	499	374	198	177	927		1	**2176**

* Preliminary data
(1) Includes Moridae

GREATER FORKBEARD (Phycis blennoides) VIII and IX

Year	France	Portugal	Spain	**TOTAL**
1988	7	0	74	**81**
1989	7	0	138	**145**
1990	16	0	218	**234**
1991	18	4	108	**130**
1992	9	8	162	**179**
1993	0	8	387	**395**
1994		0	320	**320**
1995	54	0	330	**384**
1996	25	2	429	**456**
1997	4	1	356	**361**
1998	3	6	656	**665**
1999*	4	10	42	**56**

* Preliminary data

GREATER FORKBEARD (Phycis blennoides) X

Year	Portugal (1)	**TOTAL**
1988	29	**29**
1989	42	**42**
1990	50	**50**
1991	68	**68**
1992	81	**81**
1993	115	**115**
1994	135	**135**
1995	71	**71**
1996	45	**45**
1997	30	**30**
1998	38	**38**
1999*	41	**41**

* Preliminary data
(1) Includes Moridae

Table 15.1. (CONTINUED)

GREATER FORKBEARD (Phycis blennoides) XII

Year	France	Spain	**TOTAL**
1988			
1989			
1990			
1991			
1992	1		
1993	1		
1994	3		
1995	4		
1996	2	n/a	
1997	2	n/a	**2**
1998	1	n/a	**1**
1999*	1	n/a	**1**

* Preliminary data
n/a Spanish catches included *Lepidion eques* (mainly) and *Phycis spp.*

GREATER FORKBEARD (Phycis blennoides) All ICES Sub-areas

Year	I+II	III+IV	Vb	VI+VII	VIII+IX	X	XII	**TOTAL**
1988	0	15	2	1898	81	29		**2025**
1989	0	12	1	1815	145	42		**2015**
1990	23	115	38	1921	234	50		**2381**
1991	39	181	53	1574	130	68		**2045**
1992	33	145	49	1640	179	81		**2127**
1993	1	34	27	1462	395	115		**2034**
1994	0	12	4	1571	320	135		**2042**
1995	0	3	9	2138	384	71		**2605**
1996	0	18	7	3590	456	45		**4116**
1997	0	7	7	2335	361	30	2	**2742**
1998	0	12	8	3040	665	38	1	**3765**
1999*	0	7	33	2176	56	41	1	**2314**

* Preliminary data

Table 15.2 – Preliminary CPUE data in ICES Sub-areas VI and VII From Irish Research Surveys (19993-1999).

ICES Sub-area VI+VII

Gear Type	Year	Effort	Weight (kg)	CPUE	Depth range (m)
Trawl	1993	11601[(1)]	3350.74	17.33[(1)]	201-1043
Trawl	1995	973[(1)]	126.34	7.79[(1)]	740-1230
Longline	1995	25563[(2)]	372.32	14.56[(2)]	
Trawl	1996	1225[(1)]	73.3	3.59[(1)]	760-1007
Trawl	1997	2345[(1)]	145.93	3.73[(1)]	615-1150
Longline	1997	26120[(2)]	457.12	17.50[(2)]	353-1178
Longline	1999	124620[(2)]	692.5	5.59[(2)]	468-1124

[(1)]Effort (mins) and CPUE (kgr/hr)

[(2)]Effort (hooks) and CPUE (kgr/1000 hooks)

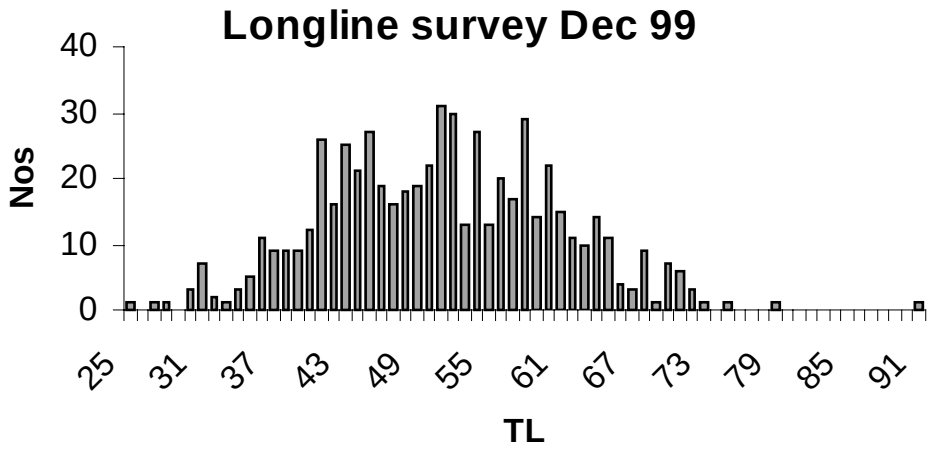
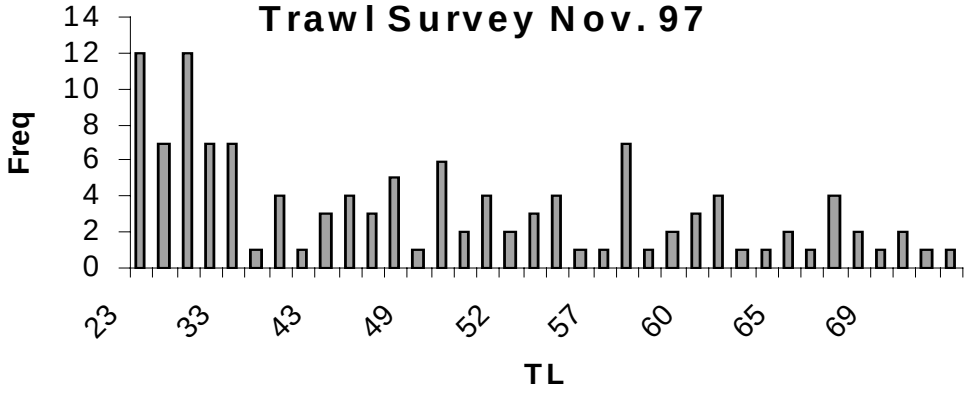


Figure 15.1 – Greater Forkbeard (*Phycis blennoides*) Length distribution from Irish Surveys (ICES VII Sub-area)



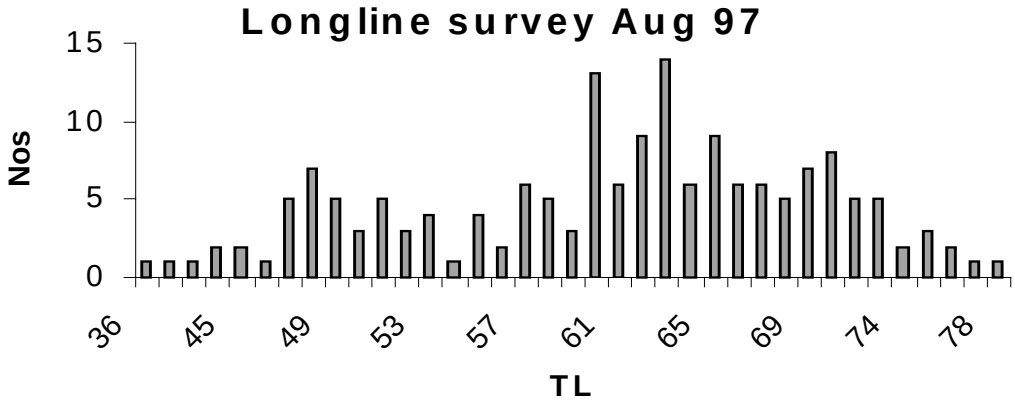


Figure 15.2 - Greater Forkbeard (*Phycis blennoides*) Length distribution from Irish Surveys (ICES VI and VII Sub-areas).

16 ALFONSINOS/GOLDEN EYE PERCH (*BERYX SPP*)

16.1 Catch trends

Table 16.1 shows the landings data for Golden eye perch (Alfonsinos), *Beryx* spp, by ICES Sub-areas as reported to ICES or to the Study Group. This table includes by first time landings for 1995 to 1999 from the fishery at Madeira which is outside the ICES area. No data on discards have been presented. In most cases the statistics refer to both species combined (*Beryx splendens* and *Beryx decadactylus*). In general, except for Sub-area X, it is not known if the annual variations in landings are due to changes in fish abundance, changes in the direction of the fisheries or to more accurate reporting or monitoring of the landings, which are usually the bycatch of demersal fisheries targeting other species.

Landings reported from Sub-areas IV-V combined are very small (a maximum 6 t in 1990 and 1992) and most of them were reported by French vessels.

In Sub-areas VI-VII, landings used to be very small and variable until 1995, ranging from 12 t (in 1989) to 1 t (in 1993). In 1996, however, landings increased to 178 t, taken as a bycatch of the Spanish demersal, mainly longline, fisheries in Sub-area VII. In 1998 and 1999 landings amounted to about 80 t and were reported by France and Spain.

In Sub-areas VIII-IX, the reported landings were very small (1-2 t) and scattered until 1994, but they have increased continuously from 1995 onwards. In 1998 they amounted to 269 t. The decrease observed in 1999 (only 47 t) can be explained because Spanish data reported are preliminary and not complete. Most of these landings can be regarded as bycatches of the Spanish and Portuguese demersal (longline) fisheries.

Most of the reported catches of *Beryx* spp are from Sub-area X. They are mainly from longliners within the Azorean EEZ and by trawlers north of that area. Catches from the Azores have been increasing steadily from 185 t in 1987 to 635 t in 1994 and then have been decreasing (175 t in 1999). The catch series in the period 1988-1999 for both species separately is presented below (G. Menezes and M. Pinho, pers. com.).

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
B. splendens	108	122	113	137	203	274	317	404	331	366	268	160	119
B. decadactylus	77	103	147	201	168	176	217	231	192	171	111	68	56
Beryx spp Total	185	225	260	338	371	450	533	636	523	536	378	228	175

Golden eye perch catches by former USSR trawlers were estimated in 1800 t during 1978–1979. Catches by Russian trawlers in the North Azores area have been also estimated for some years in the 1990s. They oscillated between 100 and 864 t.

Finally, in Sub-area XII, catches (2 t) were reported only in 1995, by the Faroe Islands.

16.2 Commercial CPUE and Research Surveys

For the Mid-Atlantic Ridge (Figure 16.1) estimates of the abundance of *Beryx splendens* and *Beryx decadactylus* in two different areas were obtained by means of trawl and longline experimental surveys in the years 1993 and 1996 (Tables 16.2 and 16.3). In both cases maximum values of catch per unit effort were found at around 600 m depth (Figure 16.2).

For the Azores region estimates of golden eye perch relative abundance and length frequency distributions by stratum (geographical area and depth) were obtained in 1995 and the results were presented to the 1996 Study Group (ICES, C.M.1996/Assess:8). This information on the Relative Abundance Index (RPN) for *Beryx splendens* and *Beryx decadactylus* from longline cruises has been updated in 1999 (Figure 16.3 and 16.4). The general trend of these indices is not clear due to the short time series and, moreover, because the yearly oscillations could be related with the effect of the mobility of these species (Menezes *et al.* 1999).

16.3 Length compositions

For the Mid-Atlantic Ridge, *Beryx splendens* length distribution data, in fork length (FL), from bottom trawl, pelagic trawl and longline catches, were available from EC FAIR (1999) (Møre Research, Norway). Differences in length composition for the different gears were observed (Table 16.4 and Figure 16.5). Longlines normally catch the largest fish as is typical in many fisheries (Hareide, 1995). From the commercial catches in 1993 it was found that the length distributions differed between banks (Figure 16.6). Vinnichenko (unpublished information) found that the length distribution changed considerably between day and night in pelagic trawl catches. This variation was most probably due to daily vertical migrations up to the scattering layer to feed.

For the Azorean area no new data were available to the Study Group. In the 1996 Study Group Report length and age compositions of the catches in this area were presented for the period 1983–1993 (ICES C.M.1996/Assess:8).

16.4 Biological parameters

Beryx splendens has a worldwide distribution in temperate and tropical waters. In the North Atlantic it is distributed mainly from Ireland and southwards along the East-Atlantic continental slope, on the Mid-Atlantic Ridge from 51º N and southwards. In the western Atlantic it is distributed on the continental slope from Nova Scotia southwards. On the Mid-Atlantic Ridge *Beryx splendens* was most abundant at depths between 450 and 800 m and at temperatures of between 7º and 12º C. Often dense schools were recorded close to the tops of seamounts (Hareide and Garnes, 1998) (Figure 16.7).

For the Mid-Atlantic Ridge *Beryx splendens* new biological information on length-weight relationship and age was available from EC FAIR (1999) (Møre Research, Norway).

Length-weight relationship

The relationship between fork length (FL) and weight of *Beryx splendens* on the Mid-Atlantic Ridge can be described by the following equations:

$$\text{Males:} \quad \text{Weight (g)} = 0.0075 * FL^{3.291}$$

$$\text{Females:} \quad \text{Weight (g)} = 0.0025 * FL^{2.961}$$

Age and growth

An age length key, based on otolith reading of *Beryx splendens* from the Mid-Atlantic Ridge in 1993, for both sexes combined, is presented in Table 16.5. No differences in growth were found between the sexes. The opaque fast-growth zones in the otoliths were seldom homogeneous but appeared as bands split by thin, but sometimes distinct, hyaline zones which may be wrongly considered as annuli. Some inconsistency may be caused by the interpretation of the first fast-growth zone, i.e. the nucleus and the opaque area deposited during the 0-group stage. This zone is wide compared to most other deep-water species.

For the Azorean region, information on length-weight relationship, spawning season, depth distribution and others biological items for both *Beryx* species was reported in 1996 (ICES C.M.1996/Assess:8) and in 1998 (ICES C.M.1998/ACFM:12). New data on age, growth and reproduction obtained in 1995-1997 for both *Beryx* species in the Azorean area were presented to the present Study Group by Krug *et al.* (WORKING DOCUMENT).

Age and growth

Age determination was carried by means of the *sagittae* otoliths reading. ANCOVA of each species results indicated no significant differences in the growth parameters between sexes ($P>0.05$).

Species	Fish Aged	Age range	Length Range	Von Bertalanffy Growth equation		
				L_∞	K	t_o
	(n)	years	(FL in cm)	(FL in cm)	(years $^{-1}$)	years
Beryx splendens	1245	0-11	14-40	50.8	0.114	-3.58
Beryx decadactylus	523	1-13	21-51	53.7	0.163	-1.52

Reproduction

In *Beryx splendens* the female GSI tends to be higher from late summer, through autumn and winter (January/February). In males the GSI evolution suggests a protracted spawning season from September to March/April (Isidro, 1996).

In *Beryx decadactylus* the female GSI is of low amplitude and does not suggest any particular restricted period of spawning activity. In males the GSI evolution shows some tendency for a maximum between May and July and a minimum between August and December (Isidro, 1996).

The length and age at 50% fist maturity values for both species have been estimated as below:

Species	Fish analysed (n)			Length at maturity (FL in cm)		Age at maturity (years)
	Males	Females	All	Males	Females	All
Beryx splendens	359	447	806	22.9	23.0	2
Beryx decadactylus	149	206	355	30.3	32.5	4

16.5 Assessment

The Study Group, due to the lack of the basic data, attempted no assessment in 2000 as in previous years.

16.6 Biological reference points

As the Study Group carried out no assessment, no biological reference points have been considered.

16.7 Comments on the Assessment

No comments because no assessment.

16.8 Management considerations

No management considerations.

Table 16.1 Alfonsinos. Study Group estimates of landings (tonnes).

ALFONSINOS (Beryx spp.) IV

Year	France	**TOTAL**
1988	0	**0**
1989	0	**0**
1990	1	**1**
1991	0	**0**
1992	2	**2**
1993	0	**0**
1994	0	**0**
1995	0	**0**
1996	0	**0**
1997	0	**0**
1998	0	**0**
1999*	0	**0**

* Preliminary

ALFONSINOS (Beryx spp.) Vb

Year	Faroes	France	**TOTAL**
1988			**0**
1989			**0**
1990		5	**5**
1991		0	**0**
1992		4	**4**
1993		0	**0**
1994		0	**0**
1995	1	0	**1**
1996	0	0	**0**
1997	0	0	**0**
1998	0	0	**0**
1999*	0	0	**0**

* Preliminary

ALFONSINOS (Beryx spp.) VI and VII

Year	France	UK (EW)	Spain	**TOTAL**
1988				**0**
1989	12			**12**
1990	8			**8**
1991				**0**
1992	3			**3**
1993	0		1	**1**
1994	0		5	**5**
1995	0		3	**3**
1996	0		178	**178**
1997	17	4	4	**25**
1998	10	0	71	**81**
1999*	67	0	11	**78**

* Preliminary

ALFONSINOS (Beryx spp.) VIII and IX

Year	France	Portugal	Spain	**TOTAL**
1988				**0**
1989				**0**
1990	1			**1**
1991				**0**
1992	1			**1**
1993	0			**0**
1994	0		2	**2**
1995	0	75	7	**82**
1996	0	43	45	**88**
1997	69	35	31	**135**
1998	1	9	259	**269**
1999*	8	29	10	**47**

* Preliminary

Table 16.1 (continued)

ALFONSINOS (Beryx spp.) X

Year	Faroes	Norway	Portugal	Russia	**TOTAL**
1988			225		**225**
1989			260		**260**
1990			338		**338**
1991			371		**371**
1992			450		**450**
1993		195	533		**728**
1994		0	636	864	**1500**
1995	0	0	523	100	**623**
1996	0		536		**536**
1997	5		378	600	**983**
1998	0		228		**228**
1999*	0		175		**175**

* Preliminary.

