Zooplankton and Micronecton Associated with Acoustic Scattering Layers on the Nova Scotia Shelf and Slope during June 1978.

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Fisheries and Aquatic Sciences 936

April 1980

ZOOPLANKTON AND MICRONEKTON ASSOCIATED WITH ACOUSTIC SCATTERING LAYERS ON THE NOVA SCOTIA SHELF AND SLOPE DURING JUNE 1978

by

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Sameoto, D.D. and M.K. Lewis. 1980. Zooplankton and micronekton associated with acoustic scattering layers on the Nova Scotia shelf and slope during June 1978. Can. Tech. Rep. Fish. Aquat. Sci. No. 936: 32 pp.

Zooplankton, macrozooplankton, and micronekton communities were sampled during the night on the slope of the Nova Scotia shelf during June 1978. The numbers of copepods and biomass of zooplankton were highest off the shelf in an area about 12 nautical miles south of the edge of the shelf (the 180 m contour). The fish and fish larvae collected were dominated by Ammodytes tobianus on the inner stations and by myctophids, primarily Benthosema graciale, on the stations farther offshore.

Intense acoustic scattering layers were found on the stations off the shelf. The biological samples provided evidence as to the animals responsible for the acoustic scattering.

Over 100 species of zooplankton and nekton species were identified and enumerated.

RÉSUMÉ

Sameoto, D.D. and M.K. Lewis. 1980. Zooplankton and micronekton associated with acoustic scattering layers on the Nova Scotia shelf and slope during June 1978. Can. Tech. Rep. Fish. Aquat. Sci. No. 936: 32 pp.

En juin 1978, pendant la nuit, on a recueilli sur le versant du plateau de la Nouvelle-Écosse des échantillons de collectivités de zooplanctons, macrozooplanctons et micronectons. La quantité de copépodes et la biomasse de zooplanctons étaient plus importantes à l'extérieur du plateau dans un secteur couvrant environ 12 milles marins de l'extrémité sud du plateau (courbe de niveau de 180 m). Dans les stations à l'intérieur du plateau, les Ammodytes tobianus l'emportaient sur les poissons et les laves de poissons recueillis, tandis que dans les stations plus loin au large c'était les myctophides qui primaient, surtout les Benthosema graciale.

On a retrouvé des couches diffusantes acoustiques impressionnantes dans les stations à l'extérieur du plateau. Les échantillons biologiques ont permis d'établir la preuve que les animaux sont responsables de la diffusion acoustique.

On a identifié et dénombré plus de 100 espèces de zooplanctons et de nectons.

INTRODUCTION

This is the second in a series of reports dealing with the zooplankton and micronekton community on the edge and slope of the Nova Scotia shelf. Due to technical difficulties and the loss of some samples, the data series on all the stations is not complete. Therefore there are no estimates of the backscattering volumes in decibels of the acoustic scattering layers. Station #5 does not have biological data for the upper 50 m water which contained the largest numbers of animals judging from the echograms of the station.

This report demonstrates as did the first report in this series (Sameoto and Lewis 1980) that a large and complex community of zooplankton and micronekton exists on the slope of the Nova Scotia shelf.

METHODS

The method for acoustic measurements and biological sampling were the same as described by Sameoto and Lewis (1980). The techniques used in measuring the chlorophyll concentrations were described in Irwin and Platt (1979).

The positions of the stations are given in Figure 1. One station was located on the shelf while all the other stations were located on the shelf slope beyond 180 m of water. All stations were sampled at night. Samples were taken with the BIONESS (Sameoto et al. 1980) fitted with 243 μm mesh nets. The samples were handled in the same manner as described by Sameoto and Lewis (1980). The identification of the zooplankton was done by the Canadian Oceanographic Identification Centre, National Museum of Natural Sciences, Ottawa, Ontario.

RESULTS

Temperature

The water column showed a three-layered structure with the warmest water being found at a depth below 100 m (Fig. 2). This pattern was seen on all the stations.

Zooplankton

A list of all species of zooplankton, macrozooplankton, and micronekton identified in all the samples is given in Table 1. The numbers of each species in the different samples and the biomass of euphausiids, myctophids, and zooplankton are given in Table 2.

