

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

By Correspondence

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TABLE OF CONTENTS

Section	Page
1 INTRODUCTION	1
2 UPDATE AVAILABLE DATA ON LANDINGS OF DEEP-WATER SPECIES AND THEIR FISHERIES, INCLUDING BLUE LING, LING AND TUSK, BY ICES SUB-AREA OR DIVISION	1
3 UPDATE IN TABULAR FORM, BY SUB-AREA WHERE POSSIBLE, AVAILABLE DATA ON LENGTH/AGE AT MATURITY, GROWTH AND FECUNDITY FOR DEEP-WATER SPECIES, INCLUDING BLUE LING, LING AND TUSK	19
4 INVENTORY OF AVAILABLE DISCARDS AND DEEP-WATER FISH COMMUNITY DATA	28
5 MEETING 2000	29
6 REFERENCES	29
7 WORKING DOCUMENTS	31
 Appendix 1 Report on catches of deepwater species from the northeastern United States for the ICES Study Group on the Biology and Assessment of Deep-sea Fisheries Resources	 32

1 INTRODUCTION

The terms of reference of the Study Group adopted at the 1998 Annual Science Conference (86th Statutory Meeting) were as follows (C.Res. 2:4:16).

The Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources [SGDEEP] (Chairman: Dr J. D. M. Gordon, UK) will work by correspondence in 1999 to:

- a) update 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 by Sub-area and identify target and by-catch species;
- c) update in tabular form, by Sub-area where possible, available data on length/age at maturity, growth and fecundity for deep-water species, including blue ling, ling and tusk;
- d) make an inventory of available discards and deep-water fish community data;
- e) plan a meeting for 2000.

The request for information from study group members produced a wide range of material. The information provided for Tasks a and b was in most cases difficult to separate so that these tasks have been combined. Biological data for Task c was also variable in its format and it has not been possible to present them in table format.

For the first time the Study Group received information on deep-water species from the USA. The report covers NAFO areas and as many of the species are new to the Study Group the Working Document has been appended as an Appendix to this report.

2 UPDATE AVAILABLE DATA ON LANDINGS OF DEEP-WATER SPECIES AND THEIR FISHERIES, INCLUDING BLUE LING, LING AND TUSK, BY ICES SUB-AREA OR DIVISION

France

Table 1 shows the revised French landings for 1997. The 1998 data are provisional and are for all areas combined (mainly Sub-areas V, VI and VII). They are *Coryphaenoides rupestris* (7000 t), *Molva dypterygia* (5000 t), *Molva molva* (5000 t) *Aphanopus carbo* (2000 t), *Hoplostethus atlanticus* (1200 t) and siki (2500 t).

Table 1. The revised French landings (kg) of deep-water species by ICES Sub-area for 1997.

Species	ICES Sub-areas						
	II	IV	V	VI	VII	VIII	XII
<i>Beryx spp.</i>	0	0	0	15	1,710	69	0
<i>Brosme brosme</i>	21,445	48,068	10,959	359,640	6,616	0	26
<i>Argentina silus</i>	0	0	0	25	0	0	0
<i>Macrourus berglax</i>	4,203	7,409	6,393	12,784	17	0	0
<i>Coryphaenoides rupestris</i>	155	716	507,675	5,750,210	1,024,771	95	110,557
<i>Hoplostethus atlanticus</i>	0	28	764	116,183	893,025	1,125	6,232
<i>Molva dypterygia</i>	10,093	35,803	393,024	3,740,799	113,059	134	1,476
<i>Molva molva</i>	15,925	207,521	6,979	1,630,181	930,657	227,117	160
<i>Phycis blennoides</i>	440	2,497	7,044	427,336	84,502	4,229	1,905
<i>Aphanopus carbo</i>	0	254	50,405	2,293,912	459,760	853	801
<i>Siki</i> *	0	137	260,686	2,220,925	566,381	373	31,618
<i>Epigonus telescopus</i>	5	90	7,420	27,046	22,562	0	0

*Siki is a mixture of *Centroscymnus coelolepis* and *Centrophorus squamosus*

Germany

Table 2. The German landings of deep-water species by ICES Sub-area and Division for 1998. The Roundnose grenadier landings may include small quantities of *Macrourus berglax* and some smaller grenadiers. Other sharks exclude *Squalus acanthias* and *Lamna nasus* and will include some deep-water species.

Species	ICES area / division	Landings (t)
Argentina silus	IIa	40.291
Argentina silus	IVa	128.524
Argentina silus	VIan	463.822
Molva dipterygia	IIa	0.191
Molva dipterygia	IVa	0.546
Molva dipterygia	IVb	0.006
Molva dipterygia	Va	8.836
Molva dipterygia	VIan	2.58
Molva dipterygia	VIIIk	3.303
Molva dipterygia	XIV	0.884
Other Sharks	IIa	0.046
Other Sharks	IIIan	0.004
Other Sharks	IVa	6.121
Other Sharks	IVb	0.978
Other Sharks	IVc	0.27
Other Sharks	Va	0.783
Other Sharks	VIan	10.887
Other Sharks	VIas	0.764
Other Sharks	VIIb	12.204
Other Sharks	VIIIb	2.148
Other Sharks	VIIIi-j	40.735
Other Sharks	VIIIk	19.754
Other Sharks	XIV	15.21
Molva molva	IIa	6.071
Molva molva	IIIan	0.014
Molva molva	IIIas21	0.092
Molva molva	IVa	175.364
Molva molva	IVb	18.009
Molva molva	IVc	0.026
Molva molva	Va	0.345
Molva molva	VIan	8.868
Molva molva	VIIb	9.989
Molva molva	VIIIb	1.26
Molva molva	VIIIi-j	22.78
Molva molva	VIIIk	65.591
Coryphaenoides rupestris	Va	0.166
Coryphaenoides rupestris	XIV	116.027
Brosme brosme	IIa	1.058
Brosme brosme	IVa	11.646
Brosme brosme	IVb	1.373
Brosme brosme	Va	1.452
Brosme brosme	VIan	0.101
Brosme brosme	VIIIk	3.256

Greenland

Two tonnes of grenadiers were landed from ICES Division XIVb. Since these were a by-catch of the longline fishery for *Reinhardtius hippoglossoides* they will be *Macrourus berglax*. There are no reported landings of by-catches of grenadier in the trawl fishery for *Reinhardtius hippoglossoides*.

Iceland

Table 3. Icelandic landings (t) of *Molva dypterygia* (blue ling), *Molva molva* (ling) and *Brosme brosme* (tusk) and *Argentina silus* (greater silver smelt) for 1996-1998 for ICES Division Va. The 1998 data are provisional.

Year	Blue ling	Ling	Tusk	Greater Silversmelt
1996	1284	3670	5226	808
1997	1319	3626	4814	3367
1998	1048	3653	4120	15577

Ireland

Ireland does not have a directed deepwater fishery and only two trawlers in the Irish fleet are capable of fishing at depths > 400 m.

Small quantities of blue ling and tusk are caught by Irish trawlers and gill-netters, particularly off the west coast (Table 4). Ling is landed in many Irish ports and sold both for the flesh and ling roe. Greater forkbeard is landed in small quantities from grounds on the west, north west and south west coasts and the largest landings are from the Porcupine prawn grounds in Divisions VIIb and VIIc (Table 5). Pelagic trawlers in Division VIa fish for argentine (*Argentina silus*) for short periods when quotas for other species are exhausted. The landings (live weight t) for 1997-1998 were 1065 and 405 t respectively. Three tonnes of roundnose grenadier (*Coryphaenoides rupestris*) were landed from Sub-area VIa in 1997.

Table 4. Preliminary landings (live weight tonnes) of ling, blue ling and tusk by Irish vessels in 1997 and 1998.

Area	Species	1997	1998
IVa	Blue Ling		0.1
VIa	Blue Ling	0.81	0.5
VIIb	Blue Ling		39.8
VIIc	Blue Ling	2.3	8.3
VIIj	Blue ling	0.4	11.4
VIIk	Blue Ling	5.5	80.6
VIa	Ling	59.4	52.1
VIIb	Ling	17.2	29.1
VIIa	Ling	7.9	15.0
VIIb	Ling	121.9	354.9
VIIc	Ling	68.4	426.7
VIIe	Ling	0.5	0.8
VIIf	Ling	0.2	0.0
VIIg	Ling	44.8	213.8
VIIh	Ling	4.3	7.7
VIIj	Ling	33.4	244.0
VIIk	Ling	24.2	101.3
VIa	Tusk	2.2	
VIIb	Tusk	9.2	10.7
VIIb	Tusk	4.0	8.3
VIIc	Tusk	0.4	
VIIk	Tusk	2.2	

Table 5. Preliminary landings (live weight tonnes) of greater forkbeard and black scabbardfish by Irish vessels in 1997 and 1998.

Area	Species	1997	1998
VIa	Greater forkbeard	2.0	21.3
VIb	Greater forkbeard		21.3
VIIb	Greater forkbeard	10.6	79.4
VIIc	Greater forkbeard	38.4	224.4
VIIe	Greater forkbeard	0.2	
VIIg	Greater forkbeard	0.2	0.6
VIIh	Greater forkbeard	0.7	
VIIj	Greater forkbeard	40.3	69.9
VIIk	Greater forkbeard	37.9	113.2
VIIk	Black Scabbardfish	0.3	0.3

Norway

The Norwegian landings of deep-water species in 1997 and 1998 by ICES Areas or Divisions are listed in Tables 6 and 7. There were no significant changes in the distribution of landings by area and species in 1997 or 1998. The major deep-water fishery is the longline fishery for ling and tusk, and the tusk landings from IIa, IVa and VIb increased in 1998 but not above the long-term level. The same was the case for ling in IIa, IVa and VIa.

For accounts of the Norwegian fisheries, see descriptions in previous reports.

There were no major changes in 1998. In 1997, 53 vessels took part in the major longline fishery targeting ling and tusk in ICES Areas IIa, V, IV, VI, VII and XIV. In 1998, this number was again 57 as in 1996.

The longline and dropline fishery at the Mid-Atlantic Ridge (Sub-area XII) targeting redfish and Greenland halibut declined to a low level in 1998.

