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Deep-sea bottom-living fishes at two repeat stations at 2 200 and 2 900 m in the Rockall Trough, northeastern Atlantic Ocean

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Abstract

Repeated sampling of deep-sea bottom-living fishes was conducted at two stations in the Rockall Trough at depths of 2 200 and 2 900 m. The 2 200 m station (M) was sampled 16 times by an Agassiz trawl between April 1978 and April 1985 and yielded 473 fish belonging to 17 species. The 2 900 m permanent station (PS) yielded 781 fish belonging to 11 species from 9 Agassiz trawls, 2 small box otter trawls, 4 semi-balloon otter trawls and 7 epibenthic sledges between March 1975 and April 1985. Macrourid fishes were numerically dominant at both stations with *Coryphaenoides guentheri* and *Coryphaenoides (Nematonurus) armatus* being the most abundant species at M and PS, respectively. In terms of biomass the morid, *Antimora rostrata*, was dominant at M but *C. (N.) armatus* was dominant at PS. The only species that showed clear evidence of a seasonal reproductive cycle was *C. guentheri.* Many species showed no indication of reproducing in the Rockall Trough. The diets of almost all the species are described and considered in relation to the food resources exploited. Investigations on the pelagic and benthic invertebrate faunas at these stations should reveal the extent to which the bottom-living fishes exploit the available resources.

Introduction

A survey of the bottom-living fish populations of the Rockall Trough, which began in 1975, was concentrated on a relatively gently sloping region of the eastern margin known as the Hebridean Terrace (56–57°N; 09–10°W) at depths between 250 and 2 000 m (Gordon and Duncan, 1985 a). Limited sampling was also carried out at greater depths, and some preliminary results have been given by Gordon (1986). At the same time, investigations of the pelagic and benthic invertebrate populations were also being undertaken in the Rockall Trough. The pelagic sampling was centred in the area 55°N; 12°W (Mauchline, 1986) which is also the site of a permanent benthic station (PS) at 2 900 m (Gage *et al.,* 1980; Gage, 1986). Most of the bottom-living fishes at this permanent station were captured by an Agassiz trawl (AT), a small box otter trawl (SWT) and a semi-balloon otter trawl (OTSB), although a few were obtained from an epibenthic sledge (ES). The Institute of Oceanographic Sciences has also carried out a vertical pelagic series at this station (Hargreaves, 1984, 1985; Hargreaves *et al.,* 1984).

To the north of the Hebridean Terrace a second, benthic station was established in 1978 at about 57°18′N, 10°11′W at a depth of about 2 200 m (Gage and Tyler, 1982, 1985). It is designated "M" which refers to the position of a hydrographic station on a transect between Barra Head and Rockall (Ellett *et al.,* 1986). This station has been sampled by the Agassiz trawl and the epibenthic sledge, but only the Agassiz trawl yielded catches of bottom-living fishes. In this paper, the fish assemblages at each of these stations will be described with special emphasis on their diets, which it is hoped to relate to the available prey as determined by the pelagic and benthic programmes. Where appropriate, published or unpublished data on the depth range and length-frequency distributions of individual species from our own sampling in the Rockall Trough will be cited.

Materials and methods

Full descriptions of the trawls and the fishing methods have been given by Gordon and Duncan (1985 a) and Gordon (1986). The Agassiz trawl had a mouth width of 3 m, while the box and semi-balloon trawls had approximate mouth widths of 7.1 and 8.6 m. The station data are given in Table 1 and the positions are also shown in Fig. 1. Most of the catches were preserved either in formalin or deep-frozen and identified and worked up in the labora-

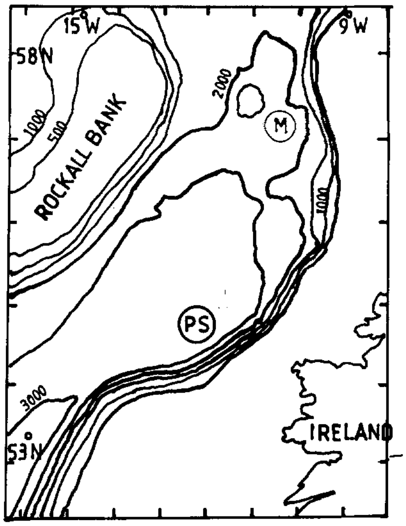

Fig. 1. Rockall Trough, showing the locations of Station M (~2 200 m) and Scottish Marine Biological Association permanent station, PS, (~ 2 900 m)

tory. Some large catches of species such as *Coryphaenoides (Nematonurus) armatus* were worked up at sea and discarded. The fish were routinely measured and weighed, and individual stomach contents were removed for later analysis. The stomach contents were analysed as described by Mauchline and Gordon (1984). Sex and maturity was also recorded and the ovaries were weighed. A six-point scale was used to describe the maturity of the female fishes based on macroscopic examination: I, immature; II, resting; III, maturing; IV, advanced maturity; V, ripe; VI, spent. The gonosomatic index (GSI) was calculated as follows:

$$\mathrm{GSI} = \frac{\text{ovary wt}}{\text{total wt of fish} - \text{ovary wt}} \times 100.$$

Depending on the nature of the ovary, fecundity was either estimated by counting the number of ova in weighed sub-samples or in samples of known volume. Measurements of ova diameters were also made for some species.

Gnathoproctal lengths (GNP, length from tip of lower jaw to the anal opening) were used for *Halosauropsis macrochir* and *Polyacanthonotus challengeri*. Head (HL) and total (TL) lengths were used for macrourids, and in this paper head lengths have been used for the analysis of length-frequency distributions. The relationships between head length and total length are given in Table 2 together with the length-weight relationships which were used to calculate the biomass of species which were only measured and discarded at sea. Either total (TL) or standard length (SL) was used for all the other species.

Results

A total of 17 species of fishes belonging to ten families were caught by the 16 Agassiz trawls at Station M. The list of species and the number of specimens is given in Table 3. Only two species, the macrourid *Coryphaenoides guentheri* and the morid *Antimora rostrata* occurred in all hauls, and in every haul *C. guentheri* was numerically dominant, accounting for 51% of the total combined catch. *A. rostrata* accounted for 13% of the numbers, but was dominant in terms of biomass (52%) compared with *C. guentheri* (24%). There were no obvious seasonal or annual changes in species composition between hauls.

Table 1. Details of trawls at Station M (~2 200 m) and Permanent Station, PS (~2 900 m) from which bottom-living fishes were obtained