ALFONSINOS (Beryx spp.) XII

Year	Faroes	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995	2	**2**
1996	0	**0**
1997	0	**0**
1998	0	**0**
1999*	0	**0**

* Preliminary

ALFONSINOS (Beryx spp.) in Madeira (Portugal)

Year	Portugal	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995	1	**1**
1996	11	**11**
1997	4	**4**
1998	3	**3**
1999	2	**2**

ALFONSINOS (Beryx spp.). All ICES sea areas

Year	IV	Vb	VI+VII	VIII+IX	X	XII	**TOTAL**
1988	0	0	0	0	225	0	**225**
1989	0	0	12	0	260	0	**272**
1990	1	5	8	1	338	0	**353**
1991	0	0	0	0	371	0	**371**
1992	2	4	3	1	450	0	**460**
1993	0	0	1	0	728	0	**729**
1994	0	0	5	2	1500	0	**1507**
1995	0	1	3	82	623	2	**711**
1996	0	0	178	88	536	0	**802**
1997	0	0	25	135	983	0	**1143**
1998	0	0	81	0	228	0	**309**
1999*	0	0	78	0	175	0	**253**

* Preliminary

Table 16.2 Average catch (kg) per trawl haul in Area D and E from the Mid-Atlantic Ridge. (From EC-FAIR, 1999, p. 933. Møre Research, Norway).

	Area D			Area E				
Average depth	700	800	900	500	600	700	800	900
Number of hauls	3	2	2	34	41	12	14	12
Temperature (C °)	5.5-7.0	5.5-5.0	5.0-4.7	11.2-10.2	10.2-9.4	9.4-8.9	8.9-8.2	8.2-7.6
Beryx splendens				2572.7	3492.9	518.6	380.7	720.1
Beryx decadactylus				14.5	30.0			

Table 16.3 Average catch (kg/ 1000 hooks) in area E from the Mid-Atlantic Ridge. (From EC-FAIR, 1999, p. 934. Møre Research, Norway).

	E							
Average depth	400	600	700	800	900	1000	1100	1200
No. samples	1	9	6	3	4	1	1	1
Temperature (C °)	11.5	9.9	9.1	8.4	8.1	7.1	6.1	5.2
Beryx splendens		1.8	3.6					
Beryx decadactylus	1.0							

Table 16.4 Mean, minimum and maximum lengths (Fork length in cm) and weights (kg) of *Beryx splendens* from three types of gear from the Mid-Atlantic Ridge. (From EC-FAIR, 1999, p. 929. Møre Research, Norway).

Gear	Year	L_{max}	L_{min}	L_{mean}	N	W_{max}	W_{min}	W_{mean}	N
Longline	1996	49	27	39.4	352	1.62	0.29	0.86	352
Trawl	1993	62	17	33.5	7571	2.35	0.095	0.66	576
Pelagic trawl	1994	40	20	27.9					

Table 16.5 Age length key of Beryx splendens from the Mid-Atlantic Ridge, in 1993, both sexes combined. (From EC-FAIR, 1999, p. 930. Møre Research, Norway).

16.8.1.1.1 **Age**

Fork length	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**Total**
16	1													1
17	2													2
18	3													3
19		1												1
20		1												1
21		1												1
22		2												2
23			1											1
24		3	2	2										7
25			1	2										3
26			3	2										5
27			1	2										3
28				2										2
29				1	1									2
30					1									1
31					1	1								2
32					2	1								3
33					1	1	1							3
34					1	3	1	1						6
35						2	3	1						6
36						2	2	2						6
37							2	2	1	1				6
38								2	2	1	1	1		7
39								1	1	2	1	1		6
40									1	1		1		3
41										2		1		3
42													1	1
Total	6	8	8	11	7	10	9	9	5	7	2	4	1	87

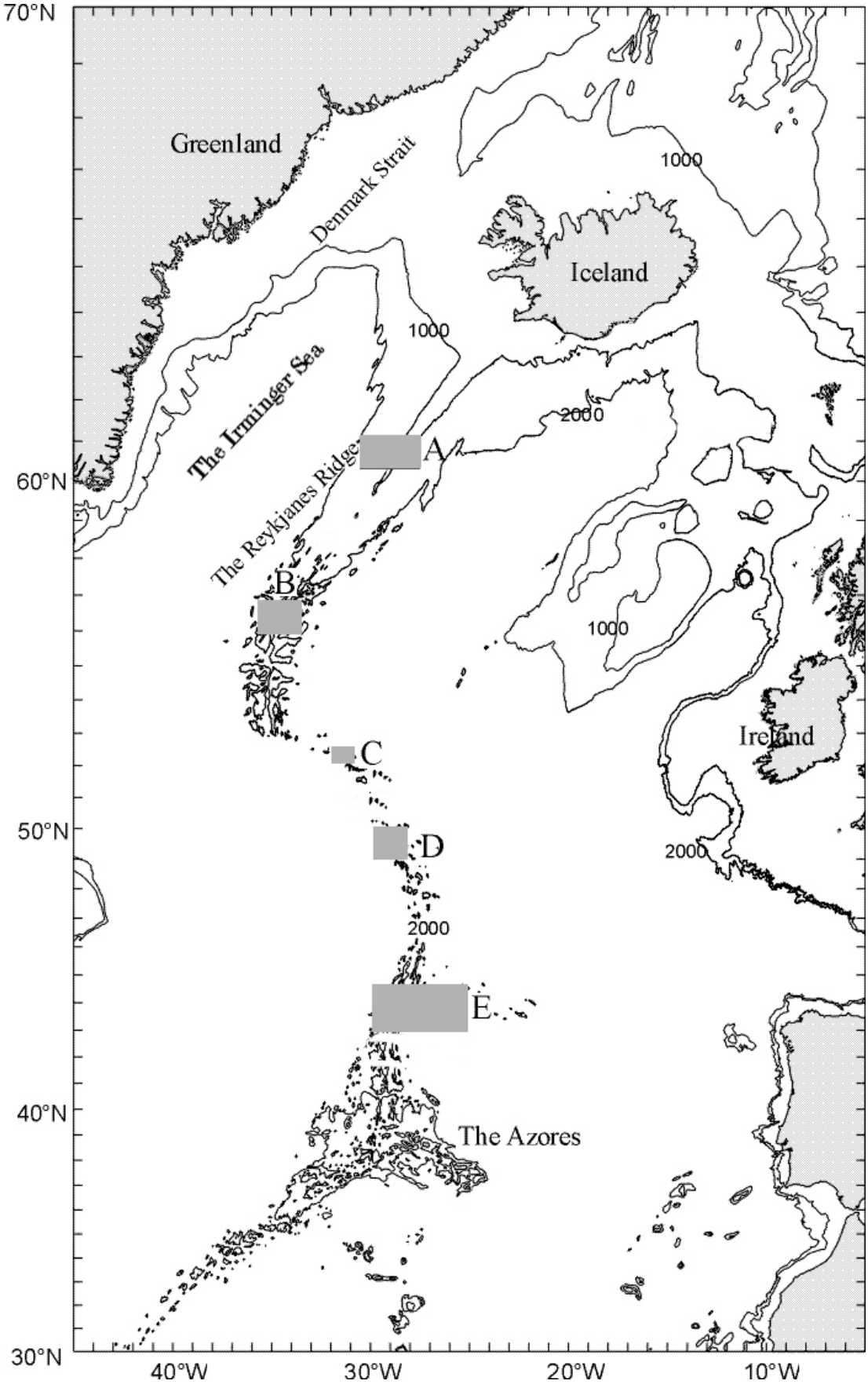


Figure 16.1 The North Atlantic with investigated areas A, B, C, D and E from which the information related to *Beryx spp.* has been obtained. (From EC-FAIR, 1999, p. 937. Møre Research, Norway).

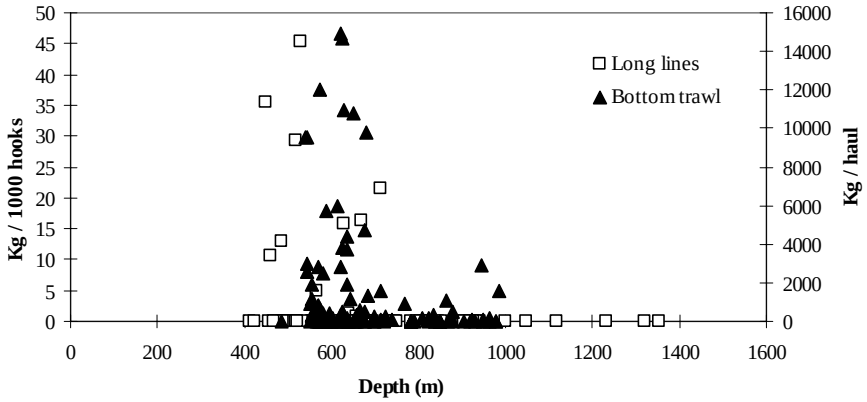


Figure 16.2 Catch per unit of effort for trawl and longlines from the Mid-Atlantic Ridge in 1993 (trawl) and 1996 (longline) for *Beryx splendens*. (From EC-FAIR, 1999, p. 938. Møre Research, Norway).

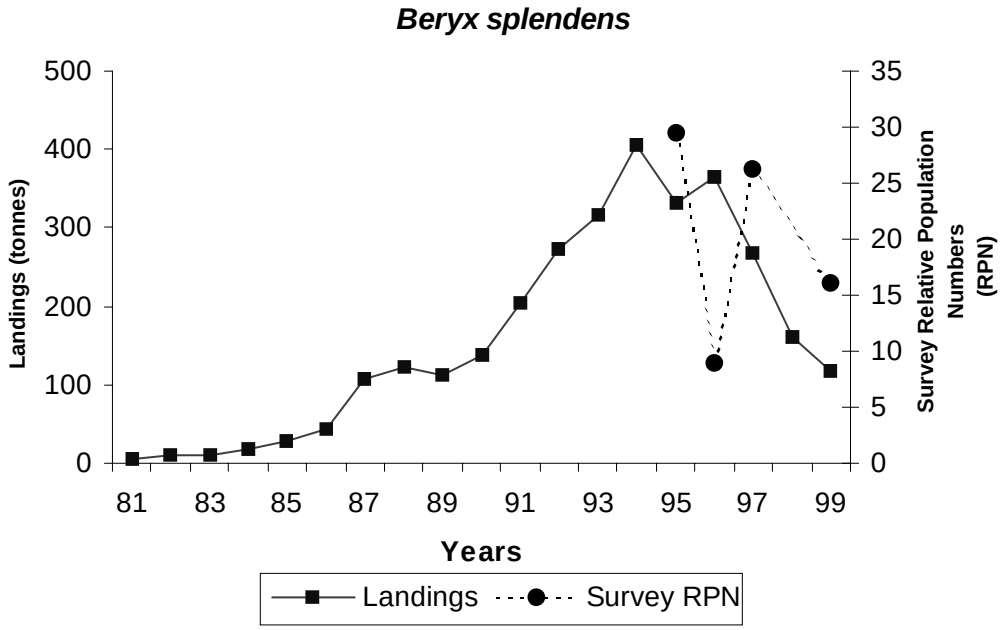


Figure 16.3 *Beryx splendens* landings and Relative Abundance Index (RPN) evolution from annual longline surveys in the Azores region (ICES Sub-Area X), in the period 1981-1999. (From Menezes *et al.* 1999).

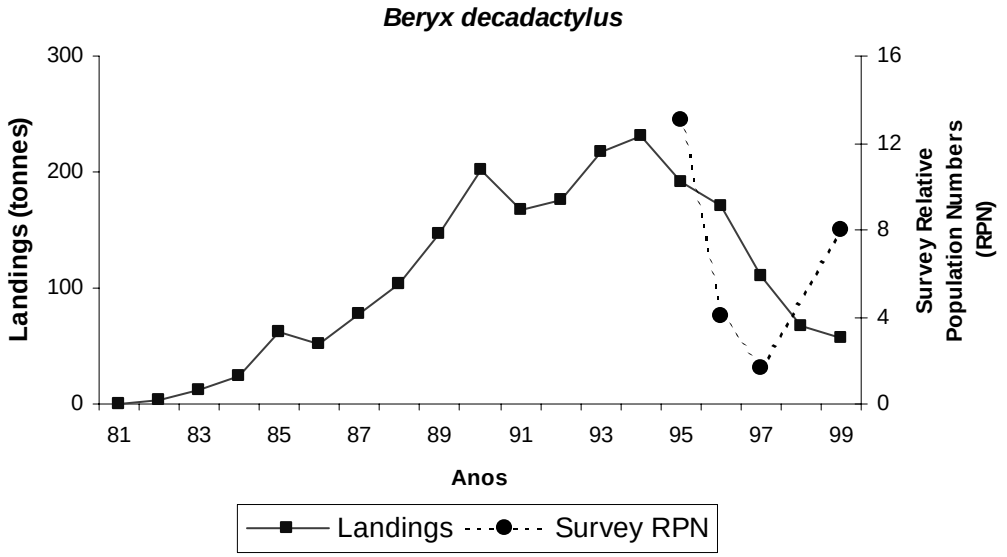


Figure 16.4 *Beryx decadactylus* landings and Relative Abundance Index (RPN) evolution from annual longline surveys in the Azores region (ICES Sub-Area X), in the period 1981-1999. (From Menezes *et al*. 1999).

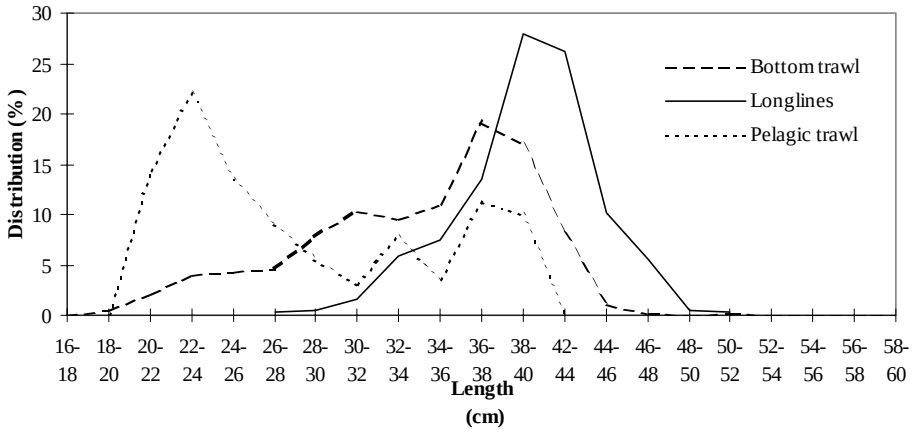


Figure 16.5 Length distributions (fork length) of *Beryx splendens* from bottom trawl, pelagic trawl and longline catches in the Mid-Atlantic Ridge area. (From EC-FAIR, 1999, p. 938. Møre Research, Norway).

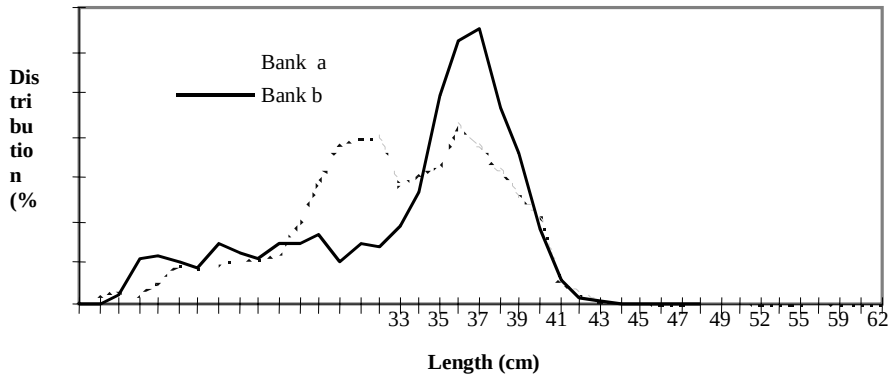


Figure 16.6 Length distributions (fork length) of *Beryx splendens* from bottom trawl catches on two different banks in the Mid-Atlantic Ridge area, 1993. (From EC-FAIR, 1999, p. 939. Møre Research, Norway).