In August-September 1998, exploratory trawl fishing was conducted by the Norwegian Directorate of Fisheries and Møre Research at Hatton Bank (VI b) (Langedal and Hareide 1998). This was an isolated fishing experiment and did not lead to a Norwegian commercial fishery in the area.

Table 6. Norwegian landings of selected deep-water species in 1997 and 1998, by ICES Area or Division. 1998 landings are preliminary. Source: The Norwegian Directorate of Fisheries

Species	ICES area	Norw. landings, tonnes	
		1997	1998
Blue ling	I	1	1
Blue ling	IIa	280	271
Blue ling	IIb		1
Blue ling	IIIa	5	2
Blue ling	IVa	61	55
Blue ling	IVb	0	1
Blue ling	Vb1	65	24
Blue ling	Vb2	48	29
Blue ling	VIa	29	21
Blue ling	VIb	6	13
Blue ling	VIIbc	2	1
Blue ling	XIVb	0	1
Blue ling Total	All areas	497	419
Tusk	I	665	803
Tusk	IIa	8642	14462
Tusk	IIb	93	73
Tusk	IIIa	25	19
Tusk	IVa	1762	2943
Tusk	IVb	24	55
Tusk	Vb1	869	753
Tusk	Vb2	420	530
Tusk	VIa	750	715
Tusk	VIb	359	630
Tusk	VIIbc	61	28
Tusk	XII	19	
Tusk	XIVb	108	14
Tusk Total	All areas	13797	21026
Ling	I	31	123
Ling	IIa	5344	9049
Ling	IIb	5	5
Ling	IIIa	105	111
Ling	IVa	4715	7068
Ling	IVb	57	129
Ling	Vb1	1428	1452
Ling	Vb2	398	819
Ling	VIa	2229	2910
Ling	VIb	504	944
Ling	VIIbc	418	89
Ling	XII	0	
Ling	XIVb	60	6
Ling Total	All areas	15294	22706
Roughhead grenadier	IIa	13	46
Roughhead grenadier	IIb	4	9
Roughhead grenadier	XIVb		6
Roughhead grenadier Total	All areas	17	61
Roundnose grenadier	1D	5	7
Roundnose grenadier	I		0

Table 6 continued.

Roundnose grenadier	IIa	100	87
Roundnose grenadier	IIIa	124	329
Roundnose grenadier	IVa	0	0
Roundnose grenadier	VIb		21
Roundnose grenadier	XIVb	7	9
Roundnose grenadier Total	All areas	236	452
Greater silver smelt	IIa	4463	7424
Greater silver smelt	IIIa	703	413
Greater silver smelt	IVa	1	21
Greater silver smelt Total	All areas	5167	7857
*Landings from human consumption fisheries only, not industrial by-catch.			

Table 7. Norwegian landings from Sub-areas V, VI, VII, XII and XIV in 1997 and 1998 of species not listed in Table 6. Source: Norwegian Directorate of Fisheries.

Species	ICES area	Landings, tonnes	
		1997	1998
Greenland halibut	Vb1	41	109
Greenland halibut	Vb2	1	5
Greenland halibut	VIb		1
Greenland halibut	XIVa	1	378
Greenland halibut	XIVb	1896	1662
Angler	Vb1	1	2
Angler	Vb2	0	2
Angler	VIb	4	6
Angler	VIIbc	1	
Angler	XIVb		0
Atlantic halibut	Vb1	17	21
Atlantic halibut	Vb2	7	19
Atlantic halibut	VIb	3	2
Atlantic halibut	VIIbc	0	
Atlantic halibut	XII	0	
Atlantic halibut	XIVb	611	271
Greater forkbeard	Vb1		4
Greater forkbeard	VIb	0	15
Greater forkbeard	VIIbc	5	
<i>Sebastes mentella</i>	XII	2678	263
<i>Sebastes mentella</i>	XIVb	476	835
<i>Sebastes marinus</i>	Vb1	20	24
<i>Sebastes marinus</i>	Vb2	5	15
<i>Sebastes marinus</i>	VIb	1	0
<i>Sebastes marinus</i>	VIIbc	0	
<i>Sebastes marinus</i>	XII	21	
<i>Sebastes marinus</i>	XIVb	35	32

Portugal

The total landings and value of deep-water species for 1997 and 1998 are shown in Table 8. The landings by gear type are shown in Table 9.

Table 8. Total annual landings of deep-water species in tonnes and euros from mainland Portugal.

Species or Group of Sps.	1997		1998	
	Tonnes	Euros	Tonnes	Euros
<i>Aphanopus carbo</i>	3552.94	5329465.08	3146.72	5879302.68
<i>Beryx spp</i>	35.19	207679.72	9.39	65876.83
<i>Brosme brosme</i>	0.00	0.00	0.00	0.00
<i>Helicolenus dactylopterus</i>	9.11	26797.97	14.04	47863.54
<i>Lepidopus caudatus</i>	1725.10	3304097.93	966.27	2127273.91
<i>Molva macrophthalmus</i>	0.29	875.33	0.20	614.63
<i>Pagellus bogaraveo</i>	202.52	1441484.55	207.05	1469262.49
<i>Phycis blennoides</i>	1.46	2134.41	6.31	13494.03
<i>Polyprion americanus</i>	170.74	1931059.72	164.63	2090202.74
<i>Pleurotermata</i>	127.95	495040.57	61.37	43178.95
<i>Centrophorus granulosus</i>	193.18	402957.74	147.08	351165.14
<i>Centrophorus squamosus</i>	383.92	625238.75	357.30	627307.94
<i>Centroscymnus coelolepis</i>	898.97	992692.62	840.77	1023429.04
<i>Dalatias licha</i>	3.69	2473.98	5.98	5501.17
<i>Galeus melastomus</i>	29.55	7739.65	22.97	9451.49
<i>Aristeus antennatus</i>	124.40	1469113.53	233.41	3026084.29

Table 9. Total landings (tonnes) of deep-water species by fishing gear type from Portugal mainland for the period between 1997 and 1998.

Species or Groups of Spp.	Fishing Gear Type		
	Trawl	Artisanal gears	Purse-seine
<i>Aphanopus carbo</i>	4.40	6699650.27	0.00
<i>Beryx spp</i>	850.30	43729.63	0.00
<i>Brosme brosme</i>	2.00	0.00	0.00
<i>Helicolenus dactylopterus</i>	0.00	23143.95	0.00
<i>Lepidopus caudatus</i>	28492.20	2662628.81	253.97
<i>Molva macrophthalma</i>	0.00	485.52	0.00
<i>Pagellus bogaraveo</i>	66103.84	342696.24	765.27
<i>Phycis blennoides</i>	8.00	7766.79	0.00
<i>Polyprion americanus</i>	883.20	334490.18	0.00
<i>Pleurotermata</i>	505.15	188797.81	19.53
<i>Centrophorus granulosus</i>	2942.60	337319.08	0.00
<i>Centrophorus squamosus</i>	76.60	741139.84	0.00
<i>Centroscymnus coelolepis</i>	302.60	1739437.17	0.00
<i>Dalatias licha</i>	289.90	9374.14	0.00
<i>Galeus melastomus</i>	5216.40	47305.56	0.00
<i>Aristeus antennatus</i>	320366.98	37448.32	3.85

Portugal, Azores

Table 10. The landings (kg) of by-catch species in the longline fishery for *Pagellus bogaraveo* (blackspot seabream) of the Azores.

Species	1997	1998
<i>Phycis phycis</i>	363456	382514
<i>Beryx splendens</i>	267677	160251
<i>Pagellus acarne</i>	81029	22191
<i>Helicolenus dactylopterus</i>	410301	378706
<i>Pontinus kuhlii</i>	61379	88196
<i>Polyprion americanus</i>	177153	138650
<i>Beryx decadactylus</i>	110694	67643
<i>Phycis blennoides</i>	29532	38043
<i>Pagrus pagrus</i>	108599	260824
<i>Pagellus bogaraveo</i>	1012166	1113698
<i>Lepidopus caudatus</i>	1114667	1186219
<i>Molva dypterygia macrophthalma</i>	21054	13462
<i>Conger conger</i>	596456	669582

Russia

The 1998 fishery for *Coryphaenoides rupestris* on the Mid-Atlantic Ridge began in March onboard an STM-type vessel. Results from the directed fishery are given in Table 11.

In March and April 1-2 trawlers of STM-type and 1 BMRTA-type vessel operated on the sea mounts. In September-October, the fishery was carried out by 1 STM-type trawler. The fleet operated in the area between 48° and 54°N during an entire fishing period, 731 t of roundnose grenadier was taken by Russian trawlers in 1998.

Table 11. Information on the fishing operations and catches of roundnose grenadier on the Mid-Atlantic Ridge by the Russian fishing fleet in 1998.

Month	Type of vessel	Number of days fishing	Catch, t	Catch per day fishing
March	STM	11	61	5.5
April	STM	31	224	7.2
	BMRTA	23	168	7.3
May	STM	5	47	9.4
	BMRTA	6	39	6.5
September	STM	17	102	6.0
October	STM	15	90	6.0
Total			731	

Spain

Spanish deep-water fisheries are basically opportunistic and are characterised by their seasonality and small catch volumes. Target species change from one season to another during the year depending on the abundance of other species with a commercial value and on the constraints imposed by fish licences in terms of TACs and quotas system. As a result the annual and even monthly landings of deep species fluctuate greatly.

Tables 12 and 13 show the revised Spanish landings for 1997 by ICES Sub-areas and Divisions. The 1998 data are provisional.

Table 12. Landings (in Kg) of target species in Deep water Spanish Fisheries by gear from 1997 (revised) and 1998 in ICES Subareas and Divisions (* Preliminary data).