Station No	Date	Position		Mid-depth
		°N	°W	(m)
Station M				
Agassiz trawl (AT)				
6/78/AT144	19. IV. 1978	57 13;	10 20	2 240
9/78/AT151	6. VI. 1978	57 21;	10 22	2 175
1A/79/AT153	15. I. 1979	57 20;	10 27	2 200
7/79/AT154	21. V. 1979	57 08;	10 22	2 264
11/79/AT167	13. VIII. 1979	57 04;	10 23	2 300
4/80/AT171	3. III. 1980	57 16;	10 17	2 225
9A/80/AT175	28. V. 1980	57 19;	10 16	2 210
9A/80/AT177	29. V. 1980	57 18;	10 16	2 200
14A/80/AT181	16. IX. 1980	57 19;	10 28	2 220
6A/81/AT186	12. IV. 1981	57 22;	10 19	2 170
12B/81/AT195	18. VIII. 1981	57 23;	10 27	2 190
15/81/AT198	15. X. 1981	57 15;	10 20	2 215
7B/82/AT201	9. V. 1982	57 22;	10 30	2 180
7/83/AT233	19. V. 1983	57 17;	10 12	2 180
10/83/AT245	26. VII. 1983	57 21;	10 21	2 165
3/85/AT288	20. IV. 1985	57 18;	10 22	2 190
Permanent Station (PS)				
Agassiz trawl (AT)				
2A/77/AT121	29. I. 1977	54 37;	12 09	2 910
6A/77/AT130	7. IV. 1977	54 46;	12 19	2 900
6A/77/AT131	7. IV. 1977	55 03;	12 20	2 900
7/77/AT1	26. IV. 1977	54 51;	12 23	2 900
7/77/AT2	26. IV. 1977	54 51;	12 23	2 900
6/78/AT141	14. IV. 1978	54 44;	12 14	2 909
8/80/AT1	14. V. 1980	55 02;	12 02	2 900
3/85/3AT284	15. IV. 1985	54 40;	12 12	2 910
3/85/6AT286	16. IV. 1985	54 44;	12 17	2 905
Box trawl (SWT)				
7/78/SWT27	4. V. 1978	54 27;	12 49	2 965
8/79/SWT34	31. V. 1979	54 55;	12 12	2 880
Semi-balloon trawl (OTSB)				
15/79/50701	11. X. 1979	54 34;	11 54	2 880
7/81/51001	30. IV. 1981	54 45;	12 23	2 890
3/82/51301	15. II. 1982	54 36;	12 14	2 925
3/85/5	14. IV. 1985	54 27;	12 25	2 975
Epibenthic sledge (ES)				
4/75/ES31	20. III 1975	55 03;	12 01	2 875
3/76/ES56	1. III. 1976	54 40;	12 16	2 886
2A/77/ES122	29. I. 1977	54 31;	12 31	2 951
9/78/ES147	2. VI. 1978	54 36;	12 19	2 921
9A/80/ES172	27. V. 1980	54 39;	12 17	2 910
14A/80/ES180	15. IX. 1980	54 42;	12 11	2 886
11/82/ES207	1. VIII. 1982	54 40;	12 11	2 906

Table 2. (A) Relationship between head length (HL) and total length (TL) of macrourid fishes from Rockall Trough (both lengths in cm); (B) weight-length relationships used to calculate biomass of fish which were measured and discarded at sea (wt in g, length in cm); SL: standard length

Species	Relationship	
(A) HL/TL		
Coryphaenoides guentheri	HL = 0.1712 TL + 0.3883	n = 1 208
Coryphaenoides (Nematonurus) armatus	HL = 0.1716 TL + 0.5059	n = 623
Coryphaenoides (Chalinura) brevibarbis	HL = 0.1971 TL + 0.3502	n = 53
Coryphaenoides (Chalinura) mediterranea	HL = 0.1803 TL + 0.1588	n = 258
Coryphaenoides (Chalinura) leptolepis	HL = 0.1975 TL + 0.1315	n = 39
Coryphaenoides (Lionurus) carapinus	HL = 0.1695 TL + 0.6687	n = 54
(B) Weight/length		
Synaphobranchus kaupi	$wt = 0.000077.SL^{3.6349}$	n = 297
Histiobranchus bathybius	$wt = 0.000079.TL^{3.7502}$	n = 38
Coryphaenoides guentheri	$wt = 0.2612.HL^{3.3451}$	n = 766
Coryphaenoides (Nematonurus) armatus	$wt = 0.2573.HL^{3.5013}$	n = 346
Coryphaenoides (Chalinura) brevibarbis	$wt = 0.2477.HL^{3.1965}$	n = 58
Coryphaenoides (Chalinura) mediterranea	$wt = 0.2545.HL^{3.3657}$	n = 183
Coryphaenoides (Chalinura) leptolepis	$wt = 0.3943.HL^{2.9975}$	n = 48
Coryphaenoides (Lionurus) carapinus	$wt = 0.1858.HL^{3.4607}$	n = 74

PS was sampled by an Agassiz trawl, a small box trawl, a semi-balloon trawl and an epibenthic sledge. Eleven species belonging to seven familes were recorded (Table 4). Excluding the epibenthic sledge, which is a poor sampler of fish, the only species which occurred in all the Agassiz and otter trawls was the macrourid *Coryphaenoides (Nematonurus) armatus,* which was dominant in terms of abundance and biomass. Other species which were well represented in the catches were the synaphobranchid eel *Histiobranchus bathybuis* and the macrourids *Coryphaenoides (Lionurus) carapinus* and *Coryphaenoides (Chalinura) leptolepis.*

Family Rajidae

Raja (Amblyraja) jensenii Bigelow, 1950

A single specimen, which was a juvenile female of 483 mm total length was collected from Station M (Table 3). Its identification was confirmed by M. Stehmann and it was the only specimen in our sampling in the Rockall Trough (unpublished observations).

Raja (Rajella) bigelowi Stehmann, 1978

Five specimens were collected from Station M (Table 3), only one of which was a male, and they ranged in length from 135 to 447 mm total length. This species appears to have a fairly restricted depth distribution. Only three other specimens were recorded in our surveys of the Rockall Trough, at depths between 2 018 and 2 225 m (unpublished observations). The diet of the Station M fish was dominated by polychaetes and amphipods, with copepods including *Aetideopsis multiserrata,* cumaceans, isopods and unidentifiable material as minor components.

Bathyraja pallida Forster, 1967

Only two specimens were taken by our sampling in the Rockall Trough, both were male and one, of 306 mm total length, was from Station M (Table 3) and the other of 317 mm total length was from Station PS (Table 4). Only the PS fish had food in its stomach, consisting of copepods (*Aetideopsis* sp.) and unidentified isopods together with a polychaete and an amphipod (*Ampellisca* sp.).

Family Alepocephalidae

Alepocephalus agassizii Goode and Bean, 1883

Four specimens of *Alepocephalus agassizii* measuring 127, 179, 417 and 455 mm standard length were collected from Station M (Table 3). The identification, especially of the 417 mm fish, is somewhat tentative because of the poor condition of the specimens. Four other species of this genus occur or could occur in the Rockall Trough: *A. bairdii, A. rostrata, A. australis* and *A. productus* (Markle and Quero, 1984). None of the Station M specimens belongs to the first three species, but the possibility that at least one is *A. productus* cannot entirely be excluded. The two larger specimens were female and one was at an early stage of maturity. All four fish had unidentifiable material in their stomachs and one also had sediment.

Bellocia koefoedi (Parr, 1951)

A damaged specimen of approximately 265 mm standard length from Station PS was tentatively identified as this species (Table 4).

Table 3. Species of bottom-living fishes present at Station M and number caught at each station. Station numbers have been abbreviated by deletion of preceding cruise numbers. –: species absent

Species	Station No.:															
	AT144	AT151	AT153	AT154	AT167	AT171	AT175	AT177	AT181	AT186	AT195	AT198	AT201	AT233	AT245	AT288
Rajidae																
Raja (Amblyraja) jensenii	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Raja (Rajella) bigelowi	–	–	–	–	1	–	–	–	–	1	1	–	–	1	1	–
Bathyraja pallida	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Alepocephalidae																
Alepocephalus agassizi	–	–	1	–	1	–	–	–	2	–	–	–	–	–	–	–
Synaphobranchidae																
Synaphobranchus kaupi	5	2	5	–	2	5	–	–	3	9	–	2	4	3	1	5
Halosauridae																
Halosauropsis macrochir	1	–	1	–	–	1	–	–	–	–	1	–	1	–	–	1
Notacanthidae																
Polyacanthonotus challengeri	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Macrouridae																
Coryphaenoides guentheri	15	20	16	5	15	16	8	9	16	22	37	6	31	9	4	9
Coryphaenoides (Nematonurus) armatus	4	1	1	4	3	10	–	–	7	–	2	–	3	–	–	–
Coryphaenoides (Chalinura) brevibarbis	1	–	7	–	4	7	–	–	4	–	–	–	–	–	–	–
Coryphaenoides (Chalinura) mediterranea	1	–	1	–	–	1	–	1	5	3	1	–	3	–	1	–
Coryphaenoides (Lionurus) carapinus	3	–	1	–	–	3	–	–	3	–	–	–	–	–	–	1
Moridae																
Antimora rostrata	4	4	3	1	7	3	2	4	3	4	3	2	5	8	6	–
Zoarcidae																
Lycodes sp. A	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Lycodes sp. B	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Ophidiidae																
Spectrunculus grandis	–	2	3	–	1	2	–	–	–	–	1	–	2	2	–	–
Bythitidae																
Cataetyx laticeps	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 4. Species present at permanent station, PS, and number of fishes at each station. Most station numbers have been abbreviated by deletion of preceding cruise numbers and trawl initials