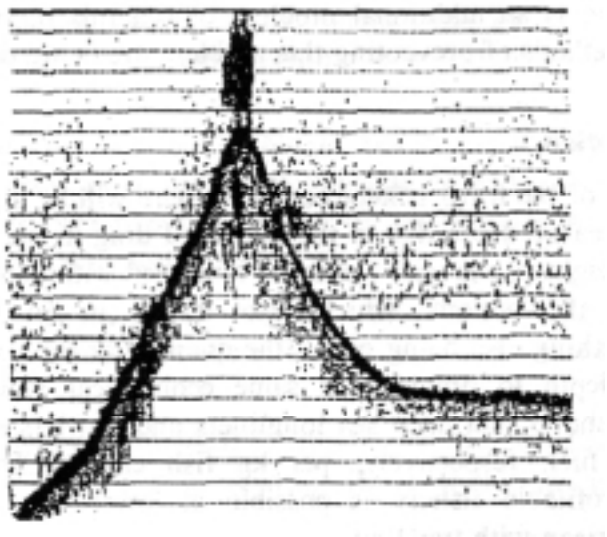


Figure 16.7 Shoal of *Beryx splendens* above an underwater mountain in the Mid-Atlantic Ridge area. (From EC-FAIR, 1999, p. 938. Møre Research, Norway).

17 DEEPWATER SQUALID SHARKS *CENTROPHORUS SQUAMOSUS* AND *CENTROSCYMNUS COELOLEPIS*

In 1998 the Study Group recommended that deepwater sharks and rays would be more appropriately placed in the Study Group on Elasmobranch Fishes (ICES CM 1998/ACFM:12). Although, no action was taken, the Study Group has maintained close contact with SGEF and it was decided that for this meeting that the Study Group should continue to deal with deepwater elasmobranchs, and in particular to catalogue what actual data are available and carry out assessments where possible. This data will be available to the Study Group on Elasmobranch Fishes. In 1999 an EU funded Concerted Action Programme developed a proposal for stock assessment of a limited number of elasmobranch species. Among the species considered where four deepwater sharks, *Centroscymnus coelolepis, Dalatias licha* and *Galeus melastomus*. Assessments of these species will be carried out as part of the EU funded DELASS study contract (See 2.4.5). The DELASS project shares members between SGDEEP and SGEF. Biological information on deepwater elasmobranchs has been compiled as part of the EC FAIR (1999). Further data on tagging, biological parameters as well as survey information will become available through the DELASS project.

17.1 Catch Trends

Landings of deepwater sharks reported to ICES are not given by species for all countries. Some countries report landings of some sharks separately and present statistics for sharks various for the remainder. Other countries report all shark landings in the "various sharks" category. ICES is in the process of updating landings statistics by species for some deepwater elasmobranch species. Landings of deep-water sharks classified as various are given in Table 17.1 and where possible the breakdown by species is given.

There have been no reported landings for Sub-areas I and II since 1990. The earlier landings were not identified to species, but were probably Greenland shark, *Somniosus microcephalus.*

Landings figures for Sub-areas III and IV may contain some deepwater species from the northern North Sea. Some French landings of *C. squamosus* and *C. coelolepis* are taken from the west of Sub-area IV, and have been the main component of the landings there. There has been a decline from the maximum of 130 t in 1992 to 30 t in 1999. Overall landings from Sub-areas III and IV have declined since 1992.

Landings of deepwater sharks in Division Va have increased somewhat from 30 t in 1989 to 70 t in 1997. However, the Icelandic catch includes Greenland sharks.

In Division Vb French, UK (English), German and Faroese vessels land squalids with the French accounting for most of the catch. Landings have fluctuated between a high of 470 t in 1993 and 260 t in 1995. French vessels have increased effort in Division Vb throughout the 1990s and this has been reflected in the landings.

The main fishery for deepwater sharks in the ICES area is in Sub-areas VI and VII. Overall, landings increased from very low levels to 2 900 t in 1997, increasing to 6 000 t in 1997. They have decreased to 3 000 t in 1999. France is the main participant with landings increasing from very low levels to 1,184 t in 1991 and increasing to 3 400 t in 1995 but declining to 1 000 t in 1999. French landings from Sub-area VII peaked in 1994 at Sub-area 1 000 t and have decreased to 500 t in 1999. In Sub Area VI French landings rose from 279 t in 1990, when squalids began to be landed to 2 500 t in 1996, and decreased to 1 400 t in 1999.

In Sub Areas VIII and IX catches were consistently high between 1998 and 1992 and were lower during the 1990s. Apart from the French landings it is not clear what component of these landings are deepwater species. Portuguese landings by species are available for Division IXa. Landings of *Centrophorus squamosus* have fluctuated around 400t per annum for most of the 1990s. *Centroscyllium coelolepis* figures are show some decline from 780t in 1995 to 550 in 1999.

Total catches of sharks in Sub-area X were stable around 3 000t from 1989 to 1992, but Spanish figures are not available for all years. The Azores had small landings of *C. squamosus* in 1998 and 1999.

In Division XIVb there are some reported German landings in 1997 and 1998, but it is not clear which species these might represent.

In Madeira landings have been stable for *C. squamosus*, with small catches of C. coelolepis in the mid 1990s.

17.2 Stocks

No information exists on the stock structure of any deepwater elasmobranch. Length frequency distribution revealed an absence of smaller individuals (Connolly and Kelly, 1996; Girard and Du buit, 1999; EC FAIR, 1999) which suggests that smaller and younger specimens occur outside the areas sampled to date. Furthermore no gravid *C. squamosus* have ever been recorded (Girard & Du Buit, 1999; Kelly *et al.* 1998), suggesting that parturition in this species occurs elsewhere. It would appear that these species, in common with other sharks range over wide areas.

17.3 Commercial CPUE and Research Surveys

In Sub-areas V,VI and VII a French CPUE time series, for *Centroscymnus coelolepis* and *Centrophorus squamosus*, from one fleet of large deepwater trawlers of similar size, power and technical specifications, is considered reliable for the period 1992 to 1999. The directed catch and effort from this fleet was analysed using a multiplicative regression model taking into account month and area effort. The annual standardised CPUE index from this model (Table17.2, Figure 17.1) were used as input for assessment using surplus production and constant recruitment models. The catch, for each trip of each trawler, in each statistical rectangle was considered to be directed at squalids if it represented more than 10 % of the total catch, and 20% of the total annual catch. Before 1992 the fishery was in the development phase and CPUE reflects this. It is clear from the series- that CPUE in Sub-area VI has declined most markedly, though the low value in CPUE before 1991 was probably due to lack of markets. CPUE in Sub-area VII increased slightly from 1991 to 1993 but has remained at the same level since 1993. In Sub-area V CPUE rose steadily until 1996 but has subsequently declined.

In Sub-areas VI and VII CPUE series from surveys (1995-1999) are available (Kelly *et al.* 1998, Clarke *et al.* in prep). On the Hatton Bank (Division VIb and Sub-area XII) CPUE, in kg per 1 000 hooks from a long line survey in 1999 are presented by Langedal and Hareide, (Working document) for *C. squamosus, C. coelolepis,* and several other squalid species For Sub-areas X and XII CPUE in kg/hour fished is given for *C. squamosus, C. coelolepis,* and other squalids by depth and area by Duran *et al.*(Working Document).

17.4 Length and age composition

Length frequencies from sampling in French ports in 1995 and 1996 are given in Figure 17.2. Figure 17.3 shows length frequency data for individual Irish surveys, 1995 to 1999. Data from two French surveys in 1996 and 1999 are given in Figure 17.4. for Sub areas VI and VII (and combined). Figure 17.5 shows length frequencies for Sub-areas VI and VII from Irish data. Girard and DuBuit (1999) give length frequencies for both species from French trawler fleets in Sub-areas VI and VII.

Unvalidated age estimates were obtained from dorsal spines of *Centrophorus squamosus* (Clarke *et al.* 1998b). Revised age estimates of 21 to 53 years for males and 24 to 68 years for females were obtained (Clarke unpublished data). Portuguese age estimation (EC FAIR, 1999) and work by Tanaka (1990), Guallart (1998) has been carried out using dorsal spines. In the Pacific validated ages from dorsal spines, of up to 80 years, for the related species *S. acanthias* were reported by McFarlane and Beamish (1987).

17.5 Biological parameters

Length weight regressions for *Centrophorus squamosus* in VI and VII in Sub-areas are as follows (Clarke unpublished data):

Sexes combined: $W = 0.002L^{3.31}$

Male: $W = 0.08L^{2.4}$

Female: $W = 0.001\ L^{3.31}$

for Centroscymnus coelolepis

Sexes combined: $W = 0.0005\ L^{3.57}$

Males: $W = 0.01\ L^{2.86}$

Females: $W = 0.0002\ L^{3.78}$

C. coelolepis is more fecund (ovarian fecundity between 8 and 22) than *C. squamosus* (7-11). Uterine fecundity in *C. coelolepis* is 8-19 (Girard and Du Buit, 1999).

Length at first maturity for *C. coelolepis* was 99 cm for females and 86 cm for males and for C. squamosus 98 cm for males and 120 cm for females (Girard and Du Buit, 1999). Total length at 50% maturity for male *Centrophorus squamosus* was determined as 103 cm, and for females as 133 cm. For *Centroscymnus coelolepis* total length at 50% maturity in males was 81 cm and 103 cm for females (Clarke, unpublished data). There is some information that parturition of *Centrophorus squamosus* takes place off Portugal.

17.6 Assessment

Little is known about the structure of deep-water shark stocks. Catches from Division Vb and Sub-areas VI and VII comprise mainly *C. coelolepis* and *C. squamosus* and although these species are widely distributed in the Atlantic, and possibly highly migratory, as an interim measure the assessment was done by treating deep-water sharks (all species) in Division Vb and Sub-areasVI and VII as a single assessment unit. Schaefer and DeLury analyses were attempted using total international landings data (all species) for the period 1989-98 and French trawl CPUE data for *C. coelolepis* and *C. squamosus* for the years 1991 and 1998.

An estimate of M is required for the DeLury model and calculations based on age estimation data using the relationship:-

$$M = \frac{\ln(100)}{\text{maximum age}}$$ (Annala and Sullivan, 1996)

gave an estimate of 0.08 for *C.squamosus.* M could not be estimated for *C. coelolepis* because age data are not available. Based on the age estimates it seemed reasonable to run DeLury with values of M of 0.05 and 0.1.

The fit from the DeLury model with natural mortalities of 0.05 and 0.1 was good for a range of error models, with log error giving a marginally better fit (R^2=0.9) (in ICES files). The results were reasonably robust for a range of values of ratio of initial stock to virgin stock (Tables 17.3 and 17.4). Prior to the development of a shark fishery in Division Vb and Sub-areas VI and VII, *C. squamosus* was caught as a by-catch in the blue ling fisheries in Division Vb and Sub-area VI and the redfish *(Sebastes mentella)* fishery in DivisionVb and discarded. It is believed that the quantities involved were not large and for DeLury model a ratio of initial to virgin stock of 0.9 was accepted (Figures 17.6 and 17.7). Virgin stock biomass is estimated to be between 50 000 and 62000 t (95% confidence limits : 45 000-71 000). Population biomass in 1998 is estimated to be between 20 000 and 25 000t, 40% of virgin biomass (95% confidence limits : 35-45%). All confidence limits were calculated by bootstrapping (included in ICES files).

The fit from the Schaefer model was good for a range of error models, with log error giving a marginally better fit (R^2=0.936) (in ICES files). Estimates of K and population in 1998 were reasonably robust for range of values of ratio of initial stock to virgin stock (Table 17.5). An initial ratio of 0.9 was selected for the reasons described for the DeLury model. A time-lag of zero was used as the data-series are too short to explore the effect of time-lag over a range of years commensurate to age of recruitment (age of recruitment around 21 years for *C. squamosus*). It was assumed, therefore, that growth rather than recruitment is the main contributor to biomass production. The results (Table 17.5 and Figure 17.8) indicate that carrying capacity is estimated to be around 74 000t (95% confidence limits: 37 000-93 000t). Population biomass in 1998 is estimated to be 29 000t, 40% of carrying capacity (95% confidence limits : 31 -80%). All confidence limits were calculated by bootstrapping (included in ICES files). MSY is estimated to be around 500t (95% confidence limits: 16–4152t).

17.7 Comments on assessment

Estimates of virgin biomass and population in 1998 from the DeLury and Schaefer analyses are quite similar at around 50-60 000t and around 20-30 000t respectively, although it should be noted that the confidence limits from Schaefer are very wide.

Estimates of MSY from the Schaefer model appear to be poorly estimated with extremely wide confidence limits.

The declining trend in French trawl CPUE in Division Vb and Sub-areas VI and VII is largely driven by a strong decline in Sub-area VI (Figure 17.1). *C. squamosus and C. coelolepis* show differing distributions by depth with peak catches-rates occurring at 1000m and 1300m, respectively. In Sub-area VI it is known that the French fleet has fished progressively deeper down to depths of 1500m (targeting other deep-water species as well as sharks), and it is possible that this may have introduced a bias in CPUE. However, it could also be argued that vessels have fished deeper and deeper because of falling catch-rates (of sharks, for example) in shallower depths. Catches of deep-water sharks were considerable in the early to mid-1990s. It is not possible to adjust for depth in the GLM model of CPUE because depth of fishing is not reported.

17.8 Management considerations

Our analyses indicate that current exploitable biomass (U) of deep-water sharks in Division Vb and Sub-areasVI and VII at the end of 1998 was below U_{pa} (50% of virgin biomass). However, the results presented in this assessment should be treated with caution because they are based on short time-series and little is known about the stock structure and migration of deep-water sharks in these areas. A possible bias in CPUE because of depth effects is also a concern.

It is known that *C. coelolepis* and *C. squamosus* are widely distributed in the Atlantic, and as more information becomes available it may be appropriate to carry out assessments of stock over a wider area, to include landings from Sub-area IX, for example.

Table 17.1 Study group estimates of landings of deep water sharks

Sharks various in I and II including Greenland shark

	Russia/USSR	France	**Total**
1988	37		**37**
1989	15		**15**
1990	0	1	**1**
1991	0		**0**
1992	0		**0**
1993	0		**0**
1994	0		**0**
1995	0		**0**
1996	0		**0**
1997	0		**0**
1998	0		**0**
1999	0		**0**

Sharks various in III and IV possibly including some deepwater species

	France*	Germany	UK (England)	UK (Scotland)	**Total**
1988	1	0	4	0	**5**
1989	0	0	2	14	**16**
1990	9	0	1	10	**20**
1991	3	5	4	5	**17**
1992	132	0	2	5	**139**
1993	51	4	2	6	**63**
1994	86	2	3	8	**99**
1995	30	1	2	6	**39**
1996	43	2	3	8	**56**
1997	3	2	68	18	**91**
1998	44	6	1	13	**64**
1999	34				**34**

* exclusively C. squamosus and C. coelolepis

Sharks various in Va including Greenland shark and other deepwater species

	Iceland*	Germany	**Total**
1988	0		**0**
1989	31		**31**
1990	54		**54**
1991	58		**58**
1992	70		**70**
1993	39		**39**
1994	42		**42**
1995	45		**45**
1996	65		**65**
1997	70		**70**
1998		1	**1**
1999			**0**

* includes Greenland shark

Table 17.1. (CONTINUED)

Sharks various in Vb including deepwater species

	Faroes	France**	Germany	UK (England)	**Total**
1990		140			**140**
1991	3	75			**81**
1992	36	121		5	**162**
1993	376	90	2	9	**477**
1994		149	43		**192**
1995		262			**262**
1996		348	31	1	**380**
1997		261	27	20	**308**
1998	79*	354			**433**
1999		284	1		**285**

* C. coelolepis exclusively

** C. coelolepis and C. squamosus exclusively

Sharks various in VI and VII including deepwater species

	Faroes	France*	Germany	Spain	Norway	UK(E+W)	UK(Scot)	**Total**
1988				66	0	19	0	**85**
1989					0	32	8	**40**
1990		302			0	38	5	**345**
1991		1184			0	201	53	**1438**
1992	3	2802			0	503	133	**3441**
1993		3426	124		0	821	447	**4818**
1994		3609	395		0	742	727	**5473**
1995		3417	2		0	1315	782	**5516**
1996		3284	276		0	1345	555	**5460**
1997		2984	66	152	0	2721	301	**6224**
1998		2567	65	645	0	1812	501	**5590**
1999		1939	189	199	13	1403	n/a	**3743**

* French landings figures given here are for C. squamosus and C. coelolepis exclusively.