Species	ICES Sub-area /Division	1997	1998*	
		Trawl	Long-line	Trawl
<i>Phycis blennoides</i>	VII	2036		
<i>Phycis blennoides</i>	VIIIc		171379	59413
<i>Pagellus bogaraveo</i>	VII			
<i>Pagellus bogaraveo</i>	IXa		790	519
<i>Trachyscorpia cristulata</i>	VII	1602		
<i>Hoplostethus atlanticus</i>	VII	564		
<i>Trachyrhynchus scabrus</i>	IXa	2.815		
<i>Trachyscorpia cristulata echinata</i>	IXa	1162		
<i>Helicolenus dactylopterus</i>	IXa	43		
<i>Hoplostethus mediterraneus</i>	IXa	600		

Table 13. Landings (in kg) of by-catch species (revised) of Deep water Spanish Fisheries by gear from 1997 in ICES Subareas and Divisions

Species	ICES Sub-area/ Division	1997	
		Trawl	long-line
<i>Phycis sp.</i>	VIIIabd		77278
<i>Mora moro</i>	VII	230	
<i>Mora moro</i>	VIIIabd		30
<i>Pagellus bogaraveo</i>	VIIIabd		240
<i>Helicolenus dactylopterus</i>	VIIIabd		9488
<i>Conger conger</i>	VIIIabd		6230
<i>Trachyscorpia cristulata</i>	VIIIabd		14990
<i>Molva molva</i>	VIIIabd		186499
<i>Polyprion americanus</i>	VIIIabd		31677
<i>Molva dypterygia</i>	VIIIabd		14.063
<i>Molva dypterygia</i>	XII	410,7	
<i>Beryx decadactylus</i>	VIIIabd		2.535
<i>Beryx splendens</i>	VIIIabd		17748
<i>Aphanopus carbo</i>	VII	722	
<i>Aphanopus carbo</i>	VIIIabd		1060
<i>Aphanopus carbo</i>	XII	98,4	
<i>Coryphaenoides rupestris</i>	VII	5036	
<i>Coryphaenoides rupestris</i>	XII	1800	
<i>Alepocephalus spp</i>	XII	3692	
<i>Hoplostethus atlanticus</i>	VIIIabd		21775

United Kingdom

England and Wales

Table 14 Landings (t) by UK vessels into England + Wales and English + Welsh vessels landing outside the UK in 1997.

Species													
ICES Div.	Black Scabbard	Beryx	Blue Ling	Greater Fork-beard	Ling	Livers and Oils	Orange Roughy	Portuguese	Red Crab	Red Sea-bream	Shark	Tusk	Grand Total
Ic													0
Id													0
IIa			0		3							1	11
IIc													0
IIId					2							0	3
IIe					1							1	5
IIIf					0								1
IIg													10
IVa				0	242	15			50		68	16	393
IVb					207						1	2	209
IVc					5								5
Vb					4	14			4		20		41
VIa			789	29	143	309			1		1078	1	2350
VIb			65	59	103	106			136		269	2	740
VIIa					23						2		25
VIIb			4	48	270	2		3	24	0	57	1	408
VIIc			33	177	364	130			9	5	529		1247
VIIId					7						0		8
VIIe				0	365						13		379
VIIIf				0	313						7		320
VIIg					2	269			0		3		274
VIIh			15	12	524				15		14		580
VIIIa					37				11	4	1		53
VIIIb					2					5			6
VIIIId											12		12
VIIIe											7		7
VIIj	2	1	81	784	1034	16	1	6	62	11	236		2234
VIIk		3	38	348	283	217			3	8	538		1437
112			4		9	21			4		6		45
113A													46
114A			2										104
114B													116
501A											16		16
Total	2	4	1032	1461	4209	829	1	9	319	33	2877	23	11086

Table 15 Landings (t) by UK vessels into England + Wales and English + Welsh vessels landing outside the UK in 1998.

ICES Div.	Black Scabbard	Blue Ling	Bluemouth Redfish	Greater Fork-beard	Ling	Livers and Oils	Raw Livers	Red Crab	Red Sea-bream	Sharks	Spiny Scorpion-fish	Tusk	Grand Total
Ia													0
Ic													0
Ig													0
IIa		0			1							0	1
IIc					1							0	1
IId					1							1	2
IIe													0
IIg													0
IVa		3			125			34		1		11	173
IVb					122					1		3	126
IVc					4								4
Va		1			4							1	6
VIa		12	6	26	148	406	52	16		855		1	1521
VIb		190	35	275	71	159		295		617		9	1651
VIIa					30					3			32
VIIb		12	9	68	190	2		14	0	5			300
VIIc	0	48	7	147	203	17		15	0	6	0		443
VIIe					7					0			7
VIIe					3	502				8			513
VIIe					1	328				10			339
VIIg					1	221				8			230
VIIh			1	27	573			6		15			623
VIIIa					29			128		2			159
VIIIb								0	0				0
VIIIc					0			60		0			60
VIIj	2	98	16	523	1490	33		15	4	147	0		2327
VIIk		125	18	292	303	54			1	167	1		960
112		1		4	1	22		2		63			94
113A					0								0
113C													0
114A		6											6
203C		0		0	0	2		40		4			46
501A										31			31
502B								61					61
Total	2	494	93	1367	4354	694	52	685	6	1944	1	25	9715

Table 16 Landings (t) by UK vessels into England + Wales and English + Welsh vessels landing outside the UK in 1997.

Sum of Weight Live	Species	Gear group	ICES Divisions.																											Grand Total		
			112	113	114	501	IIa	IIc	IIId	IIe	IIIf	IIg	IVa	IVb	IVc	Vb	VIa	VIb	VIIa	VIIb	VIIc	VIIId	VIIe	VIIIf	VIIg	VIIh	VIII	VIII	VIII		VIII	VIIj
			A	A	A																				a	b	d	e				
Beryx	Bottom Trawl		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
	Nets		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	
Beryx Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4	
Black Scabbardfish	Bottom Trawl		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
	Lines		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
Black Scabbardfish Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0		
Blue Ling	Bottom Trawl		0	0	2	0	0	0	0	0	0	0	0	0	0	12	49	0	3	11	0	0	0	0	0	15	0	0	29	29		
	Lines		0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0	0	8	0		
	Mid-water Trawl		0	0	0	0	0	0	0	0	0	0	0	0	0	771	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Nets		4	0	0	0	0	0	0	0	0	0	0	0	0	16	0	1	22	0	0	0	0	0	0	0	0	0	44	9		
Blue Ling Total			4	0	2	0	0	0	0	0	0	0	0	0	789	65	0	4	33	0	0	0	0	15	0	0	0	81	38	1032		
Greater Forkbeard	Beam Trawl		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0		
	Bottom Trawl		0	0	0	0	0	0	0	0	0	0	0	0	16	44	0	33	87	0	0	0	1	9	0	0	0	381	173	744		
	Lines		0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	5	16	0	0	0	2	0	0	0	0	104	10	149		
	Nets		0	0	0	0	0	0	0	0	0	0	0	0	2	15	0	10	74	0	0	0	0	0	0	0	0	298	166	566		
	Pots		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Greater Forkbeard Total			0	0	0	0	0	0	0	0	0	0	0	0	29	59	0	48	177	0	0	0	2	12	0	0	0	784	348	1461		
Ling	Beam Trawl		0	0	0	0	0	0	0	0	1	2	4	0	0	0	1	0	0	7	79	83	35	209	0	0	0	0	0	422		
	Bottom Trawl		0	0	0	0	3	0	2	1	0	0	205	164	0	0	55	24	16	125	129	0	45	9	17	6	2	2	0	574	129	1507
	Lines		0	0	0	0	0	0	0	0	0	0	9	0	0	84	0	3	31	66	0	19	6	9	63	28	0	0	170	12	500	
	Nets		9	0	0	0	0	0	0	0	0	35	30	2	4	4	79	3	114	169	0	218	214	205	246	6	0	0	286	142	1767	
	Pots		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0		
	Seine		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0	7	
Ling Total			9	0	0	0	3	0	2	1	0	242	207	5	4	143	103	23	270	364	7	365	313	269	524	37	2	0	1034	283	4209	
Livers + oils	Lines		0	0	0	0	0	0	0	0	0	0	0	0	14	297	19	0	2	58	0	0	0	0	0	0	0	10	85	483		
	Nets		21	0	0	0	0	0	0	0	0	15	0	0	0	12	87	0	0	57	0	0	0	0	0	0	0	7	123	322		
	Pots		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	9	24		
Livers + oils Total			21	0	0	0	0	0	0	0	0	15	0	0	14	309	106	0	2	130	0	0	0	0	0	0	0	16	217	829		
Orange Roughy	Lines		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1		
Orange Roughy Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1		
Portuguese Dogfish	Nets		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	6		
Portuguese Dogfish Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	6		
Red Crab	Bottom Trawl		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Lines		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	3		
	Nets		4	0	0	0	0	0	0	0	0	50	0	0	4	1	135	0	24	9	0	0	0	15	11	0	0	62	1	317		

Table 16 Landings (t) by UK vessels into England + Wales and English + Welsh vessels landing outside the UK in 1997. (Continued)

	Pots	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Crab Total		4	0	0	0	0	0	0	0	0	0	50	0	0	4	1	136	0	24	9	0	0	0	0	15	11	0	0	0	0	62	3	319		
Red Seabream	Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4	5	0	0	2	0	14				
	Nets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	9	8	22				
Red Seabream Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5	0	0	0	0	4	5	0	0	11	8	36				
Sharks	Beam Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	2	1	0	0	0	0	0	0	6	0	15	
	Lines	0	0	0	16	0	0	0	0	0	0	0	0	14	1076	137	1	51	436	0	3	1	0	4	1	0	12	7	187	487	2430				
	Mid-water Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Nets	6	0	0	0	0	0	0	0	0	0	68	0	0	6	2	132	1	3	68	0	7	4	2	11	0	0	1	0	42	38	390			
	Pots	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	3	0	0	0	0	0	0	0	0	0	0	13	41	
Sharks Total		6	0	0	16	0	0	0	0	0	68	1	0	20	1078	269	2	57	529	0	13	7	3	14	1	0	12	7	236	538	2877				
Tusk	Beam Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Bottom Trawl	0	0	0	0	1	0	0	1	0	0	16	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	
	Lines	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
Tusk Total		0	0	0	0	1	0	0	1	0	0	16	2	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	23		
Grand Total		45	0	2	16	4	0	2	1	0	0	392	209	5	41	2350	740	25	408	1247	8	379	320	274	580	53	6	12	7	2234	1437	10799			

Table 17 Landings (t) by UK vessels into England + Wales and English + Welsh vessels landing outside the UK in 1998.