Species	Net type and Station No.																					
	Agassiz trawl (AT)									Box trawl (SWT)		Semi-balloon trawl (OTSB)				Epibenthic sledge (ES)						
	121	130	131	141	284[a]	286	7/77/ AT1	7/77/ AT2	8/80/ AT1	27	34	50701	51001	51301	3/85/5	31	56	122	147	172	180	207
Family Rajidae																						
Bathyraja pallida	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Family Alepocephalidae																						
Bellocia koefoedi	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Family Synaphobranchidae																						
Histiobranchus bathybius	4	10	3	1	–	3	1	3	11	2	–	35	2	28	12	–	1	–	1	1	1	–
Family Halosauridae																						
Halosauropsis macrochir	–	–	–	–	–	–	–	–	–	–	1	–	–	3	1	–	–	–	–	–	–	–
Family Notacanthidae																						
Polyacanthonotus challengeri	–	–	–	–	–	1	–	1	–	–	–	–	–	2	1	–	–	–	–	–	–	–
Family Macrouridae																						
Paracetonurus flagellicauda	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Coryphaenoides (*Nematonurus*) *armatus*	4	22	1	2	1	9	5	19	9	41	5	101	9	146	134	–	–	–	–	–	1	–
Coryphaenoides (*Chalinura*) *brevibarbis*	1	1	–	–	–	–	–	–	2	1	–	–	–	3	1	1	–	–	–	–	–	–
Coryphaenoides (*Chalinura*) *leptolepis*	2	1	–	–	–	5	2	1	6	4	1	3	–	8	13	–	–	–	–	–	–	1
Coryphaenoides (*Lionurus*) *carapinus*	4	2	2	1	1	3	4	4	3	3	–	21	4	14	15	–	–	1	–	–	–	–
Family Moridae																						
Antimora rostrata	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–

[a] Net torn and most of catch lost

Table 5. Diet of fishes at Stations M and PS. F: percentage of stomachs containing prey item; Cn: number of each prey item expressed as percentage of all prey items

Diet	*Synaphobranchus kaupi*		*Histiobranchus bathybius*		*Coryphaenoides guentheri*		*Coryphaenoides* (*Chalinura*) *brevibarbis*			
	M		PS		M		M		PS	
	F	Cn	F	Cn	F	Cn	F	Cn	F	Cn
Coelenterata										
Polychaeta					36.5	3.5	36.4	5.4		
Echiurida										
Sipunculida										
Cirrepedia										
Cypris							4.5	0.7		
Ostracoda					8.7	0.6			16.7	3.8
Copepoda										
Unidentified					73.8	30.3	63.6	14.2	33.3	15.4
Aetideopsis multiserrata					48.4	40.1	40.9	14.2		
Megacalanus princeps var. *inormis*							13.6	2.0		
Euchaeta norvegicus					1.6	0.1				
Euchaeta scotti					1.6	0.1	9.1	1.3		
Euchaeta sarsi					0.8	0.05				
Euchaeta sp.					0.8	0.05	13.6	2.0		
Xanthocalanus profundus					4.0	0.2	4.5	0.7		
Xanthocalanus greeni										
Xanthocalanus sp.					0.8	0.05	4.5	1.3		
Heterorhabdus norvegicus							4.5	0.7		
Aetideus armatus										
Pleuromamma robusta										
Scolothrix sp.										
Gaetanus sp.					0.8	0.05				
Pseudochirella scopularis					0.8	0.05				
Pseudochirella pustulifera					0.8	0.05				
Pseudochirella brevicaudata					0.8	0.05				
Lophothrix sp.					0.8	0.05				
Bradycalanus sarsi					3.2	0.2				
Pseudoeuchaeta brevicauda										
Metridia macrura									50.0	11.5
Lucicutea sp.										
Scolecithricella sp.										
Cyclopoida					1.6	0.1				
Harpacticoida					0.8	0.05				
Leptostraca										
Nebalia sp.										
Cumacea					2.4	0.1				
Amphipoda										
Unidentified	4.5	2.8	2.0	1.4	68.2	10.9	45.5	18.2	66.7	30.8
Eusirius sp.					2.4	0.1				
Lanceolla sp.					3.2	0.2				
Ampellisca sp.										
Harpinia sp.										
Halice abyssi										
Rachotropis sp.										
Paralisca sp.										
Neohela monstrosa										
Isopoda					11.1	1.3				
Tanaidacea					2.4	0.1				
Mysidacea										
Unidentified					4.0	0.3	4.5	0.7		
Gnathophausia zoea	9.1	5.5	4.0	2.9	0.8	0.05	4.5	0.7		
Boreomysis arctica					0.8	0.05	13.6	2.0		
Boreomysis inerma							4.5	0.7		

(Diet of these fishes continued on p. 316)

Coryphaenoides (Nematonurus) armatus				*Coryphaenoides (Lionurus) carapinus*				*Coryphaenoides (Chalinura) leptolepis*		*Spectunculus grandis*	
M		PS		M		PS		PS		M	
F	Cn	F	Cn	F	Cn	F	Cn	F	Cn	F	Cn
										30.0	7.8
25.0	3.3	15.0	3.1	75.0	14.3	31.6	12.3	17.6	3.8	40.0	10.2
0.8	1.1	4.2	0.9								
		1.7	0.3							10.0	2.6
		0.8	0.2	12.5	2.4					10.0	2.6
0.3	6.6	38.3	4.2			3.5	1.3	32.3	14.6		
0.3	6.6	6.7	2.9	12.5	4.8			2.9	0.6		
								2.9	0.6		
0.2	4.4	9.2	4.8					2.9	0.6		
0.2	5.5	0.8	0.2								
		11.7	5.5								
0.8	2.2										
0.8	1.1	0.8	0.2								
0.2	2.2	0.8	0.5								
		0.8	0.2								
		0.8	0.2								
		0.8	0.2								
		0.8	0.2			1.7	0.6				
				12.5	2.4						
		0.8	0.2								
0.8	1.1	1.7	0.3	37.5	11.9	1.7	0.6				
50.0	13.2	30.0	25.6	87.5	50.0	47.4	32.5	70.6	40.8	30.0	12.8
						1.7	0.6	2.9	0.6		
		4.2	1.0			8.7	3.2				
		0.8	0.2			10.5	3.9	2.9	0.6		
						5.3	1.9				
		0.8	0.2			1.7	0.6				
						1.7	0.6				
						3.5	1.3				
		4.2	1.7			3.5	1.3				
		1.7	0.3	12.5	4.8	8.7	3.2	8.8	6.4		
		0.8	0.2	12.5	2.4	7.0	2.6			10.0	2.6
		0.8	0.2					5.9	1.3		
25.0	3.3	2.5	0.5								

(Diet of these fishes continued on p. 317)

Table 5 (continuation of p. 314)