The biomass of zooplankton per cubic metre in the top 20 m was the highest on the slope stations #3, 7, and 8. Six species of copepods made up the majority of animals, these were: Calanus finmarchicus, C. hyperboreus, C. glacialis, Euchirella rostrata, Pseudocalanus minutus, and Metridia lucens. The maximum number of copepods were found on Stations 8 and 7. the numbers decreased with the stations farther offshore (Table 2).

The numbers of copepods per cubic metre were the highest above 50 m depth with less than 500 m^{-3} generally being found below 50 m (Table 2 and Fig. 2).

Macrozooplankton and Micronekton

The dominant forms of macrozooplankton were the hyperiidae amphipods and the euphausiids, which were dominated by Meganyctiphanes norvegica. The numbers of these animals per cubic metre and the biomass of euphausiids per cubic metre are shown in Fig. 2 and Table 2. The numbers per cubic metre of the different species of amphipods and euphausiids collected in the samples are given in Table 2.

Only two species of fish were common: Ammodytes tobianus and the myctophid Benthosema glaciale. The length frequency distributions of these species is given in Fig. 3 and Table 3. Myctophids totally dominated the fish species on the outer stations 1, 3, and 2 (Table 4). The maximum density of myctophid adults collected was 0.21 m^{-3}. The mean and standard deviation of myctophids for the slope stations was 0.04 $\pm$0.05 m^{-3}, which was about an order of magnitude higher than the April 1977 densities (Sameoto and Lewis 1980).

Numbers of Animals per Square Metre on Different Stations

The number of animals per square metre were integrated to the maximum sample depth to calculate the number of the major animal groups per square metre (Table 4). The numbers of copepods, euphausiids, amphipods, and gastropods increased with stations farther offshore. The other groups of animals did not show any trend in their numbers. The major difference between these data and those given by Sameoto and Lewis (1980) for the April 1977 cruise was the absence of juvenile squid.

Acoustic Scattering Layers

The acoustic scattering layers (Fig. 4) showed two basic patterns, one where the scattering was found only in the top 20 m of

water, as the case for the shallow water stations 4 and 8, and the other pattern seen on the stations in deeper water, was more complex; here the layers were more intense and wider vertically. These stations also had multiple layers of varying intensity which were not seen on the shallower stations.

It was possible to attribute the acoustic scattering in the different layers to different groups of animals. On and near the shelf, Stations 4 and 8, the scattering was likely due entirely to the copeods and euphausiids, since no other types of zooplankton or macrozooplankton were present in the water column. The backscattering in the top 50 m of water seen on the slope stations was likely caused by a combination of copepods, euphausiids, amphipods, and myctophids; this combination of species would account for the very intense echograms seen. The deeper layers of backscattering seen on Stations 1 and 7 likely resulted from myctophids and amphipods. The density of the various species and their relation to the backscattering layers is seen in Fig. 2.

Vertical Distribution of Animals and Chlorophyll a Distribution

The vertical distribution of chlorophyll a concentrations during the time each of the samples was taken is shown in Fig. 5. The maximum concentration of the different species of animals was compared to the chlorophyll maximum layer defined as the concentrations within the 0.5 mg m^{-3} contour. *Calanus finmarchicus*, *C. hyperboreus*, *Metridia lucens*, and *Meganyctiphanes norvegica* showed the highest densities in the chlorophyll maximum layer on three or more of the stations. The other species of animals were usually more abundant at depths other than at the chlorophyll maximum. This suggested that the four above species were likely feeding on phytoplankton.

ACKNOWLEDGEMENTS

We would like to express our thanks and appreciation for the able technical assistance received from W.B. Fraser and D.P. Reimer during the data collection period.

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Irwin, B. and T. Platt. 1979. Phytoplankton productivity and nutrient measurements at the edge of the continental shelf off Nova Scotia. Can. Data Rept. Fish. Aquat. Sci. No. 174: 50 pp.

Sameoto, D.D. and M.K. Lewis. 1980. Zooplankton and micronekton associated with acoustic scattering layers on the Nova Scotia shelf and slope. Can. Tech. Rept. Fish. Aquat. Sci. No. 875: 44 pp.