Sharks various in VIII and IX including deepwater species

	Portugal*	Spain	France***	UK (E&W)	UK (Scotland)	**Total**
1988		3545				**3545**
1989		1789				**1789**
1990		N/a				**0**
1991		2850				**2850**
1992		3740	12	0	0	**3752**
1993			10		0	**10**
1994			9		4	**13**
1995			0	32	7	**39**
1996			0	25	0	**25**
1997		1059**	1	20		**1080**
1998		1811**	0			**1811**
1999		476**	0			**476**

* Detailed information on Portuguese landings in IXa given below

** Preliminary

*** C. coelolepis and C. squamosus exclusively

Table 17.1. (CONTINUED)

Shark landings by Portugal in IXa

	G. melastomus	C. granulosus	C. squamosus	D. licha	C. coelolepis	**Total**
1988	21	995	560	149	n/a	**1725**
1989	17	1027	507	57	n/a	**1608**
1990	17	1056	475	7	n/a	**1555**
1991	17	577	420	12	n/a	**1026**
1992	16	683	421	11	n/a	**1131**
1993	20	555	338	11	n/a	**924**
1994	37	169	577	11	n/a	**794**
1995	29	193	544	7	784	**1557**
1996	35	122	411	4	757	**1329**
1997	29	188	356	4	841	**1418**
1998	22	147	357	6	840	**1372**
1999	23	92	428	6	544	**1093**

Sharks various in X including some deepwater species

	Portugal	Spain	**Total**
1988	549		**549**
1989	560	1583	**2143**
1990	602		**602**
1991	896	2072	**2968**
1992	761	2719	**3480**
1993	592	n/a	**592**
1994	n/a	n/a	**0**
1995	925	n/a	**925**
1996	901	n/a	**901**
1997	829	n/a	**829**
1998	957	n/a	**957**
1999	n/a	n/a	

Landings of C. squamosus and D. licha in X by the Azores

	C. squamosus	D. licha	**Total**
1988		549	**549**
1989		560	**560**
1990		602	**602**
1991		896	**896**
1992		761	**761**
1993		591	**591**
1994		309	**309**
1995		321	**321**
1996		216	**216**
1997		30	**30**
1998	4	34	**38**
1999	8	31	**39**

Table 17.1. (CONTINUED)

Sharks various in XII including deepwater species

	Spain	Franc*	**Total**
1988			
1989			
1990			
1991		1	**1**
1992		2	**2**
1993		6	**6**
1994		8	**8**
1995		139	**139**
1996		147	**147**
1997		32	**32**
1998	1050**	56	**1106**
1999	1018**	45	**1063**

* C. coelolepis and C. squamosus exclusively

** Preliminary

Landings of C. squamosus and C. coelolepis at Madeira

	C. squamosus	C. coelolepsis	**Total**
1990	22		**22**
1991	10		**10**
1992	31		**31**
1993	14	16	**30**
1994	5	15	**20**
1995	27	1	**29**
1996	14	0	**14**
1997	17		**17**
1998	28		**28**
1999	20		**20**

Sharks various in XIVb possibly including some deepwater species

	Germany	Total
1997	9	9
1998	15	15

Study Group estimates of shark catches for each Sub area and combined.

Year	II and II	II and IV	Va	Vb	Vi and VII	VIII and IX	IXa (Portugal - deep species)	X	X (Azores only)	XII	XIVb	Madeira	Total ICES Area	Total all areas
1988	37	5	0		85	3545	1725	549	549				**6495**	**6495**
1989	15	16	31		40	1789	1608	2143	560				**6202**	**6202**
1990	1	20	54	140	345		1555	602	602			22	**3297**	**3319**
1991	0	17	58	81	1438	2850	1026	2968	896	3864		10	**13188**	**13198**
1992	0	139	70	162	3441	3752	1131	3480	761	4241		31	**17146**	**17177**
1993	0	63	39	477	4818	10	924	592	591	1183		30	**8667**	**8697**
1994	0	99	42	192	5473	13	794		309	309		20	**7211**	**7231**
1995	0	39	45	262	5516	39	1557	925	321	1246		29	**9921**	**9950**
1996	0	56	65	380	5460	25	1329	901	216	1117		14	**9535**	**9549**
1997	0	91	70	308	6224	1080	1418	829	30	859	9	17	**10901**	**10918**
1998	0	64	1	433	5590	1811	1372	957	38	1106	15	28	**11359**	**11387**
1999	0	34	0	285	3743	476	1093		39	1063		20	**6713**	**6733**

Table 17.2. Deepwater sharks, directed catch and effort and standardised CPUE from a reference fleet of trawlers in ICES Divison Vb and sub-areas VI and VII

ICES sub-area	Year	Total international catch (t) (1)	Data for the reference fleet (2) Directed Catch (t)	Directed effort (hours)	Standardised cpue (kg/h)
Vb	90	140	59	600	92
Vb	91	81	41	313	127
Vb	92	162	97	774	110
Vb	93	477	72	439	148
Vb	94	192	110	640	171
Vb	95	262	172	929	149
Vb	96	380	247	1412	169
Vb	97	308	183	1745	95
Vb	98	433	325	3920	84
VI	90		159	944	143
VI	91		692	2627	255
VI	92		721	3440	189
VI	93		757	4846	148
VI	94		539	4166	128
VI	95		486	5023	94
VI	96		386	4869	75
VI	97		428	5036	81
VI	98		320	4933	63
VII	90		0	0	
VII	91		168	2138	84
VII	92		551	6305	87
VII	93		560	5117	107
VII	94		731	6810	104
VII	95		625	5941	104
VII	96		333	3384	97
VII	97		184	2028	90
VII	98		228	2504	88
Combined	90	345	218	1544	114
Combined	91	1438	901	5078	167
Combined	92	3441	1369	10519	126
Combined	93	4818	1389	10402	135
Combined	94	5473	1380	11616	126
Combined	95	5516	1283	11893	111
Combined	96	5460	966	9665	95
Combined	97	6224	795	8809	87
Combined	98	5590	873	11357	73

(1) : may include various sharks in some years
(2) : data for Centrophorus squamosus and Centroscymnus coelolepis combined.

Table 17.3. Deep-water sharks in Sub-areas Vb,VI & VII. DeLury model (M=0.05)

Ratio	K (nos)	q	Pop (nos)	K(tonnes)	Pop(tonnes)	Pop /K
1.0	7298682	0.00000258	3175672	59119	25772	0.43
0.9	7631086	0.00000267	3068387	61812	24854	0.40
0.8	7980396	0.00000279	2937101	64641	23791	0.37

Note Popns are for the final year 1998

Table 17.4 . Deep-water sharks in Sub-areas Vb,VI & VII. DeLury model (M=0.1)

Ratio	K (nos)	q	Pop (nos)	K(tonnes)	Pop(tonnes)	Pop /K
1.0	6136727	0.00000304	2641238	49707	21394	0.43
0.9	6176884	0.00000322	2476787	50033	20062	0.40
0.8	6192731	0.00000346	2285952	50161	18516	0.37

Note Popns are for the final year 1998

Table 17.5 Deep-water sharks in Sub-areas Vb,VI andVII. Schaefer model

Schaefer	Time lag=0					
Ratio	K (tonnes)	q	r	MSY	Pop (tonnes)	Pop /K
1.0	67738	0.00000227	0.031	533	30329	0.45
0.9	72579	0.00000234	0.03	542	29203	0.40
0.8	55191	0.00000321	0.157	2164	21695	0.39

Note : Popn values are for the final year 1998

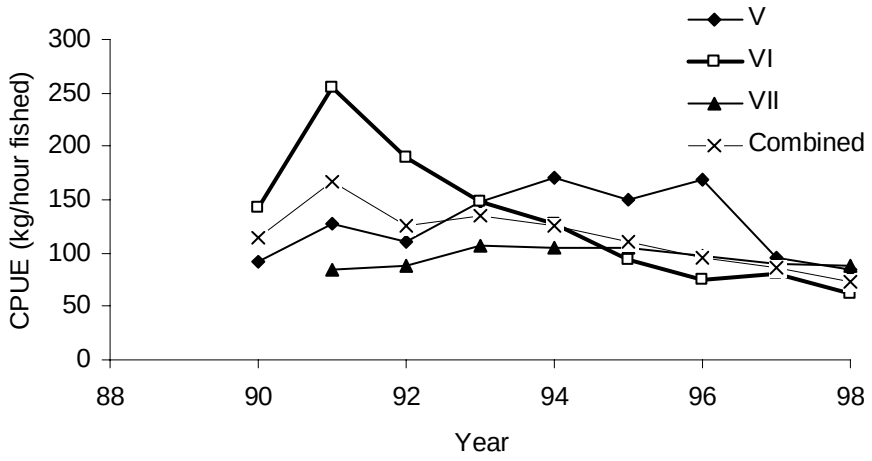
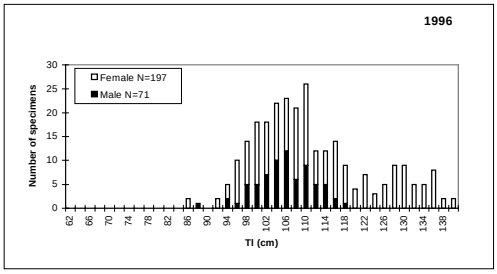
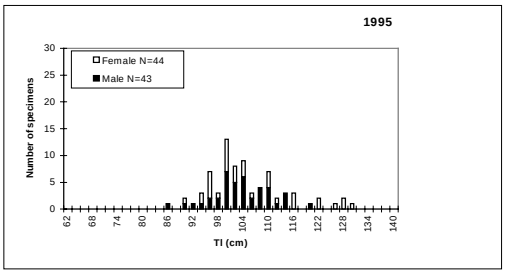


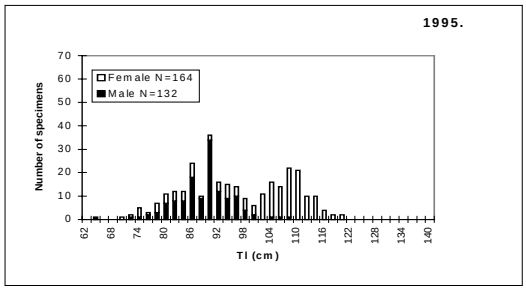
Figure 17.1 CPUE series, kg/hour fished from French reference fleet of trawlers in IVES Division Vb, Sub-area VI and VII and for all 3 combined.

Centrophorus squamosus





Centroscymnus coelolepis



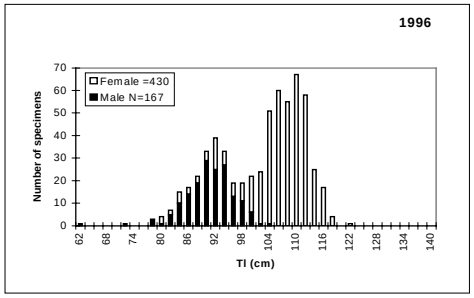


Figure 17.2. Length frequencies from port samples of landings of *C. squamosus* and *C. coelolepis* in France in 1995 and 1996.

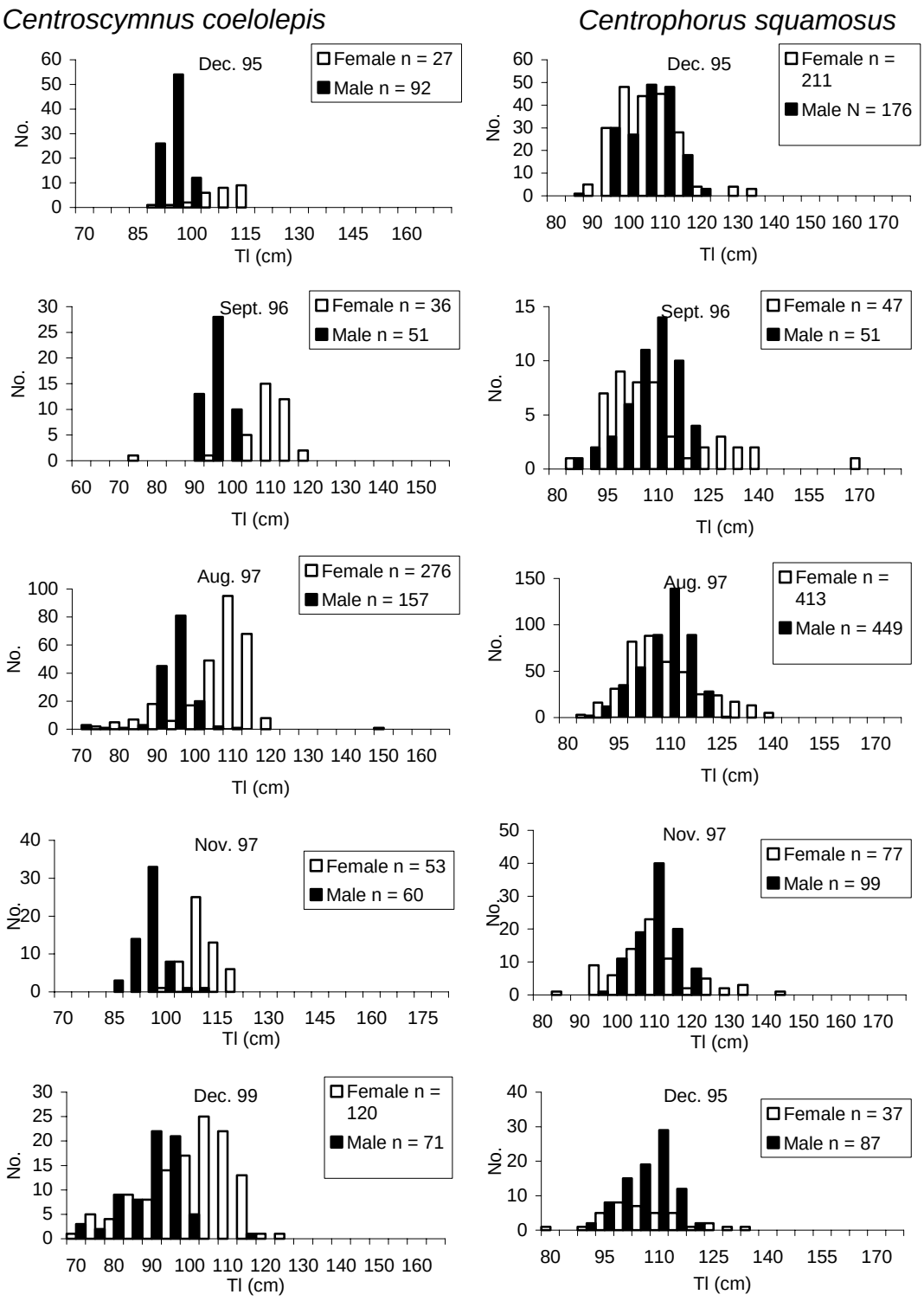


Figure 17.3 Length frequencies from Irish surveys 1995 to 1999 for *Centroscymnus coelolepis* (left) and *C. squamosus* (right).

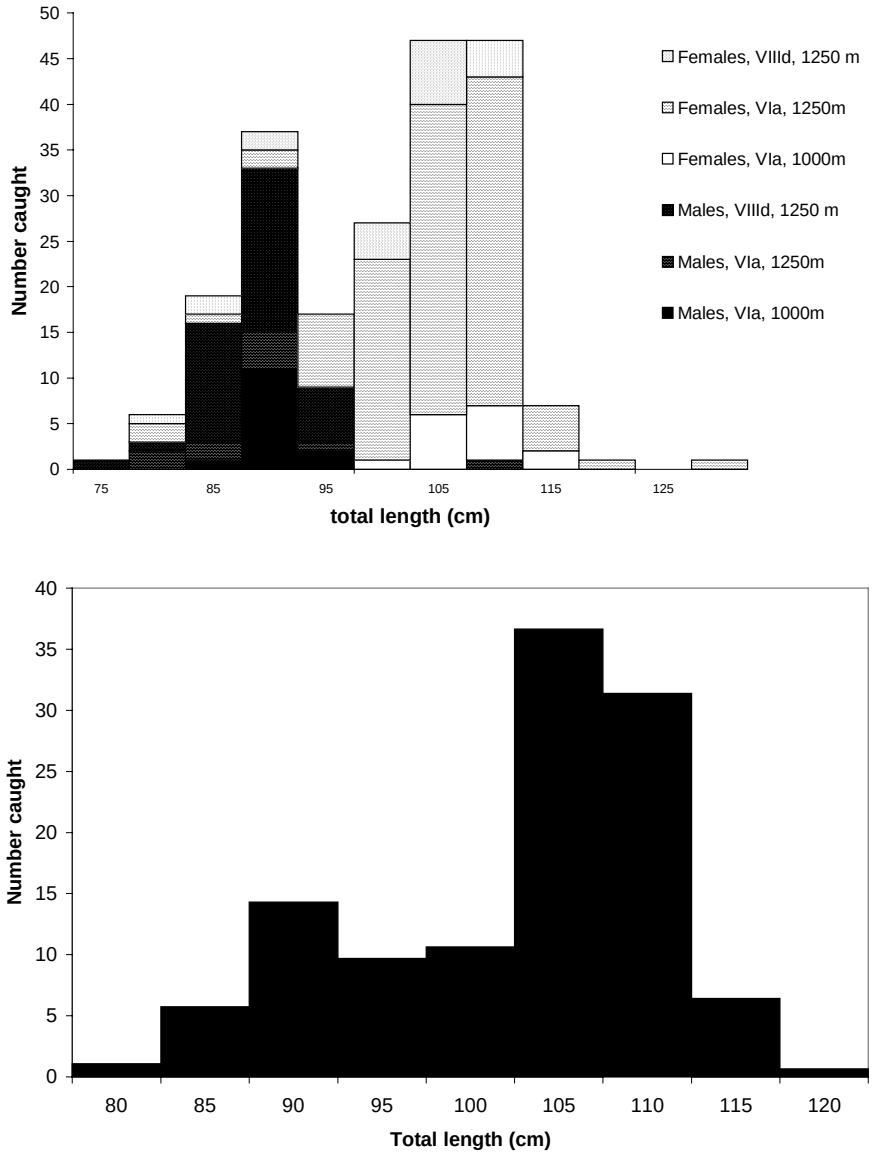


Figure 17.4 Length frequencies for C. coelolepis from 1999 French trawl survey (above) and 1996 French trawl survey (below).