Diet	*Synaphobranchus kaupi*		*Histiobranchus bathybius*		*Coryphaenoides guentheri*		*Coryphaenoides (Chalinura) brevibarbis*			
	M		PS		M		M		PS	
	F	Cn	F	Cn	F	Cn	F	Cn	F	Cn
Boreomysis microps										
Dactylerythrops gracilura										
Amblyopsoides ohlinii					0.8	0.05	4.5	0.7		
Amblyops sp.									16.7	3.8
Paramblyops rostrata					3.2	0.2	4.5	0.7		
Paramblyops bidigitata					0.8	0.05	4.5	0.7		
Paramblyops sp.					1.6	0.1				
Eucopia grimaldi										
Michthyops parva					7.1	0.5	4.5	0.7		
Pseudomma nanum					1.6	0.1				
Pseudomma sp.					2.4	0.1				
Decapoda										
Unidentified			6.0	4.3	7.1	0.4			16.7	3.8
Acanthephyra sp.			2.0	1.4						
Acanthephyra purpurea										
Pasiphaea tarda	4.5	2.8								
Pasiphaea sp.	4.5	2.8			1.6	0.1				
Sergestes arcticus										
Pontophilus sp.					0.8	0.05				
Munida bamffica					0.8	0.05				
Hymendora glacialis			2.0	1.4						
Nematocarcinus ensifer									33.3	7.7
Crangonidae										
Crustacean fragments	4.5	2.8	6.0	4.3	8.7	0.5	36.4	5.4		
Crustacean eggs and larvae					0.8	0.05	4.5	0.7		
Bivalvia					23.8	1.9				
Gastropoda										
Unidentified										
Diacria trispinosa					3.2	0.2				
Cephalopoda	59.0	47.2	8.0	7.2			9.1	6.1		
Echinodermata										
Ophiocten sp.					2.4	0.1				
Echinoidea					0.8	0.05	4.5	0.7		
Spatangoidea					1.6	0.1				
Holothuriodea										
Chaetognatha							45.5	6.7		
Pisces										
Unidentified	36.4	25.0	86.0	65.2	7.9	0.5	18.1	2.7		
Micromesistius poutassou			2.0	5.8						
Unidentified tissues	18.2	11.2	8.0	5.8	92.9	5.7	63.6	9.4	83.3	19.2
No. of full stomachs	22		50		126		22		6	
No. of prey items	36		69		2 038		148		26	

Family Synaphobranchidae

Synaphobranchus kaupi Johnson, 1862

Synaphobranchus kaupi has a wide depth distribution in the Rockall Trough, from about 500 to 2 500 m. The length-frequency distributions from individual collections at Station M were similar, and the combined data for all fish from this station are shown in Fig. 2 together with previously unpublished Agassiz trawl data from other bathymetric zones in the Rockall Trough. It is well known from other areas that *S. kaupi* increases in size with depth (Polloni *et al.*, 1979; Merrett and Domanski, 1985), and the Rockall Trough is no exception. The population at Station M therefore represents some of the larger fish. None of the females showed evidence of maturing, although a few females of comparable size have been found to be maturing at other bathymetric zones. The diet of the

Table 5 (continuation of p. 315)

Coryphaenoides (Nematonurus) armatus				*Coryphaenoides (Lionurus) carapinus*				*Coryphaenoides (Chalinura) leptolepis*		*Spectunculus grandis*	
M		PS		M		PS		PS		M	
F	Cn	F	Cn	F	Cn	F	Cn	F	Cn	F	Cn
		0.8	0.2								
		1.7	0.3								
0.8	1.1	0.8	0.2			1.7	0.6				
0.2	3.3										
		0.8	0.2								
		0.8	0.2								
0.7	8.8	7.5	1.5			1.7	0.6	8.8	1.9	10.0	2.6
25.0	3.3										
								2.9	0.6		
		0.8	0.2								
0.8	1.1	0.8	0.2								
0.8	2.2	1.7	0.3							10.0	2.6
		0.8	0.2								
0.4	5.5	24.2	5.0			1.7	0.6	41.2	8.9		
		1.7	0.3	12.5	2.4	7.0	2.6				
				12.5	2.4						
										10.0	2.6
1.6	2.2	30.8	6.4	12.5	2.4	5.3	1.9	11.8	2.5	10.0	2.6
								2.9	0.6		
										40.0	10.2
		0.8	0.2			1.7	0.6				
								8.8	1.9	10.0	2.6
58.3	7.7	80.8	16.5			1.7	0.6	8.8	1.9	20.0	5.1
		0.8	0.2								
100	13.2	64.2	13.3	75.0	14.3	68.4	25.3	52.9	11.5	100	25.6
12		120		8		57		34		10	
91		577		42		154		157		39	

Station M fish was dominated by fish and cephalopod fragments, with crustaceans as minor components (Table 5).

Histiobranchus bathybius (Günther, 1877)

A total of 119 *Histiobranchus bathybius* were collected from Station PS. The length-frequency distributions of *H. bathybius* between trawls were similar, and Fig. 9 shows the length-frequency of all fish combined. A female, caught in April, was at an early stage of maturity and had a GSI of 6.9 and all the other females were recorded as Stages I or II. The diet (Table 5) was dominated by fish which were in an advanced state of digestion, with squid, amphipods, mysids and decapods as minor components. The presence of the gadid *Micromesistius poutassou* in the stomachs in April suggests a possible scavenging role,

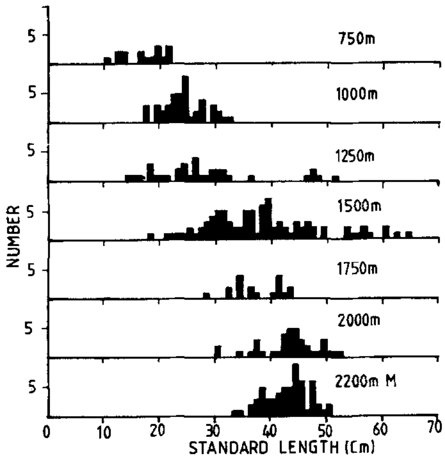

Fig. 2. *Synaphobranchus kaupi.* Frequency distributions of standard lengths of fish caught by Agassiz trawls at different bathymetric zones compared with those caught at Station M (2 200 m)

since at this time of year this gadid forms large aggregations in the upper water column of the Rockall Trough.

Family Halosauridae

Halosauropsis macrochir (Günther, 1878)

Halosauropsis macrochir is distributed from about 1 750 to at least 2 900 m in the Rockall Trough and was never abundant (unpublished observations). Both Stations M and PS yielded six specimens with GNP lengths ranging from 173 to 328 mm. None of the females from these stations showed any indication of maturing and, indeed, throughout the sampling in the Rockall Trough only two maturing females were found. One of 265 mm GNP length had a fecundity of 22 042 and the distribution of ova diameters suggested that it was a batch spawner.

Three of the Station M fish had food in their stomachs, consisting of the mysid *Boreomysis microps,* unidentified decapod and crustacean remains, fish fragments and unidentifiable tissues. A single decapod, *Nematocarcinus ensifer,* was the sole diet of all the Station PS fish. The importance of crustaceans in the diet of *Halosauropsis macrochir* was confirmed by the analysis of the stomach contents of a further 22 fish from the Rockall Trough. The diet was dominated by crustaceans, especially amphipods, mysids, including *Boreomysis* spp. *Paramblyops bidigitata* and *Amblyopsoides ohlinii,* and decapods, including *Nematocarcinus ensifer* and *Acanthephyra purpurea.* Other less important components were polychaetes, coelenterates, copepods including *Lophothrix insignis,* and unidentifiable tissue (Mauchline, unpublished data). Only two fish had sediment in their stomachs, in contrast to the high proportion found by Sedberry and Musick (1978) in the western Atlantic Ocean.

Family Notacanthidae

Polyacanthonotus challengeri (Vaillant, 1888)

Only eight specimens of *Polyacanthonotus challengeri* were captured at depths between about 2 200 and 2 900 m throughout our sampling of the Rockall Trough (unpublished observations). Two of the specimens were from Station M and had GNP lengths of 139 and 191 mm, and four were from Station PS with GNP lengths from 127 to 188 mm. Both fish from Station M were female, the smaller was Stage III, the larger Stage IV, with GSIs of 0.5 and 6.1, respectively. The Stage IV fish, which was caught in June, had a fecundity of 28 120. Measurements of ova diameters showed that about 1% were small and white, while the remainder formed a single peak of larger-diameter yellow ova of about 0.9 mm diameter. Two of the fish from Station PS were Stage III females with GSIs of 0.7 and 1.1.