Species	Gear group	ICES Divisions																												Grand Total			
		112	113	114	203	501	502	Ia	IIa	IIc	IIe	IIg	IVa	IVb	IVc	Va	VIa	VIb	VI	VII	VIIc	VII	VIIe	VIIg	VII	VII	VIII	VIII	VIII		VIIj	VIIk	
		A	A	C	A	B												Ia	b		d			g	h	a	b	d					
Black Scabbardfish	Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2		
Black Scabbardfish Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2		
Blue Ling	Bottom Trawl	0	0	6	0	0	0	0	0	0	0	0	1	0	0	1	6	138	0	10	42	0	0	0	0	0	0	0	87	118	409		
	Lines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2			
	Nets	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	6	52	0	2	6	0	0	0	0	0	0	8	7	83			
Blue Ling Total		1	0	6	0	0	0	0	0	0	0	0	3	0	0	1	12	190	0	12	48	0	0	0	0	0	0	98	125	494			
Bluemouth Redfish	Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	7	7	0	0	0	0	0	0	0	15	17	72			
	Lines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	1	0	0	0	7			
	Nets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	1	0	0	0	0	0	0	0	0	1	1	14			
Bluemouth Redfish Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	35	0	9	7	0	0	0	0	1	0	0	16	18	93		
Greater Forkbeard	Beam Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
	Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	42	0	49	120	0	3	1	0	1	0	0	374	236	828		
	Lines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	1	1	0	0	0	0	3	0	0	1	19			
	Nets	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	234	0	18	26	0	0	0	0	23	0	0	147	56	519		
Greater Forkbeard Total		4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	275	0	68	147	0	3	1	1	27	0	0	523	292	1367		
Ling	Beam Trawl	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	2	0	0	5	72	70	24	141	0	0	0	0	319		
	Bottom Trawl	0	0	0	0	0	0	0	1	1	1	0	0	116	90	0	4	21	21	16	74	97	0	82	13	11	2	0	0	436	173	1160	
	Lines	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	65	1	6	8	18	0	10	3	1	107	29	0	0	43	0	302	
	Mid-water Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Nets	1	0	0	0	0	0	0	0	0	0	0	8	18	1	0	61	49	5	109	88	2	328	241	182	323	0	0	0	1004	130	2550	
	Pots	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	10	
	Seine	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7	0	12		
Ling Total		1	0	0	0	0	0	0	1	1	1	0	0	125	122	4	4	148	71	30	190	203	7	502	328	221	573	29	0	0	1490	303	4354
Livers + oils	Lines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	406	62	0	2	0	0	0	0	0	0	0	9	18	497			
	Nets	22	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	97	0	0	17	0	0	0	0	0	0	24	36	198			
Livers + oils Total		22	0	0	2	0	0	0	0	0	0	0	0	0	0	0	406	159	0	2	17	0	0	0	0	0	0	33	54	694			
Raw Livers	Lines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Nets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Pots	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Raw Livers Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	
Red Crab	Lines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0	5		
	Nets	2	0	0	40	0	0	0	0	0	0	0	34	0	0	0	16	217	0	12	15	0	0	0	0	1	8	0	1	14	0	357	
	Pots	0	0	0	0	0	61	0	0	0	0	0	0	0	0	0	1	75	0	0	0	0	0	0	0	6	121	0	59	1	0	323	

Table 17 Landings (t) by UK vessels into England + Wales and English + Welsh vessels landing outside the UK in 1998. (Continued)

Red Crab Total		2	0	0	40	0	61	0	0	0	0	0	0	34	0	0	0	16	295	0	14	15	0	0	0	0	6	128	0	60	15	0	685
Red Seabream	Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	6	
	Nets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Red Seabream Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	6	
Sharks	Beam Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	10	2	1	1	0	1	2	1	0	0	0	5	10	33	
	Lines	13	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	837	180	1	1	1	0	1	0	1	5	2	0	0	59	122	1253
	Mid-water Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Pots	50	0	0	4	0	0	0	0	0	0	0	0	1	1	0	0	18	427	0	3	4	0	3	8	7	10	0	0	0	83	36	655
Sharks Total		63	0	0	4	31	0	0	0	0	0	0	1	1	0	0	855	617	3	5	6	0	8	10	8	15	2	0	0	147	167	1944	
Spiny Scorpionfish	Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
Spiny Scorpionfish Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
Tusk	Bottom Trawl	0	0	0	0	0	0	0	0	1	0	0	10	1	0	1	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	23	
	Lines	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
Tusk Total		0	0	0	0	0	0	0	0	1	0	0	11	3	0	1	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	25	
Grand Total		94	0	6	46	31	61	0	1	1	2	0	0	173	126	4	6	1521	1651	32	300	443	7	513	339	230	623	159	0	60	2327	960	9715

Species – *Brosme brosme* (tusk) - Live wt (t)

year	IIa	IIb	IVa	IVb	IVc	Va	Vb1	Vb2	VIa	VIb	VIIa	VIIb,c	VIIId,e	VIIIf	VIIg-k	VIII	XII	XIV
1993			146	1					25	54								
1994			151	1			1		38	65								
1995			170	2			1		79	35	1	1						
1996			167	1			4		126	67								
1997			227	3			12	1	130	89	1							
1998	1		256	3			12	1	136	188	1							

Species – *Argentina silus* (argentine) - Live wt (t)

year	IIa	IIb	IVa,b,c	Va	Vb1	Vb2	VIa	VIb	VIIa	VIIb,c	VIIId,e	VIIIf	VIIg-k	VIII	XII	XIV
1993			56				406									
1994			24				37									
1995			20				145									
1996			22		3		221									
1997			20				19									
1998	1		31		1		57									

Species – *Phycis blennoides* (greater forkbeard) - Live wt (t)

year	IIa	IIb	IVa,b,c	Va	Vb1	Vb2	VIa	VIb	VIIa	VIIb,c	VIIId,e	VIIIf	VIIg-k	VIII	XII	XIV
1993							1			2						
1994							4	2		1						
1995			1				15									
1996			6				54			1						
1997			5				130	50		1						
1998			11				91	6								

3 UPDATE IN TABULAR FORM, BY SUB-AREA WHERE POSSIBLE, AVAILABLE DATA ON LENGTH/AGE AT MATURITY, GROWTH AND FECUNDITY FOR DEEP-WATER SPECIES, INCLUDING BLUE LING, LING AND TUSK

Ireland

The Fisheries Research Centre commenced a deep-water survey programme in 1993, and to date 4 trawl and 2 long line surveys have been completed in the deep waters to the west of Ireland and Scotland (Clarke *et al.*, 1999). The purpose of these surveys was to obtain samples of deep-water teleost and chondrichthyan fish for the deep-water fisheries programme of the Marine Institute. The differences in species composition, abundances and discarding levels between trawl and long line gears were also investigated (Clarke *et al.*, 1999). A preliminary investigation of the selectivity of the commercial trawl gear used was conducted during this survey and is discussed in more detail below.

In 1998 two surveys, one trawl and one longline, were undertaken in the deep waters of the Rockall Trough. The trawl survey was undertaken using a commercial vessel and demersal trawl gear (Clarke *et al.*, 1999). The long-line survey was carried out on a Norwegian long-liner using a Mustad autoline system (Connolly *et al.* 1999). Revised CPUE and discard information collected from these surveys is presented in Tables 19, 20, 21 and 22. Figure 1 shows the areas within which fishing took place during these two surveys.

Recent biological work carried out in Ireland has focussed on age, growth, maturity and fecundity of *Helicolenus dactylopterus* (Kelly *et al.* 1999). Samples for this study were obtained from the deep-water survey programme. Age was estimated at between 1 and 43 years and Brody growth coefficients (K) suggest that this species is slow growing. Ripe female fish were obtained in April and May. Total length at maturity for female fish was found to be 23 cm (age 13) (Kelly *et al.* 1999). This species has spawned in captivity and the larvae are currently the subject of investigations at the National Museum of Ireland in Galway.

Table 19 Discard levels expressed as a percentage of the total catch during long-line survey on the eastern and southern slopes of the Rockall Trough, see Figure 1.

Area	Species name	Discard weight sampled	Total Discard Weight	Total catch (kg)	Discard rate
4	<i>Helicolenus dactylopterus</i>	14.820	14.820	6555.550	0.002
5	<i>Helicolenus dactylopterus</i>	47.590	47.590	6618.980	0.007
3	<i>Lepidion eques</i>	1.400	1.400	3749.759	0.000
4	<i>Lepidion eques</i>	7.000	7.000	6555.550	0.001
5	<i>Lepidion eques</i>	2.920	2.920	6618.980	0.000
2	<i>Synaphobranchus kaupii</i>	8.730	8.730	2127.828	0.004

Table 20 Discarding levels in kg/tonne *C. rupestris* landed, during deepwater trawl survey of eastern and southern slopes of the Rockall Trough in 1997, see Figure 1.