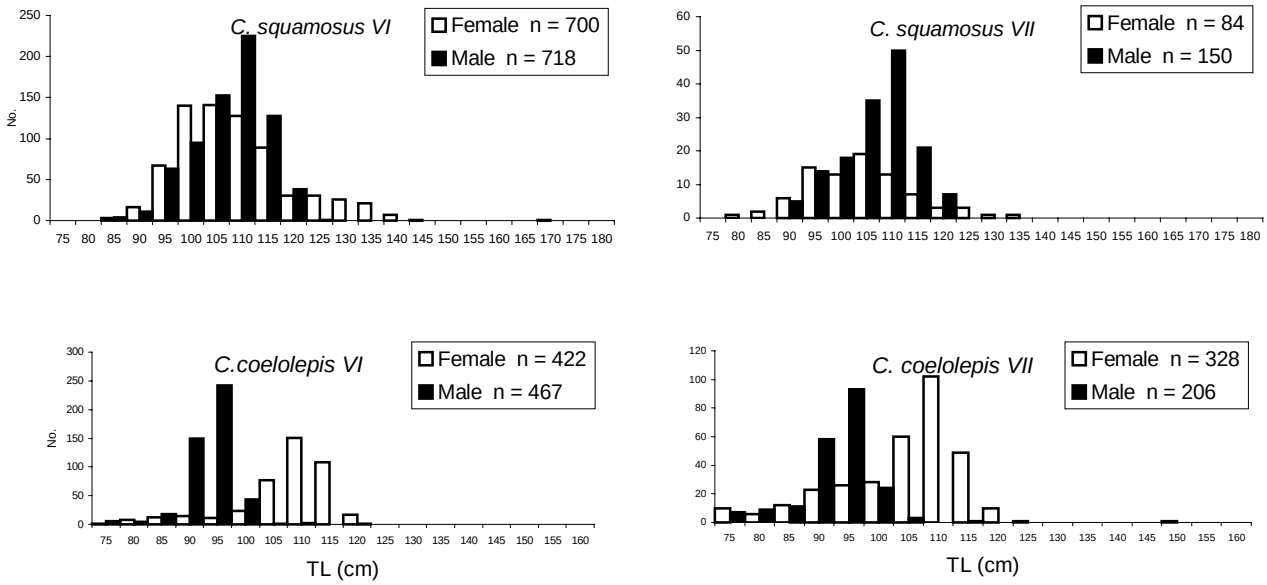


Figure. 17.5 Length frequencies for *C. squamosus* and *C. coelolepis* from Irish surveys (1995 to 1999 combined) for VI and VII

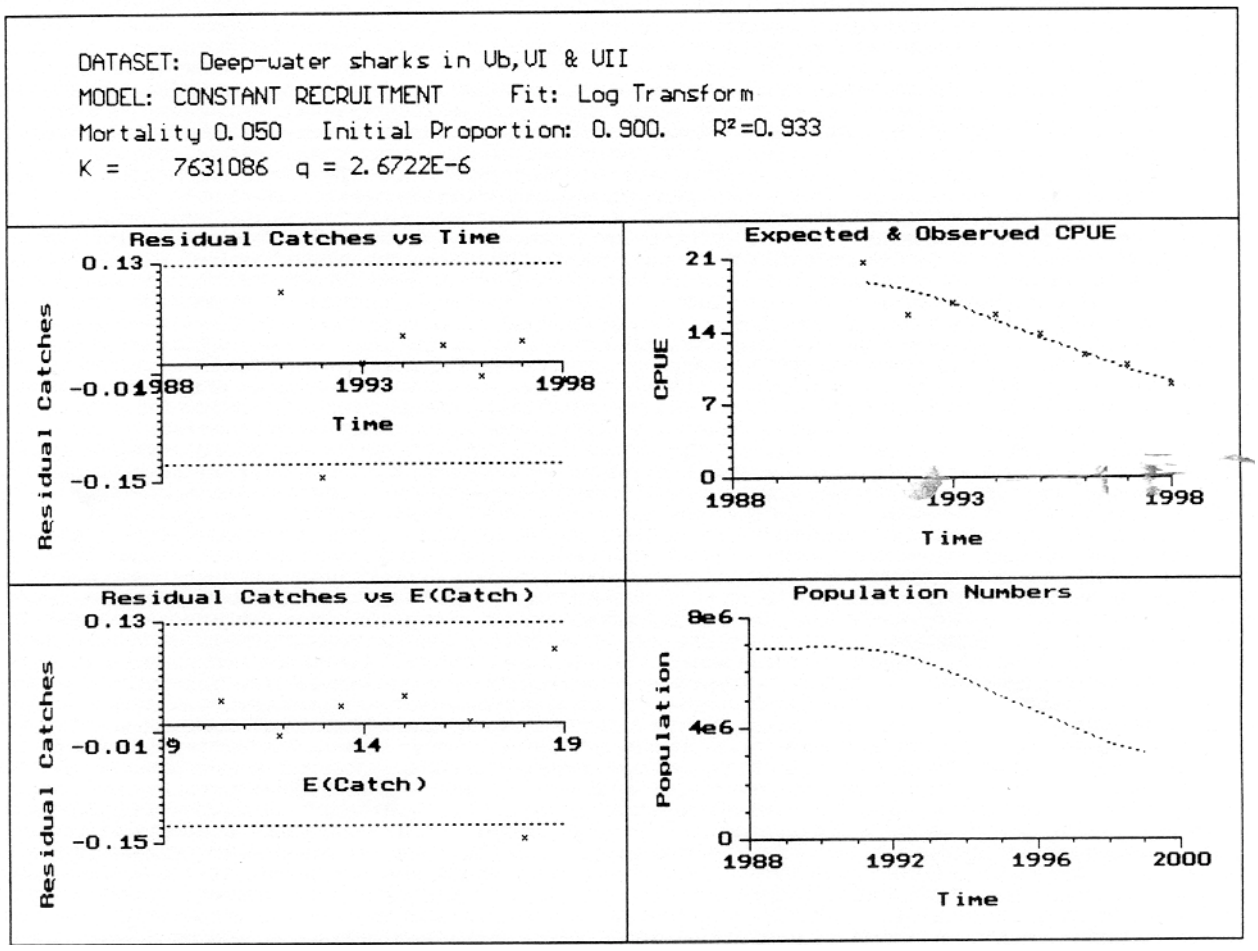

DATASET: Deep-water sharks in Vb,VI & VII
MODEL: CONSTANT RECRUITMENT Fit: Log Transform
Mortality 0.050 Initial Proportion: 0.900. R²=0.933
K = 7631086 q = 2.6722E-6
Residual Catches vs Time
Residual Catches
0.13
-0.01
-0.15
1988
1993
1998
Time
Expected & Observed CPUE
CPUE
21
14
7
0
1988
1993
1998
Time
Residual Catches vs E(Catch)
Residual Catches
0.13
-0.01
-0.15
9
14
19
E(Catch)
Population Numbers
Population
8e6
4e6
0
1988
1992
1996
2000
Time

Figure 17.6

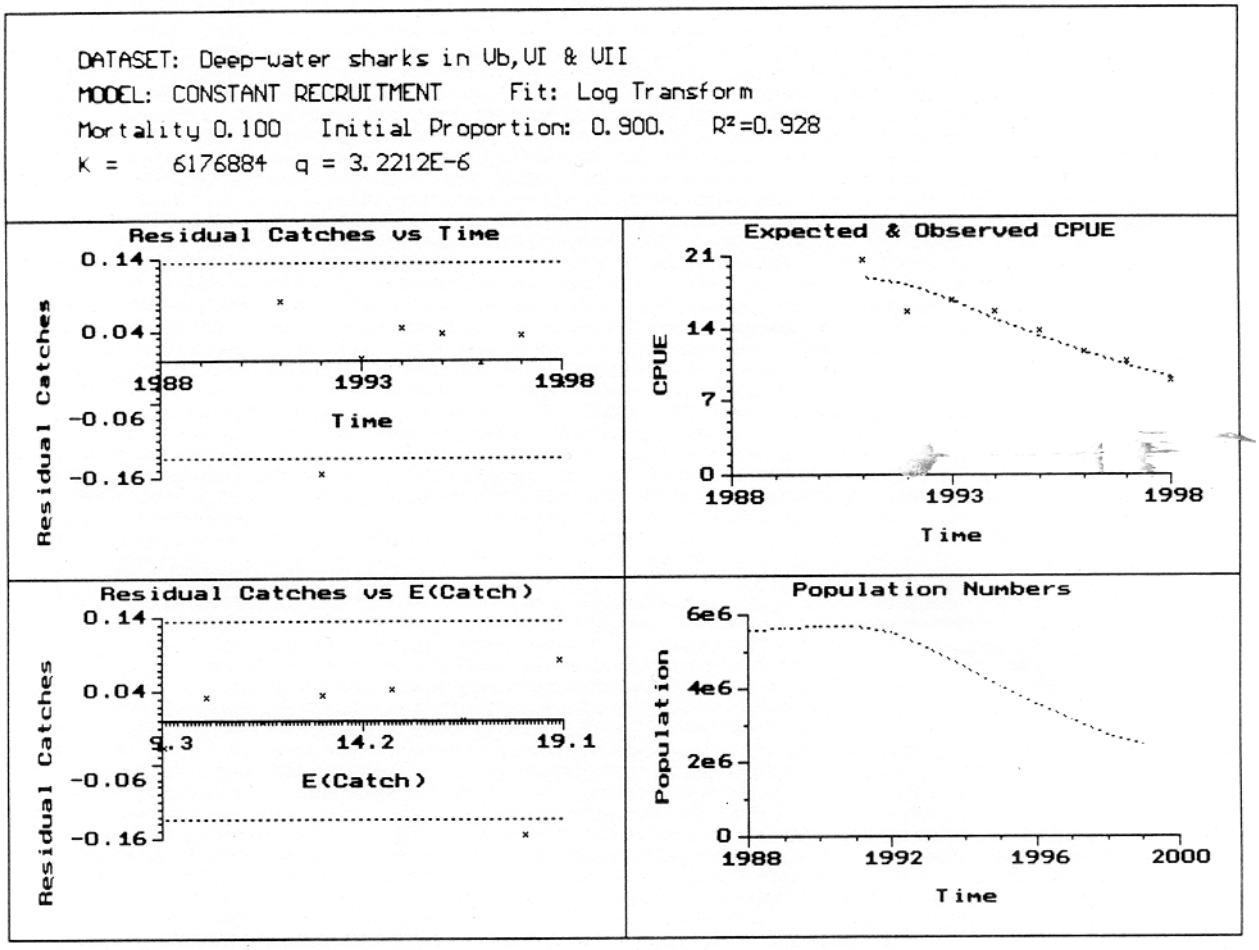

DATASET: Deep-water sharks in Vb,VI & VII
MODEL: CONSTANT RECRUITMENT Fit: Log Transform
Mortality 0.100 Initial Proportion: 0.900. R²=0.928
K = 6176884 q = 3.2212E-6
Residual Catches vs Time
Residual Catches
0.14
0.04
-0.06
-0.16
1988
1993
1998
Time
Expected & Observed CPUE
CPUE
21
14
7
0
1988
1993
1998
Time
Residual Catches vs E(Catch)
Residual Catches
0.14
0.04
-0.06
-0.16
9.3
14.2
19.1
E(Catch)
Population Numbers
Population
6e6
4e6
2e6
0
1988
1992
1996
2000
Time

Figure 17.7

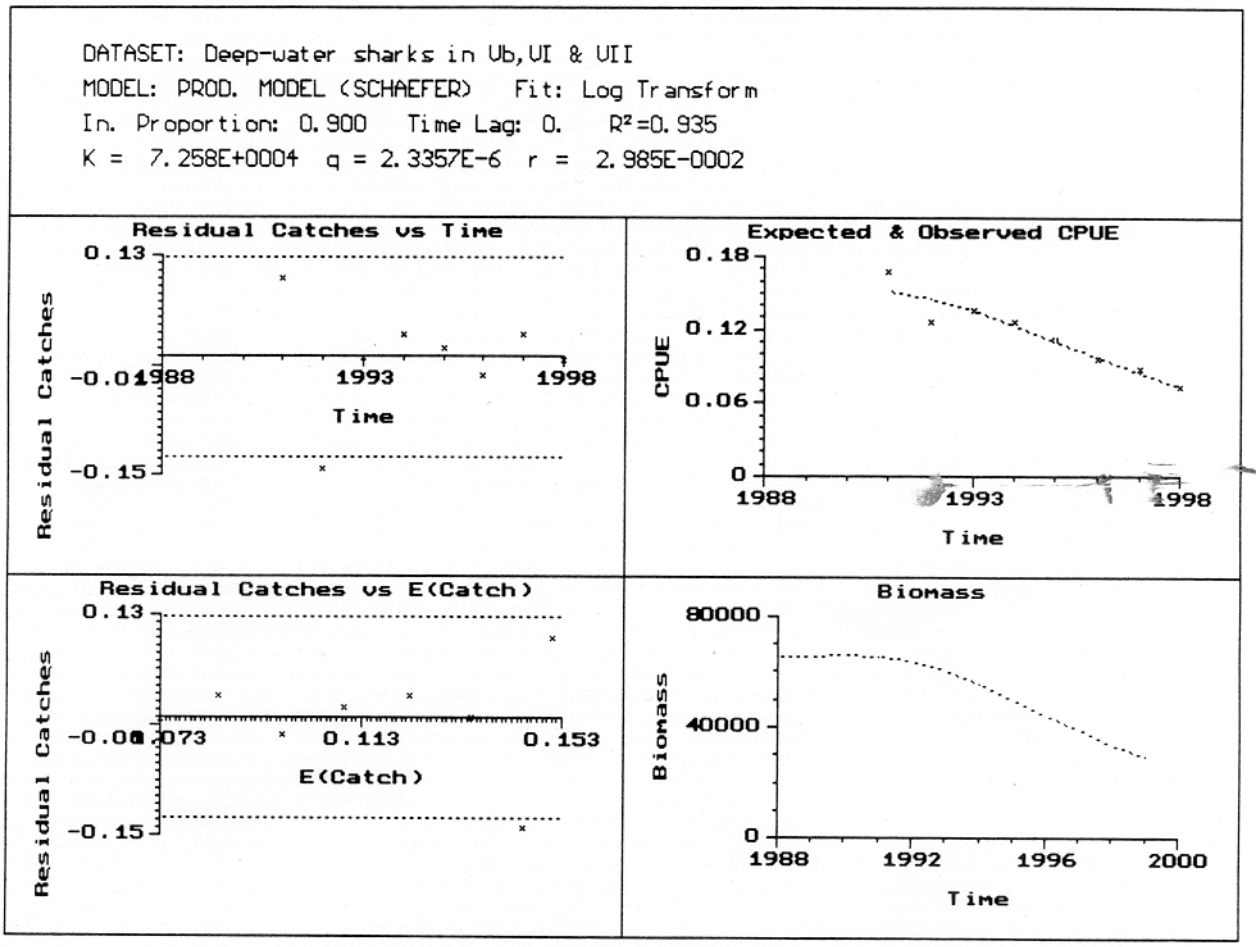

DATASET: Deep-water sharks in Vb,VI & VII
MODEL: PROD. MODEL (SCHAEFER) Fit: Log Transform
In. Proportion: 0.900 Time Lag: 0. R²=0.935
K = 7.258E+0004 q = 2.3357E-6 r = 2.985E-0002
Residual Catches vs Time
Residual Catches
0.13
-0.01
-0.15
1988
1993
1998
Time
Expected & Observed CPUE
CPUE
0.18
0.12
0.06
0
1988
1993
1998
Time
Residual Catches vs E(Catch)
Residual Catches
0.13
-0.01
-0.15
0.073
0.113
0.153
E(Catch)
Biomass
Biomass
80000
40000
0
1988
1992
1996
2000
Time

Figure 17.8

18 OTHER SPECIES

This section will consider only bycatch and/or discard species not specifically dealt with under Sections 7 to 17.