Both Station M fish had food in their stomachs, consisting of polychaete, copepod and amphipod fragments together with unidentified tissues. All four fish from Station PS had food in their stomachs, consisting of polychaete and crustacean remains, amphipods and coelenterates.

Family Macrouridae

Paracetonurus flagellicauda (Koefoed, 1927)

A single specimen of 235 mm total length (42 mm head length) from Station PS is the only record of this species in our surveys of the Rockall Trough.

Coryphaenoides guentheri (Vaillant, 1888)

Coryphaenoides guentheri was the most abundant species at Station M. Elsewhere in the Rockall Trough it was distributed from about 1 000 to 2 500 m (unpublished observations). The length-frequency distribution (HL) of *C. guentheri* is shown in Fig. 3. As with many other macrourids there is a trend for the largest fish to occupy the deepest part of the depth range (unpublished data and Mauchline and Gordon, 1984). The Station M fish are therefore composed of the largest length groups.

The length-frequency of male and female *Coryphaenoides guentheri* at Station M are shown in Fig. 4, which reveals that the females attain a larger size than the males. This is not specific to Station M, but was observed throughout the Rockall Trough. Table 6 gives maturity stages for female *C. guentheri* by month of capture, and the preponderance of Stage VI (spent) fish in April and May suggests a spring spawning. This is supported by the high GSI values in March (Fig. 5). These ovaries in March were classified as Stage III (maturing) because, externally, they did not have the partly translucent appearance of a Stage IV (ripening)

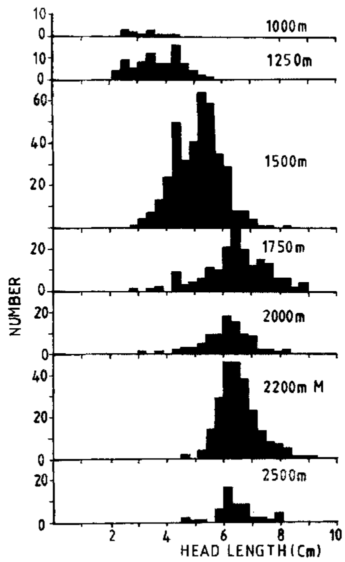

Fig. 3. *Coryphaenoides guentheri.* Frequency distributions of head lengths in 3 mm groupings of fish caught by OTSB at the 1 000, 1 250, 1 500, 1 750, 2 000 and 2 500 m bathymetric zones compared with those caught by Agassiz trawl at Station M (2 200 m)

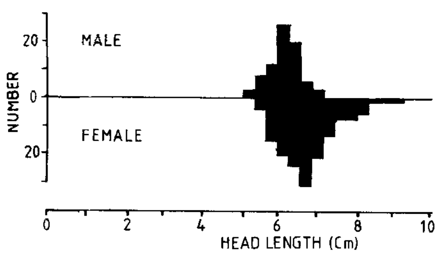

Fig. 4. *Coryphaenoides guentheri.* Frequency distributions of head lengths of males and females for all Agassiz trawls at Station M

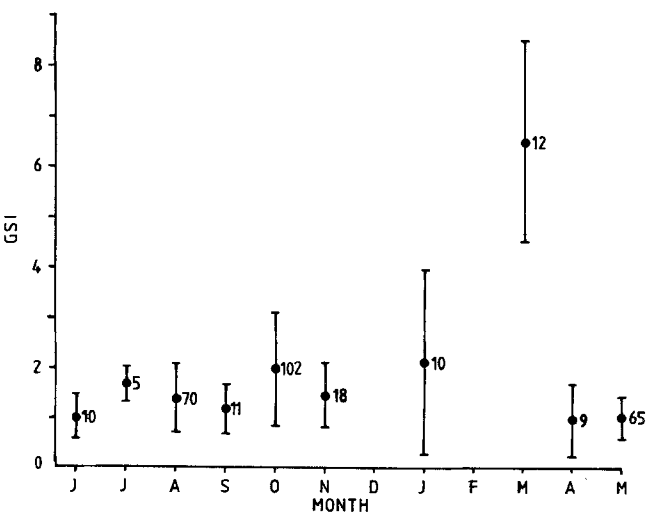

Fig. 5. *Coryphaenoides guentheri.* Gonosomatic index (GSI) (± 1 standard deviation) of females >50 mm head length for each month (all years combined). Number of individuals is also shown

Table 6. *Coryphaenoides guentheri.* Number of females (immatures excluded) at each maturity stage by month of capture at Station M (2 200 m) in Rockall Trough (all years combined). No samples made in February, July, November or December

Month	Maturity stage				
	II	III	IV	V	VI
January	–	6	–	–	–
March	1	12	–	–	–
April	7	1	–	–	10
May	15	–	–	–	2
June	8	–	–	–	–
August	35	7	–	–	–
September	–	10	–	–	–
October	3	–	–	–	–

ovary. Measurements of ova diameter were made on three of these fish, and in two the ova were all of one size (ca. 1 mm) while in the third two size-groups were evident. The smaller ova which were dark yellow in colour had a diameter of 0.4 to 0.5 mm and the larger ova, which were pale yellow, had a diameter of about 0.8 mm. This suggests that the ova in two ovaries were hydrated and that in the third they were in the process of hydrating; these fish should, therefore, have been classed as Stage IV. *C. guentheri* is probably a seasonal spawner, with all the eggs being shed in one batch. The fecundities of these three fish were 12 366, 21 596 and 37 483 for head lengths of 62, 67 and 69 mm, respectively.

Coryphaenoides guentheri is primarily a benthopelagic feeder, consuming mainly copepods, amphipods and mysids (Mauchline and Gordon, 1984). These authors showed that the diet of fish from 2 200 m, which were not all from Station M, was most similar to the diets of fish caught between 1 500 and 2 500 m, where the fish sampled were of a similar size. The diet at Station M, which includes some new data, is given in Table 5. It is similar to that of the intermediate size-group of fish described by Mauchline and Gordon (1984), and is dominated by copepods, especially *Aetideopsis multiserrata,* and amphipods. The only obvious difference between the diets of individual hauls was in the relative proportions of unidentified copepods and *A. multiserrata,* which may be related to the degree of digestion of the stomach contents and also to the difficulty of identifying the copepodite stages.

Coryphaenoides (Nematonurus) armatus (Hector, 1875)

Coryphaenoides (Nematonurus) armatus is a cosmopolitan, abyssal, benthopelagic macrourid (Wilson and Waples, 1983, 1984). In the Rockall Trough it was distributed from about 2 000 m to depths of over 3 000 m (own unpublished observations). It was only caught in 9 out of the 16 Agassiz trawls at Station M, with a maximum of 10 fish per trawl.

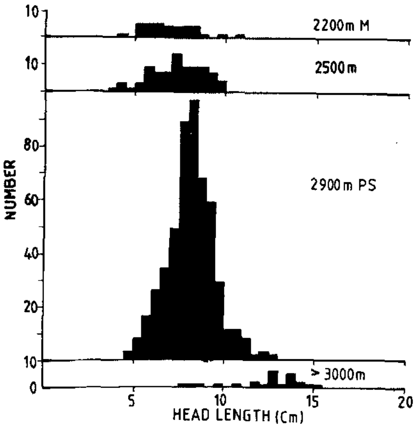

Fig. 6. *Coryphaenoides* (*Nematonurus*) *armatus.* Frequency distributions of head lengths in 5 mm groupings for all trawls at different bathymetric zones compared with distributions at Stations M and PS

C. (N.) armatus is at the upper limit of its distribution at Station M and the length-frequency distribution when compared with Station PS and deeper zones (unpublished data) (Fig. 6) shows that only smaller fish occur at this station. Of the 35 fish caught, 33 were immature females.