Area	Species	Discard weight sampled	Raised Discard Weight	Catch (kg) <i>C. rup.</i>	Discard rate
1	<i>Alepocephalus bairdi</i>	26.92	174.44	2270.32	0.08
2	<i>Alepocephalus bairdi</i>	66.76	309.65	2421.69	0.13
3	<i>Alepocephalus bairdi</i>	1.68	20.33	3856.23	0.01
4	<i>Alepocephalus bairdi</i>	19.26	213.94	4674.64	0.05
5	<i>Alepocephalus bairdi</i>	9.48	233.30	4689.80	0.05
1	<i>Argentina silus</i>	19.86	92.66	2270.32	0.04
3	<i>Argentina silus</i>	20.14	181.26	3856.23	0.05
4	<i>Argentina silus</i>	4.94	48.92	4674.64	0.01
1	<i>Coryphaenoides rupestris</i>	29.53	133.14	2270.32	0.06
2	<i>Coryphaenoides rupestris</i>	38.28	185.31	2421.69	0.08
3	<i>Coryphaenoides rupestris</i>	42.90	665.51	3856.23	0.17
4	<i>Coryphaenoides rupestris</i>	44.02	535.28	4674.64	0.11
5	<i>Coryphaenoides rupestris</i>	60.50	1339.36	4689.80	0.29
4	<i>Trachyrhynchus murrayi</i>	5.08	68.36	4674.64	0.01
5	<i>Trachyrhynchus murrayi</i>	1.78	38.50	4689.80	0.01
3	<i>Lepidion eques</i>	8.38	119.62	3856.23	0.03
4	<i>Lepidion eques</i>	27.34	316.10	4674.64	0.07
5	<i>Lepidion eques</i>	4.06	99.18	4689.80	0.02

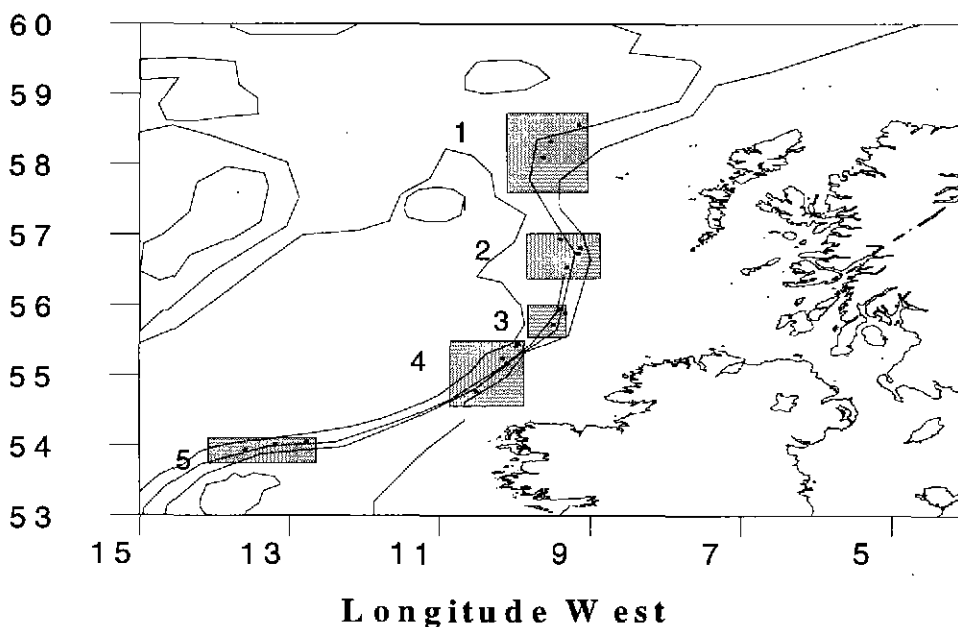


Figure 1. Areas within which fishing took place during 2 deepwater surveys carried out in 1997 by the Marine Institute.

Table 21 Catch per unit effort kg per hour of fishing and depth for seven species caught during trawl survey on eastern and southern slopes of the Rockall Trough in 1997. See Figure 1 for areas covered.

Area	Min Depth	Max depth	Species	CPUE kg/hour
1	930	930	<i>Alepocephalus bairdi</i>	42.72
	823	930	<i>Aphanopus carbo</i>	5.56
	640	823	<i>Argentina silus</i>	11.60
	640	1150	<i>Coryphaenoides rupestris</i>	56.69
2	1000	1100	<i>Alepocephalus bairdi</i>	35.93
	1000	1000	<i>Aphanopus carbo</i>	33.67
	880	1100	<i>Coryphaenoides rupestris</i>	83.98
3	1100	1100	<i>Alepocephalus bairdi</i>	4.52
	925	1100	<i>Aphanopus carbo</i>	13.89
	550	550	<i>Argentina silus</i>	87.00
	550	1150	<i>Coryphaenoides rupestris</i>	132.82
4	900	1100	<i>Alepocephalus bairdi</i>	16.04
	700	1100	<i>Aphanopus carbo</i>	15.10
	650	900	<i>Argentina silus</i>	4.29
	650	1100	<i>Coryphaenoides rupestris</i>	82.43
5	1035	1100	<i>Alepocephalus bairdi</i>	22.99
	1035	1158	<i>Aphanopus carbo</i>	25.33
	1035	1158	<i>Coryphaenoides rupestris</i>	169.24

Germany

Table 22 The CPUE (t/hr) in the German landings of deep-water species. (See Table 2 for additional information)

Species	ICES Sub-area/Division	CPUE (t/h)
<i>Argentina silus</i>	IIa	3.3576
<i>Argentina silus</i>	IVa	2.0082
<i>Argentina silus</i>	VIa	3.6738
<i>Molva dipterygia</i>	IIa	0.0075
<i>Molva dipterygia</i>	IVa	0.0047
<i>Molva dipterygia</i>	IVb	0.0008
<i>Molva dipterygia</i>	Va	0.0095
<i>Molva dipterygia</i>	VIa	0.0079
<i>Molva dipterygia</i>	VIIk	0.0065
<i>Molva dipterygia</i>	XIV	0.0025
Large Sharks	IIa	0.0033
Large Sharks	IIIa	0.0001
Large Sharks	IVa	0.0015
Large Sharks	IVb	0.0005
Large Sharks	IVc	0.0014
Large Sharks	Va	0.0126
Large Sharks	VIan	0.0082
Large Sharks	VIas	0.0027
Large Sharks	VIIb	0.0068
Large Sharks	VIIb	0.0081
Large Sharks	VIII-j	0.0132
Large Sharks	VIIk	0.0103
Large Sharks	XIV	0.007
<i>Molva molva</i>	IIa	0.0169
<i>Molva molva</i>	IIIan	0.0002
<i>Molva molva</i>	IIIas21	0.0004
<i>Molva molva</i>	IVa	0.0148
<i>Molva molva</i>	IVb	0.0027
<i>Molva molva</i>	IVc	0.001
<i>Molva molva</i>	Va	0.0009
<i>Molva molva</i>	VIan	0.0075
<i>Molva molva</i>	VIIb	0.008
<i>Molva molva</i>	VIIb	0.0175
<i>Molva molva</i>	VIII-j	0.0279
<i>Molva molva</i>	VIIk	0.0542
<i>Coryphaenoides rupestris</i>	Va	0.0023
<i>Coryphaenoides rupestris</i>	XIV	0.0226
<i>Brosme brosme</i>	IIa	0.0331
<i>Brosme brosme</i>	IVa	0.0074
<i>Brosme brosme</i>	IVb	0.0092
<i>Brosme brosme</i>	Va	0.0097
<i>Brosme brosme</i>	VIan	0.004
<i>Brosme brosme</i>	VIIk	0.0053

Iceland

Table 23 Length distributions of ling, tusk and silver smelt in Icelandic catches in 1998.

Blue ling		Ling		Tusk		Silver smelt	
cm	no.	cm	no.	cm	no.	cm	no.
56	1101	48	650	34	1562	27	3506
57	1101	50	1301	35	1562	28	3506
58	2202	52	650	36	10933	29	7013
59	3303	53	650	37	14057	30	24544
61	5505	54	650	38	15618	31	66620
62	3303	55	3252	39	15618	32	126227
63	12110	56	2601	40	17180	33	192846
64	2202	57	5853	41	31237	34	252453
65	9908	58	650	42	42170	35	248947
66	13211	59	8454	43	43731	36	238428
67	7706	60	7153	44	42170	37	350630
68	11009	61	3902	45	45293	38	494388
69	14312	62	4552	46	70283	39	838005
70	6605	63	5202	47	70283	40	1342912
71	4404	64	7804	48	70283	41	1742629
72	9908	65	7153	49	92148	42	2009108
73	9908	66	9755	50	96834	43	2075728
74	9908	67	3902	51	59350	44	1823274
75	11009	68	7153	52	89025	45	1777692
76	18715	69	12356	53	82777	46	1577834
77	15413	70	16258	54	99958	47	1507708
78	7706	71	11055	55	67159	48	1363949
79	9908	72	14957	56	68721	49	1009813
80	9908	73	22761	57	92148	50	813461
81	14312	74	20810	58	90587	51	452312
82	9908	75	19509	59	68721	52	245441
83	8807	76	18209	60	73406	53	115708
84	7706	77	13656	61	68721	54	24544
85	6605	78	20160	62	60912	55	7013
86	9908	79	23411	63	73406	57	7013
87	7706	80	25362	64	40608		
88	4404	81	22761	65	39046	Av. length(cm)	
89	9908	82	20810	66	40608	45,82 cm	
91	13211	83	24061	67	28113		
92	8807	84	13006	68	26551		
93	14312	85	25362	69	18742		
94	6605	86	18209	70	15618		
95	6605	87	21460	71	15618		
96	7706	88	18859	72	15618		
97	4404	89	19509	73	20304		
98	4404	90	18209	74	12495		
99	5505	91	10405	75	10933		
100	2202	92	11706	76	17180		
101	5505	93	7804	77	4686		
102	2202	94	11706	78	4686		
103	2202	95	12356	79	6247		
104	1101	96	5202	80	6247		
105	2202	97	12356	81	6247		
106	1101	98	11055	82	6247		
107	1101	99	10405	83	4686		
108	1101	100	15607	85	3124		
109	2202	101	10405	86	3124		
110	2202	102	11055	87	3124		
113	2202	103	13006	91	1562		
115	2202	104	7804	92	3124		

Table 23 continued.						
118	1101	105	7804	98	1562	
120	2202	106	9104	99	1562	
125	1101	107	5853	100	1562	
126	2202	108	7804			
129	3303	109	9104	Av.length(cm)		
130	2202	110	4552	55,54 cm		
132	1101	111	8454			
136	1101	112	5202			
139	1101	113	5202			
140	1101	114	3902			
		115	4552			
	Av.length(cm)	116	1951			
82.71		117	4552			
		118	2601			
		119	1951			
		120	3252			
		121	3252			
		122	1301			
		123	1301			
		124	3902			
		125	1951			
		126	2601			
		127	4552			
		128	650			
		129	1301			
		130	1951			
		131	1301			
		132	1301			
		133	1301			
		134	1951			
		135	650			
		136	1301			
		138	650			
		139	650			
		141	650			
		145	1301			
		147	650			
		148	1301			
		149	1301			
		153	650			
		156	1301			
		169	650			
		Av.length				
		87,58 cm				

Norway

In 1998, no new biological data were available for ling and tusk, the two major target species of the traditional high-seas longline fishery.