Much of the new biological and other information gathered since the last report of the Study Group in 1998 (C.M. 1998/ACFM:12) originates from the recently completed multinational EC FAIR Project (95/655) entitled *Developing deep-water fisheries: data for their assessment and for understanding their interaction with and impact on a fragile environment* which is described in Section 2.3.1 and by Gordon (1998 a, b). The results are summarised in the final report (EC FAIR, 1999). Most of the information will soon become freely available on a web-site and in publications by the individual partners, if not already published.

18.1 Research and Exploratory Surveys

18.1.1 France

A deep-water, bottom-trawling cruise of the *Thalassa* was carried out in April 1999. Two areas, west of Brittany at 47° N and west of Ireland and Scotland from 55 to 56° N were sampled at depths from 930 to 1360 m and around 2000 m. A total of 34 tows were carried out (Table18.1). All the species were counted weighed and measured. A total 121 species were recorded. Length distributions of the main species were available to the study group for assessment purposes.

18.1.2 Germany

Germany has not carried out deep-water research activities or sampling in recent years. Historical German research data on deep-water, bottom trawl surveys that were undertaken from 1974 to 1986 by the FRV *Walther Herwig*, mainly in the Rockall Trough area, have been reworked and analysed (EC FAIR, 1999). These data are available to the Study Group and for assessment purposes. A total of 207 demersal or benthopelagic fish species were identified and of these 32 were chosen for more detailed study (Table 18.2).

18.1.3 Greenland

A trawling survey for Greenland halibut (*Reinhardtius hippoglossoides*) was carried out by the RV *Paamiut* off east Greenland (ICES Division XIVb) in June/July 1999 between 60° and 67° N (Jørgensen, Working Document). The survey area was divided into six sub-areas and six depth strata between 400 and 1500 m. There were 54 successful hauls which caught 82 different species or groups of species. Biomass and abundance estimates have been calculated for Greenland halibut, Deep-sea redfish (*Sebastes mentella*), golden redfish (*Sebastes marinus*), roundnose grenadier (*Coryphaenoides rupestris*) and roughhead grenadier (*Macrourus berglax*).

18.1.4 Iceland

The most comprehensive data are from seven deep-water surveys in the 1990s (Magnússon *et al.*, 1997b, 1998; EC FAIR, 1999). Three of these were deep-water groundfish surveys on the Reykjanes Ridge. Two of them (S1/93 and B3/93) were carried out simultaneously, in March 1993 and the other (KA1/97) was in June-July 1997. The remaining four surveys were carried out with the main objective of investigating Greenland halibut (*Reinhardtius hippoglossoides*): one (TJ1-92) off West Iceland, the other three (TM3-96, TBR2-97, and TBR2-98) all around Iceland. Surveys before 1990 were of many kinds, which included variable numbers of deep-water hauls. Some had a definite target species, others were of a more general nature and yet others were opportunistic.

Many of the older records do not contain much biological information, e.g. information on maturity is mainly from relatively recent observations (mostly since 1990), except for those fish of direct commercial interest. However, the older data give valuable information on the distribution and abundance of deep-water species.

The material was almost exclusively collected with bottom trawls from both research vessels and commercial trawlers. The collection of material on board commercial trawlers took place during cruises on chartered trawlers, by collectors or fisheries inspectors on fishing trips and by skippers collecting frozen samples. On research vessel cruises and cruises on chartered trawlers, the codend was lined with fine-meshed net (35-40 mm). On other trips, the prescribed 135 mm mesh size in the codend was used.

33 deep-water species (Table 18.2) were selected for detailed analysis under the following headings:

- Distribution and relative abundance.
- Depth distribution by size and in most cases by sex.

- Length distribution by sex in most cases.
- Length/weight relationship.
- Information on maturity.

These 33 species were selected by using the following criteria:

- Species which were already, or were in the process of becoming, commercially important.
- Species which were considered to be of potential commercial value in the near future e.g. species which were of important commercial value elsewhere but had not been exploited in Icelandic waters to date, e.g. *Aphanopus carbo.*
- Other species occurring in considerable numbers and/or are of particular general biological interest.

Another objective of the Icelandic participation in the EU FAIR Deep-fisheries project was to screen all survey data on non-target deep-water fish species from 1975 onwards and to enter those that had not been computerised into a computer database.

Out of at least 87 cruises conducted by the MRI where deep-water fishes were recorded in the period 1975-1997, 29 cruises were either primarily or secondarily directed to deep water. In the remaining 58 cruises, deep-water fish species were caught occasionally or incidentally. In about 45 cruises, specimens had been recorded as counted without any biological measurements. Those cruises are not listed in this report. Most of the surveys were focused on commercially exploitable stocks such as Greenland halibut (*Reinhardtius hippoglossoides*) and deep-sea redfish (*Sebastes mentella*), i.e. on species that are of direct commercial interest to the fishery. In some surveys, the main target was a species of particular potential interest to the fishery such as roundnose grenadier (*Coryphaenoides rupestris*) and blue ling (*Molva dypterygia*). In other surveys, research on deep-water species was only secondary to the main task and during some surveys, occasional single incidental hauls were taken in deep water.

Species which had been commercially exploited for a long period of time *i.e.* at least 10 to 20 years were excluded. These species *e.g.* Greenland halibut (*Reinhardtius hippoglossoides*) and deep-sea redfish (*Sebastes mentella*) have been sampled and dealt with in the regular research programmes of the MRI. Also excluded were species such as ling (*Molva molva*), tusk (*Brosme brosme*), and monkfish (*Lophius piscatorius*) which appear in deep water but are more common in shallower waters and are bycatch species. All other species which inhabit depths > 400 m were included. Of those species, some have been or are occasionally target species for the commercial fishery such as orange roughy (*Hoplostethus atlanticus*), blue ling (*Molva dypterygia)* and greater silver smelt (*Argentina silus*).

All the data are stored in the ORACLE database of the MRI and an overview of the data available is given in EC FAIR, 1999

18.1.5 Ireland

A brief summary of Irish exploration and research dating back to the 19th Century is given in EC FAIR,1999. In the early 1990s, the focus of European deep-water research began to shift from exploitation, species description and distribution, to studies on the life history, population dynamics and ecology of deep-water fish. In line with these developments, the Marine Institute, Fisheries Research Centre (MIFRC) commenced a deep-water sampling programme, in the Rockall Trough in 1993, funded primarily by the EU STRIDE initiative. To date, 17 research surveys (Table 18.3) have focused on five areas in the Rockall Trough over the depth range 500 to 2925 m (Connolly and Kelly, 1994; 1997; Kelly *et al.* 1997b; Connolly *et al.* 1998; Clarke *et al.* 1998; Connolly, 1997; Clarke, 1997; Lordan, 1998; Clarke *et al.* 1999; Clarke 1999; Clarke *et al.* in prep). The main objective of these surveys has been to assess the abundance and distribution of deep-water species, carry out preliminary discard work and to secure samples for the life history programme and a food quality programme. This work has been published (Gormley *et al.* 1994; Kelly *et al.* 1996; Connolly and Kelly 1996; Kelly *et al* 1997a; Maier *et al.* 1997). In addition, a new programme on contaminant analysis commenced in 1998. A dedicated deep-water Access database has been constructed for all the Irish deep-water data (EC FAIR, 1999).

18.1.6 Norway

The Norwegian deep-water fishery with trawlers and longliners is wide ranging in the North Atlantic. Considerable exploratory fishing has been carried out on the Mid-Atlantic Ridge, the Reykjanes Ridge, Hatton Bank and the slope off East Greenland in recent years, but thus far new fisheries only developed in the latter area and these primarily target redfish and Greenland halibut. New information on distribution, length compositions, size at maturity etc. of various deep-water species, mainly collected as part of exploratory fisheries, has been described as a contribution to EC FAIR, 1999. This report documents surveys up to 1997 (Table 18.4).

Since then two further surveys have been carried out on the northwestern slope of the Hatton Bank (Area VIa); a trawl survey in August and September 1998 (Langedal and Hareide, 1998) and a longline survey in September 1999 (Langedal and Hareide, 1999, and Working Document). The results of these two surveys conducted in the same area and depth range illustrate the pronounced difference in species selectivity between these gear types (Ref. Tables 6.2, 6.3 and 6.4). On longlines, about 80% of the catch was sharks, and Greenland halibut, blue ling, *Mora moro*, and tusk were the species dominating the teleostean fraction. In contrast, trawl catches were comprised of 50 % *Coryphaenoides rupestris* and 20 % *Alepocephalus bairdii*. Of all the sharks caught by longlines, only *Centroscymnus coelolepis* contributed significantly to trawl catches (10%). Considerable gear-specific by-catches of a range of species, including many which are not presently marketable, should thus be expected if new fisheries by either trawl or longline develop in these areas. In the 1999 and 1998 experimental longline and trawl fishery, 36 and 49 % respectively, of the catch was not considered to be marketable.

The longline catches of Greenland halibut, blue ling, and tusk on the Hatton Bank slope consisted of relatively large fish compared with what is usual in traditional longlining areas, indicating that the populations on the Hatton Bank slope hitherto have been lightly exploited. Depth-stratified catch per unit of effort data, length compositions and other biological information were presented for a range of the species caught on longline in the working document by Langedal and Hareide (2000). Most detailed data were provided for *Centrophorus squamosus, Centroscymnus coelolepis, Centroscymnus crepidater, Deania calceus*, blue ling, tusk, and *Mora moro.*

18.1.7 Portugal

Portugal, Mainland

The study of the distribution, abundance and population dynamics of the main deep-water resources off the Portuguese continental slope began in 1994. An earlier survey programme for crustaceans was adapted and the surveyed area was extended to deeper and more northern areas. The Portuguese continental coast was divided into five sectors and sub-sectors that were sampled by a stratified sampling program (EU FAIR, 1999).

The biomass estimates from a research survey to the Algarve region in 1998 are given in Figueiredo *et al.* (Working Document). There were no surveys in 1999.

Portugal, Acores

A summary of recent research vessel, commercial exploratory cruises and observer trips is given in Table 18.5.

Some biological and ecological information resulting from investigations under the EEC DG-XIV Study Contracts (94/034; 95/032; 95/095), have become available since the 1996 Study Group report (ICES CM 1986/Assess:8). These are age and growth parameters and size/age at first maturity for several deep-water species with higher commercial importance.

Ageing studies of deep-water sharks caught in the cruise surveys were attempted using several techniques under de EEC DG-XIV Study Contracts (95/032). For almost all species ageing was not possible (Menezes & Pinho, pers. comm.).

Since 1998 annual surveys directed towards demersal and deep-water species have been taking place under the Project MAREDA. Other exploratory surveys directed towards deep-water crustaceans (Project CRUSTAÇO) have been running since 1999. Both projects are financed by the local authorities.

Regular sampling program of commercial landings of the most important species, financed by several projects, have been running since 1989.

Existing information from surveys for the most common species in the Azores caught are summarised in Table 18.6.

Most of the information on the depth distribution, CPUE by area and depth, feeding habits and biological parameters, etc, can be found in (Gomes *et al.* 1997; Menezes *et al.* 1998; Menezes *et al.* 1999)

Investigations on stock discrimination using microsatellite DNA, for *Beryx. splendens*, *B. decadatylus*, *Pagellus bogaraveo*, and *Helicolenus dactylopterus* are being carried out under EEC DG-XIV Study Contract (97/081). Under the EEC DG-XIV Study Contract (95/032), genetics and morphometric comparisons between Madeira, Azores and Canaries were also attempted. The selected species were: *Pontinus kuhlii, Chaceon affinis, Lepidopus caudatus, Beryx splendens.*

18.1.8 Russia

Soviet investigations on deep-water species on the Outer Bailey Bank, Hatton Plateau and the western Rockall Plateau between 1976 and 1990 have been reviewed by Vinnichenko (Working Document). A total of 22 surveys or exploratory fishing expeditions were carried out by trawlers or longliners (Table 18.7).

From May to November 1999, 1-2 Russian trawlers of BMRT-type operated in the Rockall area (Div.VIb) outside the 200-mile economic zone. The fishery, mainly on haddock (*Melanogrammus aeglefinus*), grey gurnard (*Eutrigla gurnardus*) and on small redfish (*Sebastes viviparus*), was conducted with bottom trawls. Occasionally, when operating at the depths below 250m the catches of rabbit fish (*Chimaera monstrosa*) were taken by the trawlers. Total rabbit fish catch made up 2.5 t (round weight). In catch statistics, presented to the ICES by Russia, this species is included in the category "The others". No information about biology of rabbit fish is available.

Russian longliners and trawlers, conducting the fishery for demersal fish in the Norwegian Sea during 1998-1999, occasionally caught roughhead grenadier (*Macrurus berglax*)as by-catch. Catches of roughhead grenadier were discarded by most longliners (10 vessels operated in 1998 and 17 - in 1999). Fish were processed and frozen only onboard three vessels, the catches of which constituted 13 t (round weight) in 1998 and 12 t (round weight) - in 1999. The entire catch was taken in the northern Norwegian Sea (ICES Division IIb).

Roughhead grenadier also occurred in small quantities from catches taken by trawlers that conducted a bottom fishery for cod and haddock. The whole by-catch of roughhead grenadier is practically discarded and no information about it is available in daily reports from vessels. Data on grenadier catches taken by three trawlers were reported only in 1999; total catch taken in ICES Divisions. IIa and IIb made up 0.3 t (round weight).

From the results from the observations done by research vessels, as well as by those used for experimental fishery, the catches of roughhead grenadier taken by a bottom trawl did not usually exceed several specimens per hour of trawling. Longline catches from 200-400m depth did not exceed 15 kg/1000 hooks. At 400-700m depths the catches increased and attained 100-150 kg/1000 hooks.

Trawl catches of roughhead grenadier consisted of specimens 11-81cm long, mainly 43-56cm, with an average length of 50.0cm (total length). The abundance of females in catches taken by longlines was more than twice that of males. Most fish (82%) were mature. Grenadier fed intensively on demersal organisms (echinoderms, worms, Amphipoda, shrimp).

The Russian deep-water fisheries on the Mid Atlantic Ridge have continued but no biological studies have been carried out Vinnichenko (Working Document)

18.1.9 Spain

Mid-Atlantic Ridge

Three experimental fishing surveys were carried out on the Mid- Atlantic Ridge, on adjacent seamounts and the Lorien knoll by freezer trawlers in 1997 and 1998. A new survey was carried out in 1999 by the freezer trawler *Puente Sabaris* (Durán *et al.*, Working Document). The survey was divided into two stages. The first explored a number of seamounts and banks to the north of the Azores and the second the Reykjanes Ridge and Hatton Bank. Biological data were collected for 18 deep-water species (Table 18.8).

18.1.10 United Kingdom

Several research cruises by FRV *Scotia* have been carried out since 1996 (Table 18.9).

In June 1999 trawling with a small semi-balloon shrimp trawl was carried out at 1000 m depth to the west of the Hebrides (ICES Division VIa) by *RRS Challenger*. This is an area that has been subject to commercial deep-water trawling since1989. The objective was to carry out a series of replicate hauls at the same station that had previously been sampled in the 1980s using the same ship and the same trawl. The best comparison is between 15 trawls carried out in 1985 with the 5 achieved in 1999. A detailed analysis of the results is in progress but the initial results indicate that a change has occurred in the fish assemblage.

18.2 Individual Species

18.2.1 *Macrourus berglax* (Roughhead grenadier)

Although the roughhead grenadier is generally considered to be a cold water species the German surveys in the 1970s revealed that it was also present in the Rockall Trough and around the Porcupine Bank. Similarly it also occurs all around Iceland although it was most abundant at east and west Iceland. It has a wide depth range and probably spawns all year round (EC FAIR, 1999). Discard levels and length frequencies for *Macrourus berglax* in Faroe-Shetland Channel from Irish exploratory fishing are presented in Lordan (1998). Some information on biomass, abundance and length composition for Sub-area XIV is given by Jørgensen (Working Document).