Coryphaenoides (Nematonurus) armatus was the most abundant species at Station PS, with catches of up to 146 fish from a single trawl. The male to female ratio of those fish sexed was 2.6:1 ($n=449$). None of the females at this station were maturing, and indeed only one Stage III female of 147 mm HL and a GSI of 3.2 was recorded in all our sampling of the Rockall Trough.

Mauchline and Gordon (1984) found that two size classes of *Coryphaenoides (Nematonurus) armatus* fed on a wide variety of benthopelagic organisms. The diet at Stations M and PS was no exception (Table 5) with a wide variety of crustaceans (copepods, amphipods, mysids and decapods) as well as fishes, cephalopods and other taxa being consumed. Fish and cephalopods were the dominant prey items at Station PS and, because of their size, are likely to be most important in terms of food value.

Coryphaenoides (Chalinura) brevibarbis (Goode and Bean, 1896)

Coryphaenoides (Chalinura) brevibarbis was distributed from about 1 750 to at least 2 900 m in the Rockall Trough, but it was never abundant, maximum seven per haul, and it was absent from many stations (unpublished observations). The length-frequency distributions of the fish from Stations M and PS are compared with distributions from other depths in Fig. 7 (Mauchline and Gordon, 1984, and unpublished observations). There is an increase in average size with depth. According to Marshall and Iwamoto (1973), this species grows to at least 350 mm total length, which is approximately 72 mm head length, and although a few fish of this size were recorded in our surveys none showed any indication of approaching sexual maturity.

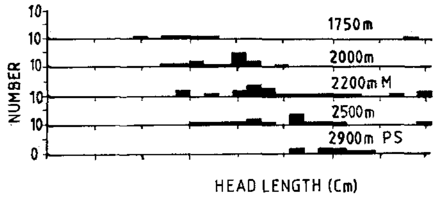

Fig. 7. *Coryphaenoides* (*Chalinura*) *brevibarbis.* Frequency distributions of head lengths in 3 mm groupings for all trawls at different bathymetric zones compared with distributions at Stations M and PS

The diet of two size classes of this species from all depths in the Rockall Trough has been described by Mauchline and Gordon (1984) and was shown to be mixed, but dominated by calanoid copepods, amphipods, and mysids. The diets of the fish from Stations M and PS were similar, and are given in Table 5.

Coryphaenoides (Chalinura) mediterranea (Giglioli, 1893)

A total of 17 specimens were obtained from Station M from nine hauls. Elsewhere in the Rockall Trough it was distributed between about 1 000 and 2 500 m. The Station M fish had head lengths ranging from 26 to 98 mm and were larger than those fish caught at shallower depths (unpublished observations). The ovaries of all the Station M females were recorded as either Stage I or II. A plot of GSI against head length for all Rockall fish, irrespective of depth of capture or season, suggested that *Coryphaenoides (Chalinura) mediterranea* began to mature at about a head length of 100 mm, but only one fish of head length 113 mm caught in November was at a fairly advanced stage of maturity and had a GSI of 5.2.

The diet of this species consists of a wide range of organisms, dominated by crustaceans (Mauchline and Gordon, 1984). Only three fish from Station M had full stomachs, containing copepods including *Euchaeta scotti*, the mysid *Paramblyops rostrata*, unidentified decapod and crustacean fragments and chaetognaths.

Coryphaenoides (Chalinura) leptolepis (Günther, 1877)

With the exception of a single juvenile at a depth of 2 400 m, Station PS was the shallowest depth at which this species occurred in the Rockall Trough. The length-frequency distribution (Fig. 9) shows that most of the fish were juveniles or sub-adults, as this species grows to at least 620 mm total length (approx 124 mm head length) (Marshall and Iwamoto, 1973). None of the fish from the Rockall Trough showed any indication of maturity. Mauchline and Gordon (1984) showed that the diet of this species is varied but is dominated by crustaceans. The diet of 34 fish which had recognisable food in their stomachs is shown in Table 5 and confirms the dominance of crustaceans.

Coryphaenoides (Lionurus) carapinus
(Goode and Bean, 1883)

With the exception of a single specimen from an epibenthic sledge at 1 900 m, Station M was the upper limit of the distribution of *Coryphaenoides (Lionurus) carapinus*. The length-frequency distributions (HL) of the fish at Stations M and PS are compared with unpublished data for other depths in Fig. 8 and, although the numbers of fish are small there is some evidence of an increase in size with depth, as found by Haedrich and Polloni (1976) off New England in the western North Atlantic. Some of the head lengths, especially those from Station PS, are estimated because *C. (L.) carapinus* is highly susceptible to trawl damage. None of the female fish from the Rockall Trough showed any indication of maturity beyond Stage II. A plot of GSI against head length suggested that *C. (L.) carapinus* became sexually mature at about 50 mm head length, and the absence of any fish of Stage III or over suggests that spawning either does not take place in the Rockall Trough or the fish are not captured by the trawls used. Haedrich and Polloni (1976) found that *C. (L.) carapinus* matured at about 70 mm anal length, which is about 35 mm head length and that it was a winter spawner.

Mauchline and Gordon (1984) reported that *Coryphaenoides (Lionurus) carapinus* in the Rockall Trough fed on a wide variety of organisms but, in contrast to the other macrourids mentioned above, the food organisms were primarily of epibenthic rather than benthopelagic origin such as polychaetes, amphipods and isopods. The diets at Stations M and PS are given in Table 5. Polychaetes, cumaceans and amphipods were the dominant prey items.

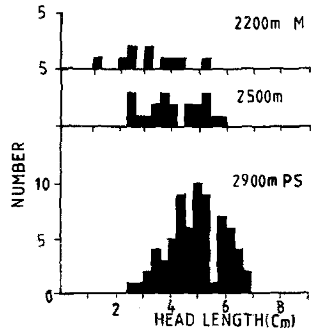

Fig. 8. *Coryphaenoides* (*Lionurus*) *carapinus*. Frequency distributions of head lengths in 3 mm groupings for all trawls at different bathymetric zones compared with those from Stations M and PS

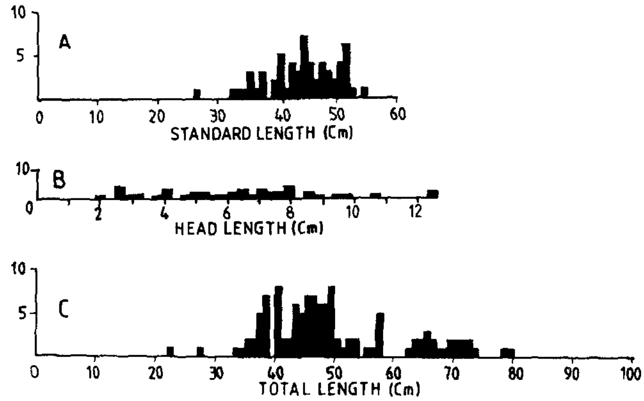

Fig. 9. *Antimora rostrata* (A), *Coryphaenoides* (*Chalinura*) *leptolepis* (B) and *Histiobranchus bathybius* (C). (A) Length-frequency distribution in standard length of all *A. rostrata* from Station M; (B) length-frequency distribution in head length in 3 mm groupings of *C.* (*C.*) *leptolepis* at Station PS; (C) length-frequency distribution of total length of *H. bathybius* from all trawls at Station PS

Family Moridae

Antimora rostrata Günther, 1878

Antimora rostrata is distributed between about 750 and at least 2 900 m in the Rockall Trough, and Gordon and Duncan (1985 b) have described some aspects of its biology. The largest fish occur at the greatest depths and its centre of maximum abundance is between about 1 750 and 2 200 m. The length-frequency distribution (Standard length) of *A. rostrata* from Station M is shown in Fig. 9. The standard lengths of the two specimens from Station PS (Table 4) were 472 and 529 mm. All but one of the fish were female and none showed any indication of maturing, the GSI values ranging from 0.4 to 1.1.