From the experimental bottom trawl fishery at the Hatton Bank, catch in terms of weight by depth, and length compositions were recorded for a number of species, including blue ling (Langedal and Hareide 1998). The species for which such data are available are *Coryphaenoides rupestris*, *Alepocephalus bairdii*, *Centroscymnus coelolepis*, *C. crepidater*, *Etmopterus princeps*, *Chimaera monstrosa*, *Molva dypterygia*, *Reinhardtius hippoglossoides*, *Sebastes mentella*, and *Aphanopus carbo*.

Portugal

Mainland Portugal

A research survey the southern coast of mainland Portugal by the R/V "Noruega". was carried out in the summer of 1998. The objective was to study the biology, distribution and biomass estimates of deep-water species at depths from 400 to 900 m.

As in earlier surveys a stratified sampling program was adopted and in each *stratum* at least two hauls of one hours duration were carried out at a speed of around 3 knots. The trawl was designed for the capture of crustaceans and had a codend of 20 mm and a horizontal opening of 30 m.

The catch data for the most frequent species captured during the survey were analysed. For each of these species, density (kilogrammes by square nautical mile – kg/SNM) and biomass (t) were determined using the stratified random sampling estimator proposed by Cochran (1977).

Table 24 presents for each species the number of hauls, the area surveyed, the standard deviation of the mean, the degrees of freedom, the density, the biomass and 80% biomass confidence interval.

Table 24 Density and biomass estimates for some deep-water species.

SPECIES	s.d.	d.f	Density (Kg/SNM)	Biomass (t)	Biomass 80% C. I.
<i>Helicolenus dactylopterus</i>	14.7	3	88.22	120.3	(87, 153)
<i>Phycis blennoides</i>	10.9	2	67.92	92.6	(65, 121)
<i>Conger conger</i>	23.0	5	95.57	130.3	(84, 177)
<i>Hoplostethus mediterraneus</i>	66.0	4	317.04	432.4	(294, 570)
<i>Trachyrhynchus trachyrhynchus</i>	7.4	4	21.14	28.8	(13, 44)
<i>Galeus melastomus</i>	41.2	3	491.19	669.9	(578, 762)
<i>Chimaera monstrosa</i>	22.7	2	148.15	202.1	(144, 260)
<i>Deania calcea</i>	11.4	4	100.35	136.9	(113, 161)
<i>Aristeus antennatus</i>	4.8	4	35.69	48.7	(39, 59)
<i>Aristeomorpha foliacea</i>	3.3	1	9.7	13.3	

s.d. - standard deviation of the mean; d.f. - degrees of freedom.

Portugal, Azores

Species	ICES Sub-area/Division	Length at maturity (cm)		Age at maturity (years)		Fecundity	Source(s) Published/Unpublished
		Females	Males	Females	Males		
<i>Pagellus bogaraveo</i>	X	29.2	26.2	4	3	290000-1125000	1
<i>Phycis phycis</i>	X	38.5	41.7	4	5		2
<i>Pontinus kuhlii</i>	X	22.6	29.9	5	9		1
<i>Beryx decadactylus</i>	X	32.5	30.3	4	4		1
<i>Beryx splendens</i>	X	23	22.9	2	2		1
<i>Helicolenus dactylopterus</i>	X	21.8	28.1	3	5		1
<i>Lepidopus caudatus</i>	X	114.9	85	3	1		1
<i>Pagrus pagrus</i>	X	29.9	33.3	4	5		2
<i>Pagellus acarne</i>	X	21.7		3			2

(1) - Estácio, S., A. Mendonça, H. Krug, G. M. Menezes, J. Branco & M. R. Pinho. Reproduction of six demersal fishes captured in Azores Archipelago, 1999. *Arquipélago, Boletim da Universidade dos Açores - Ciências Biológicas e Marinhas*. In press

(2) – Unpublished

Spain

Since 1996 a series of experimental surveys have been conducted at depths > 500 m and some information on the biology of deep-water species has been obtained.

The growth study of greater forkbeard (*Phycis blennoides*) in the North and North-west of the Spain (ICES Division VIIIc and IXa) is based on information collected in commercial (trawls and longliners) and research during 1996 and 1997. The mean lengths at age derived from otolith readings (919) by sex and their standard deviations (STD) were calculated (Table 25).

Table 25 .- Mean total length \pm SD at age , and number from age readings on *Phycis blennoides* otoliths.

Age (years)	Males		Females		Total	
	Total length (cm)	N	Total length (cm)	N	Total length (cm)	N
0.5	15.3 \pm 1.9	4	16.3 \pm 2.4	4	12.8 \pm 3.3	32
1.5	19.0 \pm 2.9	17	19.7 \pm 2.1	19	18.0 \pm 2.3	132
2.5	27.4 \pm 3.1	71	26.6 \pm 3.8	57	26.4 \pm 3.8	168
3.5	31.5 \pm 3.3	75	31.9 \pm 3.7	113	31.8 \pm 3.5	191
4.5	37.1 \pm 2.8	55	38.7 \pm 3.2	101	38.2 \pm 3.1	158
5.5	41.5 \pm 3.7	14	47.2 \pm 4.5	62	46.1 \pm 4.9	76
6.5	44.0	1	54.8 \pm 5.1	88	54.5 \pm 5.2	90
7.5			60.0 \pm 5.6	48	60.1 \pm 5.5	49
8.5			64.7 \pm 5.3	12	64.7 \pm 5.3	12
9.5			68.3 \pm 5.5	3	68.3 \pm 5.5	3
10.5			71.2 \pm 3.6	5	71.2 \pm 3.6	5
11.5			78.0 \pm 0.0	2	78.0 \pm 0.0	2
13.5			73.0	1	73.0	1

The von Bertalanffy function was adopted to model the growth pattern and the equations by sex were:

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

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

The length frequency distributions of some deep-water species have been obtained from ICES Sub-area XII (Hatton Bank) (Figures 2 to 5)

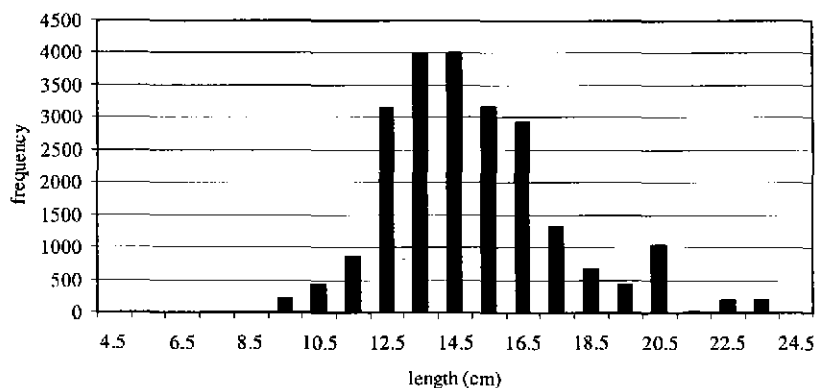


Figure 2. Catch length distribution of *C. rupestris* from Hatton Bank, (ICES Sub-area XII) in 1997.

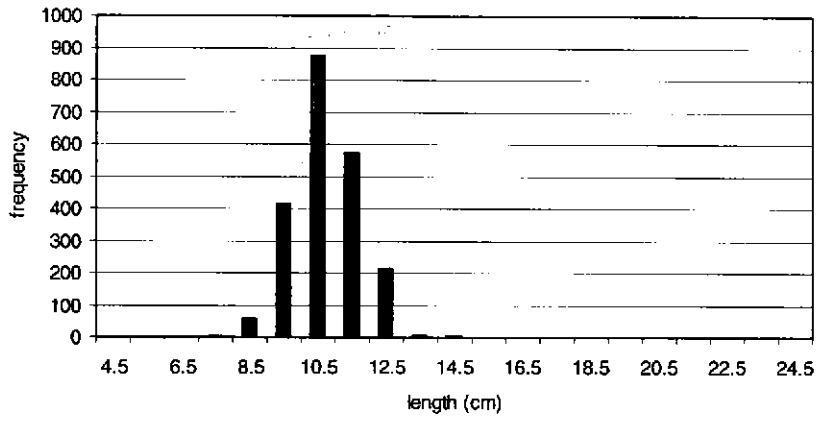


Figure 3 Length distribution of *C. rupestris* discarded in Hatton Bank (ICES Sub-area XII) in 1977.

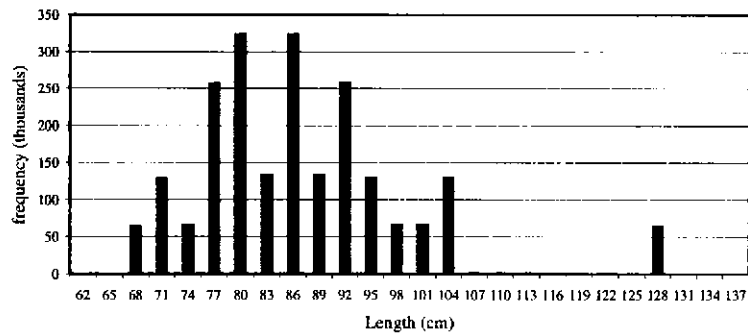


Figure 4 Catch length distribution of *M. dypterygia* from Hatton Bank (ICES Sub-area XII) in 1977.

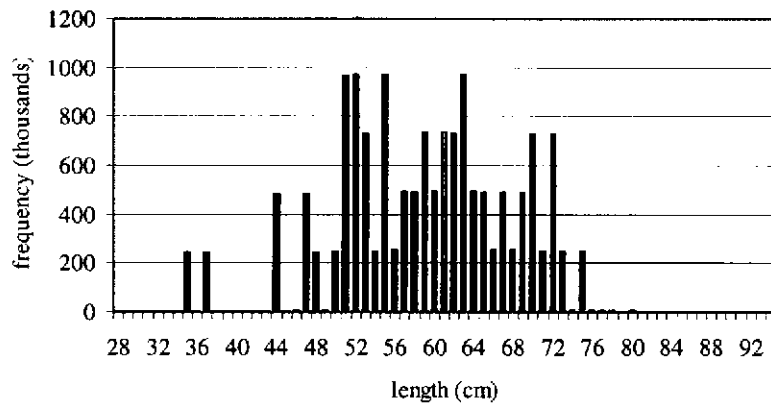


Figure 5 Length distribution of *A. baidii* discarded in Hatton Bank (ICES Sub-area XII) in 1977.