18.2.2 *Mora moro* (Mora) and Moridae

The German surveys showed that *Mora mora* was widely distributed in the Rockall Trough and adjacent areas at depths between 400 and 1200 m. In Icelandic waters is mostly distributed on the slope to the east of the Reykjanes Ridge and on the Ridge itself. It was most abundant between 700 and 800 m. Some information on length-weight relationship and sexual maturity are given in EC FAIR, 1999. CPUE, length-weight regressions and maturity information from Irish survey is available for *Mora moro* (Clarke *et al.* in prep). Discard levels from commercial trawling of two other morid species, *Lepidion eques* and *Halargyreus johnsoni*, are given by Clarke *et al.* (1999).

18.2.3 *Chimaera monstrosa* (Rabbit fish)

In the German surveys of the 1970s the rabbit fish was a very abundant species and all stages of the life cycle were observed. It was a significant discard species in Norwegian longline catches from ICES Division Via (EC FAIR, 1999). CPUE, length, weight and maturity information from Irish surveys is available for *C. monstrosa* from Irish surveys (Clarke *et al.* 1999; Clarke *et al.* in prep).

18.2.4 *Alepocephalus bairdii* (Baird's smoothhead)

In the German surveys of the 1970s Baird's smoothhead was a very abundant species and sometimes the catches were measured in tonnes. It had a very wide depth range from about 500 m to in excess of 2000 m. All sizes were caught and juveniles tended to live at shallower depth than the adults. Irish investigations on age etimation gave preliminary age estimates for this species of 8 to 28 years from whole and sectioned otoliths. Sectioning was the preferred method for larger, older fish where whole otoliths had poor readability. Whole otoliths were soaked in glycerol before reading. At Iceland Baird's smoothhead is most common off the west and southwest coasts and on the Reykjanes Ridge. The depth distribution and changes in size composition were similar to theGerman surveys. The spawning season may be prolonged, extending from winter to summer (EC FAIR, 1999).

A study of the reproduction of Alepocephalus bairdii from the Rockall Trough suggested that there was no well defined spawning period with females spawning throughout the year but with a peak from January to April. The batch fecundity was estimated to range from 2400 to 8600 oocytes per female (Allain, 1998).

The length frequency distribution of *Alepocephalus bairdii* from Spanish catches in ICES Sub-area XII in 1999 is shown in Figure 18.1.

18.2.5 Polyprion americanum

No new data were available.

18.2.6 Helicolenus dactylopterus

In ICES Sub-area VI and VII *Helicolenus dactylopterus* first matures at around three or four years and spawns from March to June (Allain, 1998).

In Azores Sub-area X the catches of *Helicolenus dactylopterus* increased from less 100 t at the beginnings of the 1980s and reached a maximum in 1994 with 698 tonnes. From 1995 to the present the catches have consistently decreased reaching in about 340 t in1999 (Table 18.10). *Helicolenus dactylopterus* are mainly caught by the demersal Azorean longliners. Because of the multispecific of the fishery, which is mainly toward the *Pagellus bogaraveo* there are no data available on the commercial CPUE. Survey CPUE's are available since 1995 and there is a general decreasing trend in the abundance of Bluemouth that seems to be comparable to the decreasing catch trends (Figure 18.2). Bluemouth is

included in the landings sampling program of the Azores. Length compositions from cruise surveys area available for 1995, 1996 and 1997 (Figure 18.3). There were no major differences between all years.

New data on age, growth and reproduction obtained from 1995-1999 were presented to the Study Group by Krug *et al.* (Working Document).

Age and growth

Age was estimated using the sagittal otoliths reading. ANCOVA results indicated no significant differences in the growth parameters between sexes (P>0.05) (Krug et al, Working Document).

Species	Fish Aged (n)	Age range years	Length Range (FL in cm)	Von Bertalanffy Growth equation L_{oo} (FL in cm)	K (years $^{-1}$)	t_o Years
	2040	1-16	15-48	48.3	0.16	-1.13

Reproduction

The most important reproductive period for both males and females is between January and May with the highest GSI occurring in June-July (Krug *et al*, Working Document).

The length and age at 50% fist maturity values was estimated as below:

Species	Fish analysed (n)			Length at maturity (FL in cm)		Age at maturity (years)	
	Males	Females	All	Males	Females	Males	Females
	1261	1312	2573	26	20.9	4	2

18.2.7 Lepidopus caudatus

Information on age, growth and reproduction of Lepidopus caudatus at the Azores (Sub-area XII) is given by Krug *et al.* (Working Document). The most important period for spawning is late summer and autumn. Ages of 0 to10 years were estimated.

18.3 Landings Reports

Tables 18.11 And 18.16 give updated landings information, as reported to the Study Group, for species which have been included in previous reports and are not included in Sections 7 to 17 of this report.

Table 18.1 Distribution of tows by the French research vessel *Thalassa* during the 1999 deep-water trawl survey, catches rates per area and depth band.

Area	Latitude	Depth range	Number of tows	Total catch rate (kg/h)
Meriadzec	47°30N –48°N	1150-1340	7	960
Terrace		1950-2000	3	70
West of British	54°20N – 56°40N	930-1124	8	510
Isles		1125-1360	12	1000
		1930-2020	4	210

Table 18.2 The 32 deep-water fish species selected for more detailed analysis by Germany and Iceland as a contribution to the EC FAIR project.

Family	*Species*	Common name (English)	German y	Iceland
Chimaeridae	*Chimaera monstrosa*	Rabbitfish	Y	
	Rhinochimaera atlantica			Y
Pseudotriakidae	*Pseudotriakis microdon*	False Catshark	Y	
Scyliorhinidae	Apristurus laurussoni			Y
	Galeus murinus			Y
Squalidae	*Oxynotus paradoxus*	Sailfin Roughshark	Y	
	Dalatias licha	Kitefin Shark	Y	
	Deania calceus	Birdbeak Dogfish	Y	Y
	Centrophorus squamosus	Leafscale Gulpershark	Y	
	Centroscymnus crepidater	Longnose Velvet-Dogfish	Y	Y
	Centroscymnus coelolepis	Portuguese Dogfish	Y	Y
	Centroscyllium fabricii	Black Dogfish	Y	Y
	Etmopterus princeps	Great Lanternshark	Y	Y
	Etmopterus spinax	Velvet Belly	Y	Y
	Scymnodon ringens	Knifetooth Dogfish	Y	
Rajidae	*Raja hyperborea*			Y
	Raja fyllae			Y
Argentinidae	*Argentina silus*	Argentine	Y	Y
Alepocephalidae	*Alepocephalus agassizi*			Y
	Alepocephalus bairdii	Baird’s Smoothhead	Y	Y
Bathylagidae	*Bathylagus euryops*			Y
Synahobranchidae	*Synaphobranchus kaupi*	Cut-throat eel		Y
Notacanthidae	*Notacanthus chemnitzi*			Y

Table 18.2 (CONTINUED)

Moridae	*Mora moro*	Mora	Y	Y
	Lepidion eques			Y
	Antimora rostrata	Blue Hake	Y	Y
Gadidae	*Brosme brome*	Tusk	Y	
	Molva dipterygia	Blue Ling	Y	Y
	Onogadus argenteus			Y
	Molva molva	Ling	Y	
	Phycis blennoides	Greater Forkbeard	Y	
Macrouridae	*Coryphaenoides rupestris*	Roundnose Grenadier	Y	Y
	Macrurus berglax	Roughhead Grenadier	Y	Y
	Nezumia aequalis			Y
	Trachyrhynchus murrayi			Y
Lophiidae	*Lophius budegassa*	Blackbellied Angler	Y	
	Lophius piscatorius	Monkfish, Angler	Y	
Scorpaenidae	*Helicolenus dactylopterus*	Bluemouth	Y	
	Trachyscorpia cristulata	Spiny Scorpionfish	Y	
Trachichthyidae	*Hoplostethus atlanticus*	Orange Roughy	Y	Y
Berycidae	*Beryx decadactylus*	Beryx	Y	
	Beryx splendens	Alfonsino	Y	
Apogonidae	*Epigonus telescopus*	Bulls-eye	Y	
Trichiuridae	*Aphanopus carbo*	Black Scabbardfish	Y	Y
Anarichadididae	*Anarichas denticulatus*			Y
Zoarcidae	*Lycodes esmarki*			Y
	Lycodes reticulatus			Y
	Careproctus reinhardti			Y
Pleuronectidae	*Reinhardtius hippoglossoides*	Greenland Halibut	Y	

Table 18.3 Summary of Irish deep-water exploratory surveys from 1992 – 1999.

Code	Boat	Gear	Type	No. hauls	Month	Year	Depth range (m)
MMIE300492	Mary M	Trawl	Exploratory	10	May	92	N/A
MMIE030992	Mary M	Trawl	Exploratory	8	September	92	630-108
MMIR130493	Mary M	Trawl	Research	48	April	93	201-915
MMIC130793	Mary M	Trawl	Commercial	4	July	93	476-1007
MMIC160893	Mary M	Trawl	Commercial	18	August	93	756-1098
MMIR010993	Mary M	Trawl	Research	47	September	93	196-1168
MMIC291093	Mary M	Trawl	Commercial	10	October	93	N/A
MMIC270795	Mary M	Trawl	Commercial	30	Aug/Sept	95	1273-1273
MMIR011195	Mary M	Trawl	Research	26	November	95	740-1400
MMIE030996	Mary M	Trawl	Exploratory	26	September	96	423-612
MMIR160996	Mary M	Trawl	Research	26	September	96	560-1102
MMIR291097	Mary M	Trawl	Research	22	Oct/Nov	97	520-1158
SKIR020987	Skarheim	Longline	Research	32	August	97	292-2925
SSIR271195	Sea Sparkle	Longline	Research	22	Nov/Dec	97	542-1332
MMIE230798	Mary M	Trawl	Exploratory	66	July/August	98	539-600
MMIC190499	Mary M	Trawl	Commercial	26	April/May	99	539-695
LOIR301199	Loran	Longline	Research	38	December	99	469-1974

Table 18.4 List of exploratory cruises carried out by Norway from 1993 to 1999.

Year	Vessel	Area	Depth (100m)	Days	18.3.1.1	Trawl hauls	B. Lines	Vert. Lines
1993	M/S Ramoen	Mid-AtlanticRidge c. 50°N	5-12	6	B. trawl	9		
1993	M/S Ramoen	Mid-AtlanticRidge N.Azores	5-12	24	B. trawl	119		
1996	M/S Loran	Mid-AtlanticRidge N.Azores	5-13	15	L. lines			26
1996	M/S Borgarin	Northern Reykjanes Ridge	5-20	30	L. lines		64	
1997	M/S Skarheim	Southern Reykjanes Ridge	5-17	12	L. lines		3	213
1997	M/S Skarheim	Mid-AtlanticRidge c. 52°N	5-18	4	L. lines		8	25
1998	M/S Koralnes	Hatton Bank	5-17	15	B.trawl	45		
1999	M/S Loran	Hatton Bank	5-19	17	L.lines		67	

Table 18.5 Research vessel surveys and exploratory commercial cruises at the Azores, Portugal.

Country	**R/V surveys**	**Exploratory commercial cruises**	**Observers activities**
Portugal Açores	Annual survey (1995/96/97- EEC DG-XIV Study contracts.94/034; 95/095); Seasonal survey (1999- EEC DG-XIV Study contract. (97/081); Annual survey (1999 - Azores financed)	*Aphanopus carbo*1998/99); Deep-water crustaceans (97- EEC DG-XIV Study.contract 95/032) Deep-water shrimp Survey (1999 – Azores financed)	Landings sampling program; observers on board (*Aphanopus carbo* exploratory fishing)
Portugal Madeira	Annual survey(1995/96/97) - EEC DG-XIV Study contracts(94/034; 95/095)		

Table 18.6 – Available information from Azorean longline cruise surveys (1995 to 1999) - selected species.

Species	Sets location	Catch: Depth/Area (Kg or nº)	CPUE's: Depth/Area (Kg or nº)	Length frequencies	Age frequencies	Otoliths or Vertebra	Sex Maturation Gonad stages	Lenght/Weight rel.	Stomachs
Elasmobranchs									
Deania calceus	X	X	X	X		X	X *	X *	
Deania profundorum	X	X	X	X		X	X *	X *	
Centrophorus squamosus	X	X	X	X			X *	X *	
Dalatias licha	X	X	X	X			X *	X *	
Etmopterus spinax	X	X	X	X		X	X *	X *	
Etmopterus pusilus	X	X	X	X		X	X *	X *	
Centrocymnus crepidater	X	X	X	X		X	X *	X *	
Centroscymnus cryptacanthus	X	X	X	X		X	X *	X *	
Raja clavata	X	X	X	X		X *	X *	X *	
Raja batis	X	X	X	X			X *		
Raja fulonica	X	X	X	X			X *		
Squaliolus laticaudus	X	X	X	X			X *		
Teleosts									
Alepocephalus rostratus	X	X	X	X		X **	X **		
Beryx splendens	X	X	X	X	X	X	X	X	X
Beryx decadactylus	X	X	X	X	X	X	X	X	X
Conger conger	X	X	X	X		X *	X	X	X
Epigonus telescopus	X	X	X	X		X *	X *		X
Molva dypterygia macrophtalma	X	X	X	X		X *	X *	X *	
Ruvettus pretiosus	X	X	X	X		X **	X *		
Coelorhinchus coelorhinchus	X	X	X	X		X **	X *	X *	
Mora moro	X	X	X	X		X *	X *	X *	
Polyprion americanus	X	X	X	X		X *	X *	X *	
Phycis blennoides	X	X	X	X		X *	X *	X *	
Pontinus kuhlii	X	X	X	X	X	X	X	X	
Helicolenus dactylopterus	X	X	X	X	X	X	X	X	
Pagellus bogaraveo	X	X	X	X	X	X	X	X	X
Aphanopus carbo	X	X	X	X		X **	X **		
Lepidopus caudatus	X	X	X	X	X	X	X	X	X
Benthodesmus elongatus	X	X	X	X		X **	X **		

X * - Data available but not analysed

X ** - Data available but in small numbers

Table 18.7 Soviet investigations and fishery in the in the open Northeast Atlantic (Outer-Bailey, Hatton and Rockall Banks).

Year	Vessel	Total catch, '000 t
1976	RV "Artemida" EV " Rzhev"	0,2
1977	EV "Torzhok" EV "Rzhev" FV "Alexander Tortsev" EV "Suloy" RV "Odissei"	12,5*
1978	EV "Rzhev"	
1979	EV "Slavgorod" EV "Poliyrnoe Siynie"	0,1
1980	EV "Kapitan Demidov"	0,3
1981	EV "Mikhail Verbitsky"	0,1
1983	EV "Nikolai Kuropatkin" RV "Odissei"	- -
1984	EV "Pavel Kaikov" EV "Nikolai Kuropatkin" EV "Medvezhiy"	0,2
1986	EV "Obva"	-
1990	EV "Maksheevo"	-

* - with allowance for catch by fishing vessels

Table 18.8. Number of samples, individuals and otoliths collect the Spanish survey

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Species	Length samples	Individ.	Length range (cm)	Biological samples	Individ.	Otoliths
Blue Ling *(Molva dipterygia)*	19	2011	59-137	19	1493	116
Roundnose Grenadier *(Coryphaenoides rupestris)*	7	998	4.5-23	4	368	-
North Atlantic Codling *(Lepidion eques)*	6	760	19-39	4	116	-
Mora *(Mora moro)*	4	23	38-65	1	9	-
Black Scabbard fish *(Aphanopus carbo)*	3	146	78-126	11	264	183
Greater Lantern Shark *(Etmopterus princeps)*	3	350	20-78	1	100	-
Halargyreus johnsonii	3	53	30-44	-	-	-
Oceanic Redfish *(Sebastes mentella)*	3	343	25-50	3	44	-
Longnose Velvet Dogfish *(Centroscymnus crepidater)*	3	92	27-87	1	36	-
Birdbeak Dogfish *(Deania calceus)*	2	190	68-114	-	-	-
Orange Roughy *(Hoplostethus atlanticus)*	1	197	48-69	10	248	153
Cardinal Fish *(Epigonus telescopus)*	1	8	52-74	-	-	-
Smoothhead *(Alepocephalus bairdi)*	1	112	37-86	1	3	-
Black Dogfish *(Centroscyllium fabricii)*	1	33	58-82	-	-	-
Roughead Grenadier *(Macrourus berglax)*	-	-	-	2	14	-
Golden Redfish *(Sebastes marinus)*	-	-	-	1	2	-
Atlantic Halibut *(Hippoglossus hippoglossus)*	-	-	-	1	4	-
Centrolophus niger	-	-	-	1	17	-
TOTAL	57	5316		60	2718	452

Table 18.9 Research Cruises of *Scotia* relevant to deep-water fishes (Data from FRS, Marine Laboratory, UK).