The stomachs of all but two of the fish were everted. A few samples of bulked intestinal contents were examined. The diet consists mainly of fish, but large amounts of unidentifiable soft tissues were also present.

Family Zoarcidae

Lycodes spp.

The two specimens from Station M (Table 3) key-out to the genus *Lycodes*, but there are difficulties with classification of this genus (Andriyashev, 1964) and as no comparative material or x-ray facilities were available no attempt has been made to identify them to species level, but each represented a different species. Their lengths were 510 and 229 mm.

Family Ophidiidae

Spectrunculus grandis (Günther, 1877)

This species is distributed between about 1 750 and 2 600 m in the Rockall Trough and was never abundant (unpublished observations). The 13 specimens from Station M (Table 3) ranged from 386 to 457 mm standard length and their diet is given in Table 5.

Family Bythitidae

Cataetyx laticeps Koefoed, 1927

This species has a shallower distribution than *Spectrunculus grandis,* from about 1 250 to 2 250 m (unpublished observations). The single specimen from Station M (Table 3) had a standard length of 48.6 mm and its stomach contained unidentified soft tissue.

Discussion

The abundance and biomass of the dominant species at Station M are shown in Fig. 10. The macrourid *Coryphaenoides guentheri* is the most abundant species at this depth but, because of its small size compared with the morid *Antimora rostrata,* it is not dominant in terms of biomass. At the deeper station, PS, the macrourid *Coryphaenoides (Nematonurus) armatus* is dominant in terms of abundance and biomass in the catches of both the Agassiz and otter trawls ("Na" in Fig. 10). At shallower bathymetric zones in the Rockall Trough, other species belonging to various families are dominant depending on the type of trawl used (Gordon and Duncan, 1985 a; Gordon, 1986), but Station M is the only station in the Rockall Trough where a morid dominates the biomass.

In commercial shelf fisheries, a wide range of trawl types are in use, depending on the nature of the sea bed and the species of fish being exploited and no one trawl will adequately sample the total fish fauna. This is also true of the deep-sea where the different trawls used in the Rockall Trough catch a different spectrum of species, especially on the upper to mid slopes. The differences between single and paired warp-trawling on the upper and mid slopes were most pronounced (Gordon and Duncan, 1985 a; Gordon, 1986). On the West African slope, Merrett and Marshall (1981) found differences between the catches of towed and static gear, and Pearcy *et al.* (1982) between different towed gears in the Pacific Ocean.

Station M was only sampled by the Agassiz trawl, and this raises the question as to how representative these samples are of the fish assemblage at this station. A plot of the cumulative number of species (Fig. 11) suggests that all the species vulnerable to this trawl have been sampled. A list of the species common to otter trawls at the 2 000 and 2 500 m bathymetric zones (unpublished data) contained none that had not been recorded by the Agassiz trawl at Station M, which tends to confirm this view, but species composition alone does not indicate whether the observed abundances are a true indication of the actual abundances of the species present. At Station PS, comparisons can be made between the Agassiz trawl and small otter trawls towed on a single warp. The curves of the cumulative number of species for each trawl (Fig. 11) show that more species were caught by the otter trawls, and it is possible that neither trawl has sampled all the species likely to be present. The differences in the number

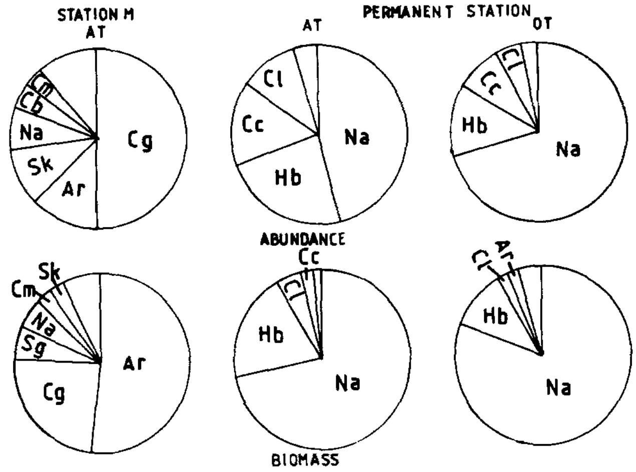

Fig. 10. Relative abundance and biomass of dominant species from Agassiz trawls (AT) at Station M and from Agassiz (AT) and combined box and semi-balloon trawls (OT) at permanent station, PS. Sk: *Synaphobranchus kaupi;* Hb: *Histiobranchus bathybius;* Cg: *Coryphaenoides guentheri;* Na: *Coryphaenoides (Nematonurus) armatus;* Cb: *Coryphaenoides (Chalinura) brevibarbis;* Cm: *Coryphaenoides (Chalinura) mediterranea;* Cl: *Coryphaenoides (Chalinura) leptolepis;* Cc: *Coryphaenoides (Lionurus) carapinus;* Ar: *Antimora rostrata;* Sg: *Spectrunculus grandis*

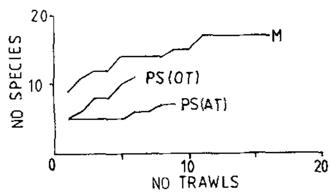

Fig. 11. Cumulative number of species on successive hauls for Agassiz trawls at Station M and for Agassiz (AT) and combined box and semi-balloon trawls (OT) at permanent station (PS)

of species recorded might be caused by the different fishing characteristics of the trawls, for example headline height, but the possibility that it is the result of the differing areas swept by the trawls cannot be excluded. The OTSB was towed for about 2 h, but the Agassiz trawls were only towed for about 1 h. To cover the same area of seabed swept by the OTSB in 2 h, the Agassiz trawl would have to be towed for about 10 h.

At Station M, the only species for which there is clear evidence of a seasonal spawning cycle is *Coryphaenoides guentheri.* The frequency of sampling over a period of years (Table 1) has confirmed that the cycle is annual and consistent from year to year. None of the other macrourids at this station showed any evidence of reproductive activity, probably because most were only represented by juveniles and sub-adults. The exception was *Coryphaenoides (Lionurus) carapinus,* which is known to spawn at a similar size in the western Atlantic (Haedrich and Polloni, 1976). Despite the presence of juvenile *Antimora rostrata* in the Rockall Trough at shallower depths (Gordon and Duncan, 1985 b) no mature adults were found, a feature which has also been observed in other areas (Small, 1981). The lack of maturing *Synaphobranchus kaupi* is related to their life history, which involves spawning in the western Atlantic and the drift of the leptocephalus larvae across the Atlantic and metamorphosis on the slopes of the eastern Atlantic (Brunn, 1937). Insufficient material was available for species of other families to determine their reproductive status.

At Station PS, five of the eleven species were macrourids. Two were present in small numbers and of the remainder none showed any evidence of reproductive activity, probably for the same reason as at Station M. It is interesting to speculate that the lack of maturity of *Coryphaenoides (Lionurus) carapinus* at both stations is because they are expatriated from other areas and the physical environment in the Rockall Trough is unsuited to reproduction. The most abundant of the non-macrourid fishes was *Histiobranchus bathybius*, which has a similar life history to *Synaphobranchus kaupi*.

Previously published information on changes in length-frequency with depth in the Rockall Trough have resulted from dietary studies (e.g. Mauchline and Gordon, 1984) and have considered only those fish with full stomachs. Everted stomachs, caused by decompression, are common in fishes with swimbladders, and if eversion is related to fish size or depth of capture then a possible bias could have been introduced into the results. Length-frequency comparisons between bathymetric zones given here are for all fish irrespective of stomach state, and they confirm the generalisation that fish size increases with depth.