United Kingdom

Information on the biology of notacanthid fishes and *Nezumia aequalis* has been published as part of the EC FAIR Deep-Fisheries Project (95/655) (Coggan *et al.*, 1998, 1999). Survey data on deep-water sharks has also been compiled for this project.

4 INVENTORY OF AVAILABLE DISCARDS AND DEEP-WATER FISH COMMUNITY DATA

France

Information on discards of *Coryphaenoides rupestris* carried out by IFREMER under the EC FAIR Deep-fisheries Project (95/655) was presented at the 1998 ICES Annual Science Conference (Dupouy *et al.* 1998).

Norway

Discard data from the Norwegian longline fishery for ling and tusk in the period 1993-1997 were assembled by Hareide and Garnes (Møre Research) as part of an EU FAIR project (Gordon, 1998). 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 26 From area VIa (Hebrides), 7 settings were sorted, and the catch composition is given in Table 27. *Phycis blennoides* is the main discard species in these areas.

Table 26 Mean catch and discards (kg) per 1000 hooks in area IVa in the years 1993-1997.

Species	1993	1994	1995	1997	Total	Discarded
<i>Molva molva</i>	115.01	88.04	98.05	87.04	91.61	
<i>Brosme brosme</i>	22.90	18.74	23.89	17.05	19.46	0.00
<i>Pollachius virens</i>	0.48	38.29	0.14	10.54	7.43	
<i>Melanogrammus aeglefinus</i>	0.40	33.57	2.68	5.95	5.25	
<i>Gadus morhua</i>	7.43	25.79	0.52	4.87	4.02	
Unidentified skates				5.23	3.28	
<i>Phycis blennoides</i>	0.91		8.25		2.62	2.62
<i>Galeus melastomus</i>	3.06		1.34	0.24	0.69	0.69
<i>Squalus acanthias</i>	0.68		1.43	0.30	0.67	0.67
<i>Raja fullonica</i>		4.80	0.17		0.15	
<i>Chimaera monstrosa</i>	0.52		0.31	0.01	0.13	0.13
<i>Conger conger</i>	1.20			0.09	0.10	0.10
<i>Scyliorhinus caniculus</i>			0.02	0.10	0.07	0.07
<i>Helicolenus dactylopterus</i>			0.21		0.06	0.06
<i>Sebastes viviparus</i>			0.19		0.06	0.06
<i>Molva dipterygia</i>			0.16		0.05	
<i>Pollachius pollachius</i>		2.07		0.01	0.05	
<i>Etmopterus sp</i>			0.15		0.05	0.05
<i>Anarhichas lupus</i>		1.20	0.03		0.03	0.03
<i>Eutrigla gurnardus</i>				0.04	0.03	0.03
<i>Prionace glauca</i>				0.03	0.02	0.02
<i>Sebastes marinus</i>			0.05	0.01	0.02	
<i>Merlangius marlangus</i>				0.02	0.01	
<i>Merluccius merluccius</i>				0.01	0.01	0.01
<i>Raja radiata</i>		0.36			0.01	0.01
<i>Hippoglossus hippoglossus</i>				0.02	0.01	
<i>Lepidorhombus whiffiagonis</i>				0.0024	0.0015	0.0015
Total	152.59	212.86	137.59	131.56	135.89	4.55

From the experimental fishery at the Hatton Bank, 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.

An updated account of the fish communities along the slope of the eastern Norwegian Sea was published (Bergstad *et al.* 1999) showing the pronounced decline in fish biomass with depth and passage into the cold Norwegian Sea Deepwater at about 700 m depth. There is also a marked change in species composition in the same depth zone.

Table 27 Mean catch and discards (kg) per 1000 hooks in area VIa in the years 1993-1995.

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

United Kingdom

Scotland

Information on discards of deep-water species carried out by Fisheries Research Services under the EC FAIR Deep-fisheries Project (95/655) was presented at the 1998 ICES Annual Science Conference (Blasdale and Newton, 1998)

5 MEETING 2000

It is recommended that the next meeting of the ICES Study Group on the Biology and Assessment of Deep-sea Fisheries Resources be held at ICES headquarters in early 2000.

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APPENDIX 1

Report on catches of deepwater species from the northeastern United States for the ICES Study Group on the Biology and Assessment of Deep-sea Fisheries Resources

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Introduction

Although many other countries are currently exploiting deepwater resources, very limited deepwater fishing is being conducted off the northeastern US. This report is a first attempt at compiling the available data on deepwater fisheries and fishery resources off the northeastern United States. Included are commercial landings data on deepwater fish and crustaceans, supplemented by data from exploratory fishing. Also included are those deepwater species caught in other fisheries and reported as by-catch by observers on commercial vessels.

Landings data

The landing figures given in Table 1 represent those officially reported by vessels coming into ports along the East Coast from Virginia to Maine (compiled from the Commercial Fisheries Database). The region fished extends from Cape Hatteras to Nova Scotia, although the precise location fished is often unreported in the database. Because of the low levels of landings, the National Marine Fisheries Service (NMFS) presently tracks the landings of very few deepwater species.

It should be noted that some portion of the regular commercial landings for cusk (*Brosme brosme*), redfish (mostly *Sebastes fasciatus*), white hake (*Urophycis tenuis*), offshore hake (*Merluccius albidus*), monkfish (*Lophius americanus*), wolffishes (*Anarhichas* spp.), and witch flounder (*Glyptocephalus cynoglossus*) come from below 300 m. Because depth of capture is frequently not reported in the Commercial Fisheries Database, it is not possible at this time to reconstruct just what portion of those catches came from the continental slope.

Table 1. Landings in pounds (metric tons in parentheses) from Commercial Fisheries Database

	1994	1995	1996	1997	1998
<i>Coryphaenoides rupestris</i>	0	58	25	668	75
<i>Helicolenus dactylopterus</i>	316	100	470	1052	618
<i>Reinhardtius hippoglossoides</i>	9	99	59	78	33
<i>Polyprion americanus</i>	74	0	0	0	96
<i>Lepidocybium flavobrunneum</i>	810	1208	272	1135	2761
<i>Pleoticus robustus</i>	0	0	6182 (2.8 mt)	29805 (13.5 mt)	105
<i>Chaseon quinquidens</i>	560	1261248 (572 mt)	1354789 (614 mt)	3804276 (1725 mt)	3473352 (1575 mt)

All the deepwater fishes reported in the Commercial Fisheries Database represent by-catch retained and landed. The roundnose grenadiers (*Coryphaenoides rupestris*) were taken in otter trawls, with the majority of landings coming from south of Martha's Vineyard (NAFO area 5Zw) and lesser amounts from either Cape Hatteras (NAFO area 6C) or unreported locations. The black-belly rosefish (*Helicolenus dactylopterus*) were taken in small amounts throughout the entire area (NAFO areas 6C, 6B, 6A, 5Zw, 5Ze) as by-catch in both trawl and longline operations. The Greenland halibut (*Reinhardtius hippoglossoides*) were entirely taken in otter trawls off New England (NAFO areas 5Zw and 5Ze). The wreckfish (*Polyprion americanus*) were taken as by-catch in longline fisheries off New England (NAFO areas 5Zw and 5Ze). Escolar (*Lepidocybium flavobrunneum*) were caught with pelagic longlines. In cases where precise locations are reported for escolar, the sets were made in the canyons ranging from Georges Bank to Cape Hatteras (NAFO areas 6C, 6B, 6A, 5Zw, 5Ze).

The landings of the two crustacean species listed in the table are the result of directed fisheries targeting those species. Red crab (*Chaseon quinquidens*) were caught using either crab pots or offshore lobster pots and were landed live. Red crabs were primarily taken on the upper slope from off New Jersey to Georges Bank (NAFO areas 6A, 5Zw and 5Ze).

Royal red shrimp (*Pleoticus robustus*) were caught using bottom otter trawls, primarily on the upper slope between Hudson Canyon and Nantucket Shoals (NAFO areas 6A and 5Zw).

Table 2 contains the landings compiled from the final reports of deepwater exploratory fishers. These four commercial trawlers were funded to explore the potential resources off the northeastern US. They examined deepwater resources between 300 and 1800 m from off New Jersey to Georges Bank (NAFO areas 6A, 5Zw, and 5Ze) and operated for a combined total of 185 days of fishing. Although these fishers were directly targeting certain species, they were exploring as many localities as feasible and were not necessarily attempting to maximize their catches.

Table 2. Landings in pounds (metric tons in parentheses) from exploratory fishers' reports.

	1994	1995	1996	1997
<i>Coryphaenoides rupestris</i>	0	0	25	0
<i>Reinhardtius hippoglossoides</i>	0	0	274	0
<i>Lophius americanus</i>	5610 (2.5 mt)	41141 (18.6 mt)	19318 (8.8 mt)	1112 (0.5 mt)
<i>Brosme brosme</i>	0	0	2495 (1.1 mt)	0
<i>Merluccius albidus</i>	1205 (0.5 mt)	1750 (0.8 mt)	6326 (2.9 mt)	5444 (2.5 mt)
<i>Alepocephalus spp.</i>	0	0	1100 (0.5 mt)	0
<i>Sebastes spp./Helicolenus mix</i>	0	0	11416 (5.2 mt)	31
<i>Hydrolagus/Rhinochimaera</i>	0	0	110	0
<i>Gephyroberyx darwini</i>	0	0	75	0
<i>Pleoticus robustus</i>	3132 (1.4 mt)	2645 (5.7 mt)	10007 (4.5 mt)	8480 (3.8 mt)
<i>Illex illecebrosus</i>	1180 (0.5 mt)	0	16600 (7.5 mt)	0

Exploratory data on by-catch

Three of the four exploratory trawlers conducted exploratory fishing for royal red shrimp in NAFO areas 6A and 5Zw. Exploratory trawling was undertaken to depths of 1450 m, but shrimp were most abundant between depths of 290 to 400 m and were rare below 460 m.