Cruise	Primary Objective	Area	No Hauls	Depth	No. Species
9/96	Hydrographic	Faroe/Shetland	14	500-950	55
10/96	Hydrographic	Faroe/Shetland	7	300-1000	27
3-4/97	Hydrographic	Faroe/Shetland	1	800	8
9/97	Gear	West of Hebrides	30	550-900	66
9/98	Survey	West of Hebrides	20	300-1100	91
10/98	Gear	West of Hebrides/ Wyville Thomson	11	600-900	49
3/99	Monkfish	West of Hebrides	45	27-1100	84

Table 18.10 Landings of *Helicolenus dactylopterus* – Azores Sub-area X (tonnes).

Year	tonnes
81	22
82	42
83	93
84	101
85	169
86	212
87	331
88	439
89	481
90	480
91	483
92	575
93	652
94	698
95	581
96	459
97	410
98	379
99	340

Table 18.11 Study Group estimates of landings (tonnes)

ROUGHHEAD GRENADIER (*Macrourus berglax*) I and II

Year	Germany	Norway	**TOTAL**
1988			**0**
1989			**0**
1990	9	580	**589**
1991		829	**829**
1992		424	**424**
1993		136	**136**
1994			**0**
1995			**0**
1996			**0**
1997		17	**17**
1998		55	**55**
1999			

ROUGHHEAD GRENADIER (*Macrourus berglax*) III and IV

Year	France	Norway	**TOTAL**
1988		0	**0**
1989		0	**0**
1990		0	**0**
1991		0	**0**
1992		7	**7**
1993		0	**0**
1994			**0**
1995			**0**
1996			**0**
1997	36		**36**
1998			
1999			

ROUGHHEAD GRENADIER (*Macrourus berglax*) Va

Year	Iceland	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995		**0**
1996	15	**15**
1997	4	**4**
1998		
1999		

ROUGHHEAD GRENADIER *(Macrourus berglax*) XIV

Country	Greenland	Norway	**TOTAL**
1988		0	**0**
1989		0	**0**
1990		0	**0**
1991		0	**0**
1992		0	**0**
1993	18	34	**52**
1994	5		**5**
1995	2		**2**
1996			**0**
1997			**0**
1998		6	**6**
1999		14	**14**

Table 18.12 Study Group estimates of landings (tonnes).

MORIDAE Vb

Year	Norway	**TOTAL**
1988	0	**0**
1989	0	**0**
1990	0	**0**
1991	5	**5**
1992	0	**0**
1993	0	**0**
1994	0	**0**
1995	0	**0**
1996	0	**0**
1997	0	**0**
1998		**0**
1999		**0**

MORIDAE VI and VII

Year	UK (Scot) (1)	Norway	**TOTAL**
1988		0	**0**
1989		0	**0**
1990		0	**0**
1991		1	**1**
1992		25	**25**
1993		0	**0**
1994			**0**
1995			**0**
1996			**0**
1997			**0**
1998			**0**
1999		8	**8**

(1) Included with Phycis blennoides

MORIDAE VIII and IX

Year	Spain	**TOTAL**
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995	83	**83**
1996	52	**52**
1997	88	**88**
1998	0	**0**
1999	0	**0**

MORIDAE X

Year	Portugal	**TOTAL**
1988	18	**18**
1989	17	**17**
1990	23	**23**
1991	36	**36**
1992	31	**31**
1993	33	**33**
1994	42	**42**
1995	n/a	
1996	n/a	
1997	n/a	
1998		
1999		

Table 18.13 Study Group estimates of landings (tonnes).

RABBIT FISH *(Chimaera monstrosa)* Va

Year	Iceland	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991	499	**499**
1992	106	**106**
1993	3	**3**
1994	60	**60**
1995	106	**106**
1996	21	**21**
1997	15	**15**
1998		
1999		

RABBIT FISH *(Chimaera monstrosa)* Vb

Year	Faroes	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995	1	**1**
1996	0	**0**
1997	0	**0**
1998		
1999		

RABBIT FISH *(Chimaera monstrosa)* VI and VII

Year	Ireland	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994	2	**2**
1995		**0**
1996		**0**
1997		**0**
1998		**0**
1999		**0**

RABBIT FISH (*Chimaera monstrosa*) XII

Year	Spain	**TOTAL**
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995		
1996		
1997	32	**32**
1998	42	**42**
1999	114	**114**

Table 18.14 Study Group estimates of landings (tonnes).

SMOOTHHEAD *(Alepocephalus* spp.) Va

Year	Iceland	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992	10	**10**
1993	3	**3**
1994	1	**1**
1995	1	**1**
1996	0	**0**
1997	+	**0**
1998		**0**
1999		**0**

SMOOTHHEAD (*Alepocephalus* spp.) XII

Year	Spain	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995		**0**
1996	230	**230**
1997	3692	**3692**
1999	4643	**4643**
1999	6549	**6549**

Table 18.15 Study Group estimates of landings (tonnes).

WRECKFISH (Polyprion americanus) VI and VII

Year	France	Spain	**TOTAL**
1988	7		**7**
1989	0		**0**
1990	2		**2**
1991	10		**10**
1992	15		**15**
1993	0		**0**
1994			**0**
1995			**0**
1996	4	79	**83**
1997			
1998		12	
1999		5	

WRECKFISH (Polyprion americanus) VIII and IX

Year	France	Portugal	Spain	UK (EW)	**TOTAL**
1988	1	188	9		**198**
1989	1	283	0		**284**
1990	2	161	0		**163**
1991	3	191	0		**194**
1992	1	268	0		**269**
1993	0	338	0		**338**
1994		406	3		**409**
1995		372	19	2	**393**
1996	3	214	69	8	**294**
1997		170	44		**214**
1998		164	63		**227**
1999		137	7		**144**

WRECKFISH (Polyprion americanus) X

Year	France	Portugal	Norway	**TOTAL**
1988	0	191	0	**191**
1989	0	235	0	**235**
1990	0	224	0	**224**
1991	0	170	0	**170**
1992	3	234	0	**237**
1993	0	308	3	**311**
1994		428		**428**
1995		240		**240**
1996		240		**240**
1997		177		**177**
1998		139		**139**
1999*		133		**133**

* Preliminary

Table 18.16 Silver Scabbardfish. Study Group estimates of landings (tonnes).

SILVER SCABBARDFISH (*Lepidopus caudatus*) VI and VII

Year	Germany	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993	2	**2**
1994		**0**
1995		**0**
1996		**0**
1997		
1998		
1999		

SILVER SCABBARDFISH *(Lepidopus caudatus)* VIII and IX

Year	Portugal	Russia/USSR	**TOTAL**
1988	2666		**2666**
1989	1385		**1385**
1990	547	37	**584**
1991	808		**808**
1992	1264	110	**1374**
1993	2397		**2397**
1994	1054		**1054**
1995	5672		**5672**
1996	1237		**1237**
1997	1725		**1723**
1998	966		**966**
1999	3058		**3058**

SILVER SCABBARDFISH (*Lepidopus caudatus*) X

Year	Latvia	Portugal	**TOTAL**
1988		70	**70**
1989		91	**91**
1990		120	**120**
1991		166	**166**
1992	1905	255	**2160**
1993	1458	264	**1722**
1994		373	**373**
1995	8	781	**789**
1996		815	**815**
1997		1115	**1115**
1998		1186	**1186**
1999		86	**86**

*excl. December

SILVER SCABBARDFISH (*Lepidopus caudatus*) XII

Country	Russia/USSR	**TOTAL**
1988		**0**
1989	102	**102**
1990	20	**20**
1991		**0**
1992		**0**
1993	19	**19**
1994		
1995		
1996		
1997*		
1998		

1999

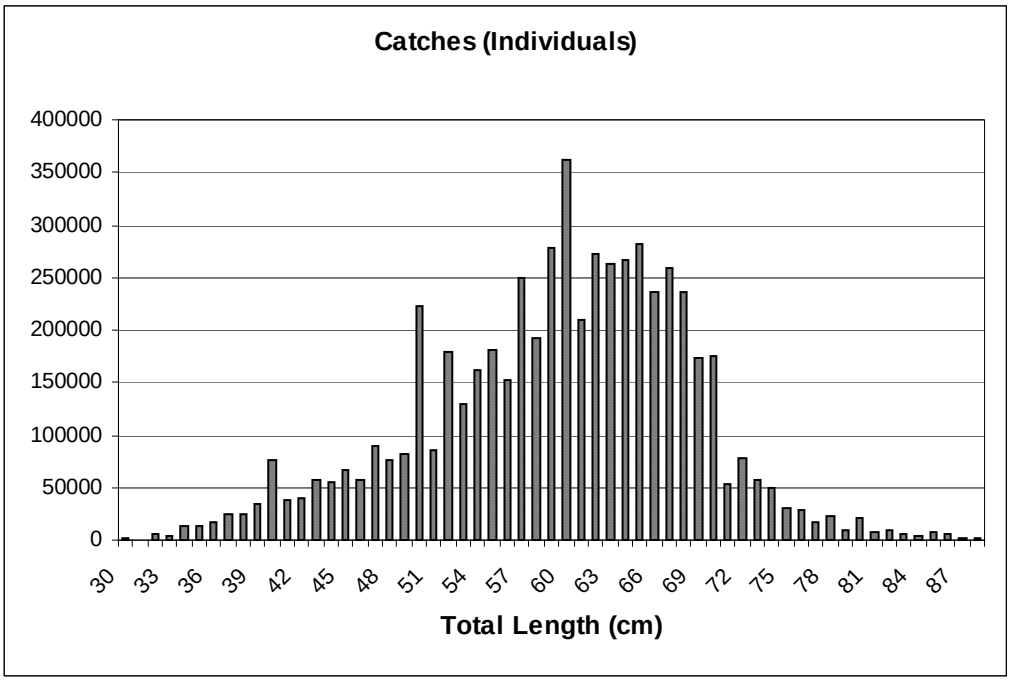

Figure 18.1 Preliminary length distribution of the Spanish catches of *Alepocephalus bairdi* by observers

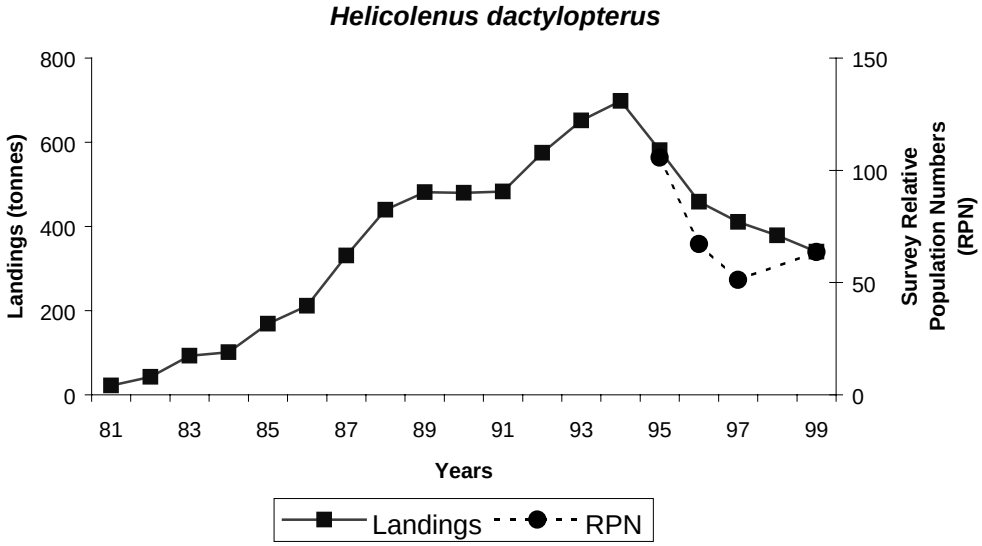

Figure 18.2 –Commercial landings (1981 – 1999) and Relative Population Numbers from surveys (1995 – 1999) for *Helicolenus dactylopterus* for Azores Sub-area X.

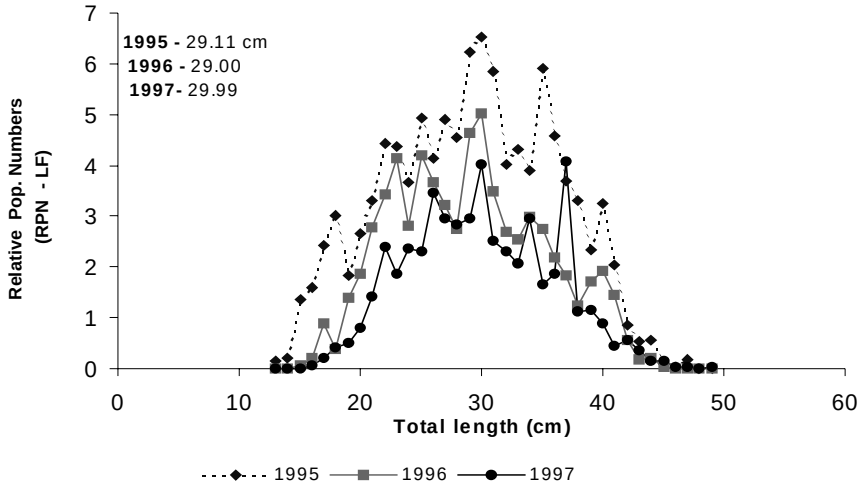

Figure 18.3 – Length frequencies weighted by relative population numbers of *Helicolenus dactylopterus* by year (Areas I to IV and depth strata 0-51 to 600 m).

19 RECOMMENDATIONS

1) The Study Group remains concerned that the landings statistics as presented may not reflect the true scale of the recent fishing activity in waters outside the national EEZs. The Study group recommends that member states should be encouraged to collect area-specific catch, landings, effort and biological data from exploratory and commercial fishing activities in international waters and report it to ICES. Any documented information that member states may have on fishing activity from non-member states in these waters should also be reported to ICES.

2) The catch and effort assessment methods used by the Group suggest that time series of effort and CPUE may be particularly valuable for the assessment of deep-water species. The present assessment of the status of stocks and reference points were almost entirely derived from CPUE analyses. Only in a few cases can it be anticipated that analytical assessments may become possible. It caused concern in the Group that CPUE series for several species, notably ling and tusk in many fishing areas, could not be updated. The Group recommends that member states maintain and refine long-term data series on catch and effort and where possible collate historical data.

3) For several species there is concern that catch rates can only be maintained by sequential depletion of relatively isolated concentrations/sub-units of a stock. The smallest unit for which data are reported at present is the ICES Sub-areas and Divisions, and this spatial resolution may not be appropriate for monitoring this type of fishing activity. The depth range within an area may be very wide, and the sizes of the areas are very different. It is therefore recommended that systems are developed and implemented for recording effort and catches at a finer temporal and geographical scale.

4) Most stocks that have been reviewed by the SG and upon which assessments have been attempted have used surplus production (biomass dynamic) models as the main assessment tool. As a precursor to data analysis by these models has been standardisation of the input CPUE indices accounting for such things as month and area effects using multiplicative regression analyses. However, the results of these analyses have not been available to the SG for examination. It is recommended that at future meetings of the SG the results of such analyses including diagnostics be provided to allow for an evaluation of the reliability and variability of the resultant indices before conducting the assessments.

5) The Study Group request that the Production Methods assessment programmes normally used by this and other Working Groups be included in the ICES network to be available to all members of the SG. In the same way, an introduction on the Production Methods assessment would be very much appreciated by the Study Group and should be offered by ICES at the next Study Group meeting. Similar information has given in the recent past in relation to the use of some other packages such as IFAP. It would contribute to increase the critical mass in the analysis of the assessments carried out by members.

6) Due to the importance of the various resources being evaluated and the serious concerns regarding stock status, consideration has been given by ACFM to elevating the group to Working Group status either as it stands or merging with several other Working Groups. Since its inception in 1994 the group has met four times and has been well attended with a healthy mixture of biological and stock assessment expertise. It has made considerable progress over the last several years in attempts to assess the deep-sea stocks and now several have been put in the context of the Precautionary Approach framework. As data acquisition improves it is expected that more analytical assessment tools can be applied as appropriate. Given the unique biological characteristics of deep-sea fishes and the extensive geographic areas for many of the resources being evaluated it is recommended that if the group is elevated to Working Group status it remain unique. In addition, the group at present does not depend critically upon ICES facilities (eg. IFAP). However, meeting at ICES headquarters constrains it to meet very early in the year when other groups are not in session. This makes it difficult to get the most up to date catch and effort statistics. It is further recommended, therefore, that in future a different venue and time be considered.

7) The Study Group felt that, given the paucity of data available, good progress had been made using Schaefer production and DeLury constant recruitment models. However, the Study Group recommends that at the next meeting it would be useful to try other assessment methods, life history models, for example, to supplement Schaefer and DeLury.

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