Assuming that the sample of fishes obtained from each of the stations is a reasonable estimate of their actual abundance, then it follows that the total sample of the prey items obtained from all stomachs combined will represent the resources exploited by the fishes from these stations. At Station M, the total number of prey items in the stomachs of all fish examined was summed and the contribution of each major prey taxa was expressed as a percentage of the total number of prey items. These percentages are represented by the areas of the respective rectangles in Fig. 12. The contribution of each prey taxa was also expressed as a percentage of the total number of prey items in the stomachs of species with more than ten full stomachs, and where this value exceeds 10% it is shown in Fig. 12 by a line connecting a fish species with a prey category. A source of bias in such an analysis would be if some species had disproportionately larger numbers of individuals with either empty or everted stomachs. At Station M, the only species in which this occurred was *Antimora rostrata*, where all but two of the stomachs were everted. The dietary information from pooled intestinal contents may underestimate soft-bodied prey items which have been digested to an unrecognisable degree in the stomach before entering the intestine. The results show the numerical dominance of copepods and amphipods as a food resource compared with benthic organisms such as polychaetes and bivalves. The food value of these smaller organisms, even if taken in quite large numbers, will of course be much smaller than a meal of for example a single fish or cephalopod. The Bray Curtis similarity coefficient has been used to compare the diets of those fish which had ten or more stomachs containing food (Fig. 13), and it shows that they can be separated into two clusters with *Synaphobranchus kaupi* being dissimilar to both, but in no case is the similarity very high.

A similar analysis of the diets at Station PS (Fig. 14) also shows that benthopelagic and epibenthic organisms dominated the food resources utilised, but compared with Station M, copepods had diminished in numbers and amphipods, fish, and cephalopods were more prominent.

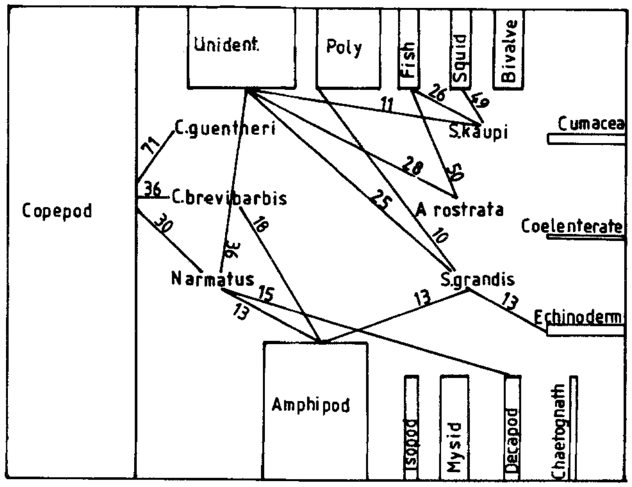

Fig. 12. Relative abundance of prey taxa from all fish with food in their stomachs at Station M, represented by areas of respective rectangles. Fish species shown are those for which there were more than ten full stomachs, and lines connecting them to prey taxa show most important components of their diet. Numbers indicate number of prey taxa expressed as percentage of total number of prey items for that species (values of < 10% excluded). Full specific names are given in Table 3. Unident.: unidentified

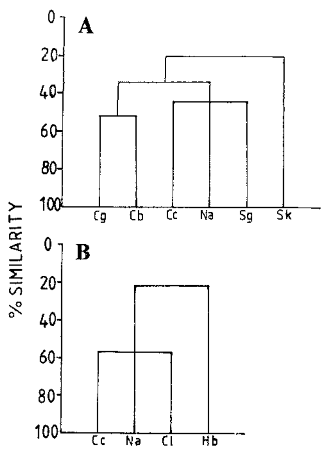

Fig. 13. Dendograms of similarity between diets of those fish species where ten or more full stomachs were collected. (A) Station M; (B) permanent station, PS. Species names abbreviated as in Fig. 10

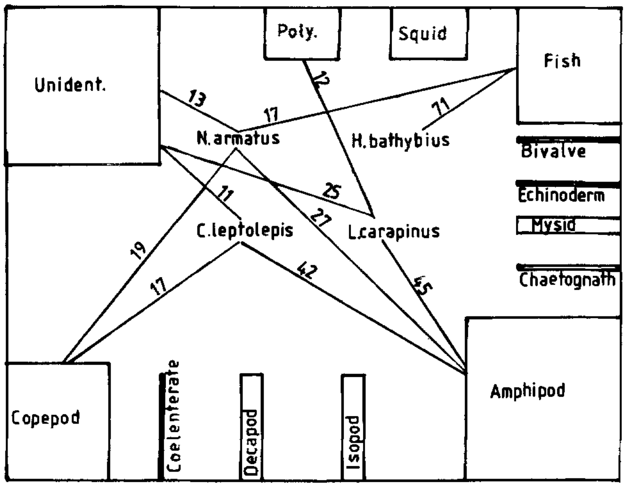

Fig. 14. Relative abundance of prey taxa from all fish with food in their stomachs at permanent station, PS, represented by areas of respective rectangles. Fish species shown are those for which there were more than ten full stomachs, and lines connecting them to prey taxa show most important components of their diet. Numbers indicate number of prey taxa expressed as percentage of total number of prey items for that species (values of < 10% excluded). Full specific names are given in Table 4

There was some evidence that at least some of the fish component had been obtained by scavenging, and this was also true at Station M, where *Micromesistius poutassou* was also found in the stomachs of *Antimora rostrata*. As at Station M, the relative proportions of fish with food in their stomachs was similar to the numbers in the catches except for *Coryphaenoides (Nematonurus) armatus*, where some of the larger catches were worked up at sea and only subsampled for stomach contents. The diets of the four species with more than ten full stomachs were compared using the Bray Curtis similarity coefficient. The three macrourid species clustered at 57% similarity but *Histiobranchus bathybius* was dissimilar at only 22% (Fig. 13). The values for the similarity coefficients at both stations are probably overestimates because of the inherent biases in the identification of prey organisms. In this study, the main expertise was in the crustacean component of the diet (Mauchline and Gordon, 1985). Other taxa, such as the polychaetes, were not identified further and if several species were present and the fishes were selective then the value of the similarity coefficient would be reduced.

Data is available on the relative abundance of macrobenthic invertebrates in epibenthic sledge hauls at Station PS (Gage *et al.*, 1980). Bivalves were dominant (53%) followed by polychaetes (12%) and ophiuroids (11%). Amphipods only accounted for 2.5% of the macrofauna. In 0.25 m^2 box-core samples, polychaetes were dominant (60%) followed by tanaids (9%) and bivalves (9%) (Gage, 1977). No data is as yet available on the composition and abundance of the near-bottom benthopelagic fauna in the Rockall Trough but, in the Porcupine Sea Bight, Hargreaves *et al.* (1984) have found increases in the abundance of some taxa, such as copepods and amphipods, compared to the overlying water column. The overall preponderance of pelagic/benthopelagic items in the diet of the fishes from Stations M and PS supports other studies on the diets of bottom-living fishes of the slopes (e.g. Marshall and Merrett, 1977; Houston and Haedrich, 1986). In studies on the upper slopes, the source of the pelagic diet is considered to be derived from the horizontal impingement of organisms onto the slope and to vertical migrators. Stations M and PS are below the depth of vertical migration and there is insufficient knowledge of the benthopelagic faunas to assess the possible impact of horizontal impingement at these depths. Another potential source of food is the rain-down of carcasses from the pelagic environment. The presence of *Micromesistius poutassou* in some stomachs is evidence that this provides a food source, but it is impossible to establish the proportion of fish and cephalopod fragments in the stomachs which might derive from scavenging.

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