One of these vessels produced a quantitative analysis of their by-catch. They reported that, without use of the Nordmore grate (an fish excluder device), the catch consisted of 12% royal red shrimp, 8% other crustaceans (including scarlet shrimp – *Plesiopenaeus edwardsianus*, galatheid crabs, lobsters – *Homarus americanus*, and red crab – *Chaseon quinquidens*), 32% monkfish (*Lophius americanus*), 17% whiting (*Merluccius bilinearis* and *M. albidus*), 9% black-belly rosefish (*Helicolenus dactylopterus*), 6% flatfish (*Reinhardtius hippoglossoides* and *Glyptocephalus cynoglossus*), and 16% miscellaneous species.

The miscellaneous species were dominated (by weight) by the following:

skates (*Raja radiata* and *R. senta*), shortnose greeneye (*Chlorophthalmus agassizi*), grenadiers (*Coelorinchus coelorhincus*, *Coryphaenoides spp.*, *Nezumia bairdii*, *Malacocephalus occidentalis*), white hake (*Urophycis tenuis*), redfish (*Sebastes fasciatus*), squid (*Illex illecebrosus*), and various anemones. The more uncommon species in the by-catch were retained and later identified as the following:

margined snake eel (*Ophichthus cruentifer*)
 snipe eel (*Nemichthys scolopaceus*)
 snubnose eel (*Simenchelys parasitica*)
 cutthroat eels (*Synaphobranchus* spp.)
 conger eel (*Conger oceanicus*)
 Atlantic argentine (*Argentina silus*)
 bluntnout smoothhead (*Xenodermichthys copei*)
 silver hatchetfish (*Argyropelecus aculeatus*)
 another hatchetfish (*Polyipnus clarus*)
 longtooth anglemouth (*Gonostoma elongatum*)
 black dragonfish (*Melanostomias bartonbeani*)
 white barracudina (*Arctozenus rissoi*)
 longnose greeneye (*Parasudis triculenta*)
 horned lanternfish (*Ceratoscopelus maderensis*)
 headlight lanternfish (*Diaphus dumerili*)
 headlight lanternfish (*Diaphus taaningi*)
 beardfish (*Polymixia lowei*)
 Atlantic batfish (*Dibranchius atlanticus*)
 Suttkus' gaper (*Chaunax suttkusi*)
 fourbeard rockling (*Enchelyopus cimbrius*)
 beardless codling (*Gadella imberbis*)
 alfonsino (*Beryx decadactylus*)
 western roughy (*Hoplostethus occidentalis*)
 deepbody boarfish (*Antigonia capros*)
 buckler dory (*Zenopsis conchifera*)
 red dory (*Cyttopsis roseus*)
 a zeniontid (*Zenion hololepis*)
 spotted tinseltail (*Xenolepidichthys dalgleishi*)

deepwater scorpionfish (*Setarches guentheri*)
 blackbelly rosefish (*Helicolenus dactylopterus*)
 armored searobins (*Peristedion* spp.)
 snailfish (*Puriliparis garmani*)
 blackmouth bass (*Synagrops bellus*)
 keelcheek bass (*Synagrops spinosus*)
 goby duckbill (*Bembrops gobioides*)
 Atlantic pomfret (*Brama brama*)
 spotfin dragonet (*Foetorepus agassizi*)
 northern wolffish (*Anarhichas denticulatus*)
 Simony's frostfish (*Benthodesmus simonyi*)
 black gemfish (*Nesiarichus nasutus*)
 brown driftfish (*Ariomma melanum*)
 tonguefish (*Symphurus* sp.)
 deepwater catshark *Apristurus* sp.
 cutthroat eel *Diastobranchus* sp.
 stout sawpalate eel *Serrivomer beanii*
 slatjaw cutthroat eel *Synaphobranchus kaupi*
 spiderfish *Bathypterois dubius*
 swordsnout grenadier *Coelorhincus occa*
 roundnose grenadier *Coryphaenoides rupestris*
 roughhead grenadier *Macrourus berglax*
 Suttkus' gaper *Chaunax suttkusi*
 ridgehead *Scopelogadus beanii*
 fangtooth *Anoplogaster cornuta*
 deepbody boarfish *Antigonia capros*
 blackbelly rosefish *Helicolenus dactylopterus*
 pallid sculpin *Cottunculus thomsonii*

The fourth exploratory trawler searched for demersal fishes in 1996. Trawling was undertaken from New Jersey to Georges Bank at depths of 360-1500m, but generally between 450-800 m. The results of four cruises, representing a total of 34 days at sea, are given in table 3 with total catches and discarded by-catch noted. The main species caught were red crabs, monkfish, "redfish" (*Helicolenus dactylopterus*, *Sebastes fasciatus*, and *S. mentella*), smoothheads (*Alepocephalus agassizi*, *A. bairdi*, *A. productus*), cusk (*Brosme brosme*), skates (*Raja radiata*, *R. jenseni*, and *R. spinacauda*), deepwater dogfish (*Centroscyllium fabricii*, *Centroscymnus coelolepis*, *Etmopterus princeps*, *Etmopterus gracilispinus*), Greenland halibut (*Reinhardtius hippoglossoides*), chimaeras (*Rhinochimaera atlantica*, *Hydrolagus affinis*, *H. pallidus*), hake (*Antimora rostrata* and *Phycis chesteri*), witch flounder (*Glyptocephalus cynoglossus*), and shrimp (*Pleoticus robustus* and *Plesiopenaeus edwardsianus*). Red crab accounted for 79% of the catch by weight, while monkfish represented 9%, redfish were 8%, and all other species combined were less than 5% of the catch. Even though red crab were a huge portion of the catch, the crabs themselves were damaged by the trawl net and the vessel involved was not equipped for immediate processing at sea of the meat, so the entire crab catch was discarded.

Table 3. Estimated catch by exploratory deepwater otter trawler

red crabs	127610+ lbs	(57.9 mt)	discarded all
monkfish	14780 lbs	(6.7 mt)	landed all
redfish	12415 lbs	(5.6 mt)	landed 11388 lbs
smoothheads	2000+ lbs	(1 mt)	landed 1100 lbs
cusk	1540 lbs	(0.7 mt)	landed all
skates	1200+ lbs	(0.5 mt)	discarded all
deepwater dogfish	500+ lbs	-	discarded all
Greenland halibut	400+ lbs	-	landed 274 lbs
chimaeras	170+ lbs	-	landed 110 lbs
hake	70+ lbs	-	discarded all
witch flounder	35+ lbs	-	discarded all
shrimp	33 lbs	-	discarded all

This fisher also retained miscellaneous by-catch for identification. Species identified include:

Observer data on by-catch

Additional data on catches is available from the Sea Sampling Observer Program. This program places a limited number of observers on commercial fishing vessels. Coverage by observers represents about 0.5% of the fleet. The observers record not only catches for each species, but also amounts discarded. Table 4 gives estimated weights (in pounds) for deepwater species noted by observers, "d" designates weight discarded and "k" is for weight kept and landed. The methods of capture were trawls (tr.), gill net (g.net), longlines (l.l.), or some combination of gear.

Table 4. By-catch species and weights (in pounds) from observer records.

		1994	1995	1996	1997	1998
<i>Anotopterus pharao</i>	tr.	1d	-	-	-	-
<i>Himatolophus</i> sp.	tr.	-	-	2d	-	-
<i>Xenolepidichthys dalgleishi</i>	tr.	<1d	-	<1d	1d	-
<i>Grammicolepis brachiusculus</i>	tr.	-	-	-	<1d	-
<i>Beryx</i> sp.	tr.	-	-	-	<1d	-
<i>Maurolicus weitmani</i>	tr.	-	-	2d	-	-
<i>Foetorepus agassizi</i>	tr.	-	-	-	2d	2d
<i>Chlorophthalmus agassizi</i>	tr.	-	-	2d	1d	-
<i>Parasudis truculenta</i>	tr.	-	-	<1d	-	-
<i>Polymixia lowei</i>	tr.	-	-	281d	294d	697d
<i>Chaunax</i> sp.	tr.	-	-	-	6d	26d
<i>Macrouridae</i>	tr.	-	3d	1d	10d	-
<i>Nezumia bairdi</i>	tr.	-	3d	2d	-	-
<i>Reinhadius hippoglossoides</i>	tr.	36k	<1d/10k	4d	-	-
<i>Argentina silus</i>	tr.	-	-	6d	-	-
<i>Gephyroberyx darwini</i>	tr.	-	-	-	-	3d
<i>Zeidae</i>	tr.	-	-	80d	-	-
<i>Cyttopsis rosea</i>	tr.	-	-	1d	-	-
<i>Antimora rostrata</i>	g.net	6d	-	-	-	-
<i>Antigonia</i> sp.	tr.	-	-	-	1d	1d
<i>Antigonia combatia</i>	tr.	-	3d	23d	7d	34d
<i>Antigonia capros</i>	tr.	-	6d	11d	64d	2d
<i>Myctophidae</i>	tr.	12d	-	-	-	-
<i>Macrorhamphosus</i> sp.	tr.	-	-	-	-	5d
<i>Macrorhamphosus gracilis</i>	tr.	-	-	6d	5d	-
<i>Macrorhamphosus scolopax</i>	tr.	-	-	4d	<1d	7d
<i>Trachipterus</i> sp.	l.l.	-	-	-	30d	-
<i>Trichiurus lepturus</i>	tr.	5k	2d/2k	56d	5d	-
<i>Gempylidae</i>	l.l.	6d	33d	-	-	-
<i>Ruvettus pretiosus</i>	l.l.	847d	533d	-	-	-
<i>Bramidae</i>	tr.	10d	-	-	-	-
<i>Taraticthys longipinnis</i>	l.l./tr.	44d/96k	10d/16k	-	-	-
<i>Brama brama</i>	tr.	8d	11.9d	-	-	-
<i>Lampris guttatus</i>	l.l./tr.	200d/497k	153k	-	-	-
<i>Lepidocybium flavobrunneum</i>	l.l.	211k/672d	64k/1319d	-	102k/1415d	-