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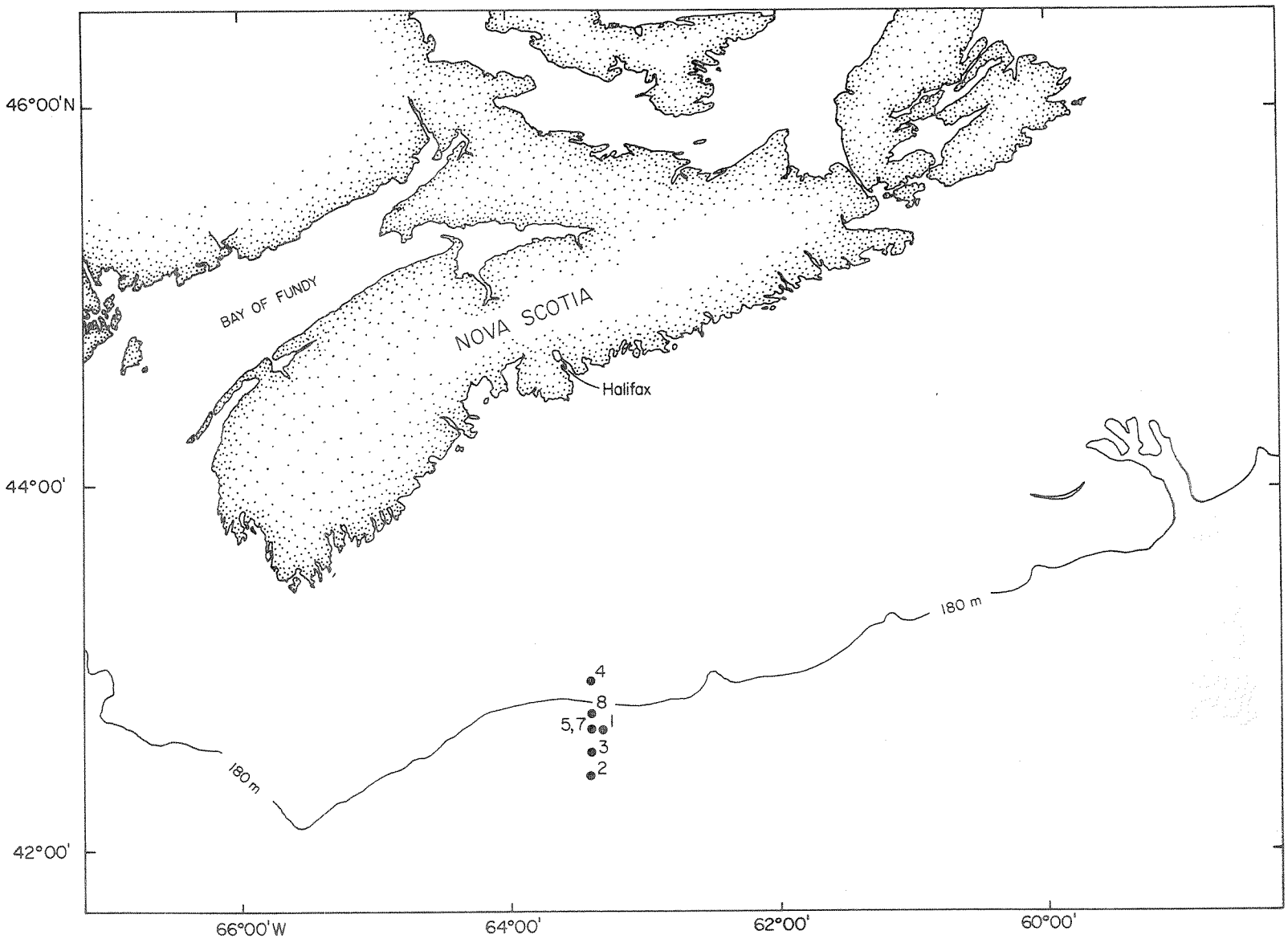


Fig. 1. Positions of sampling stations.

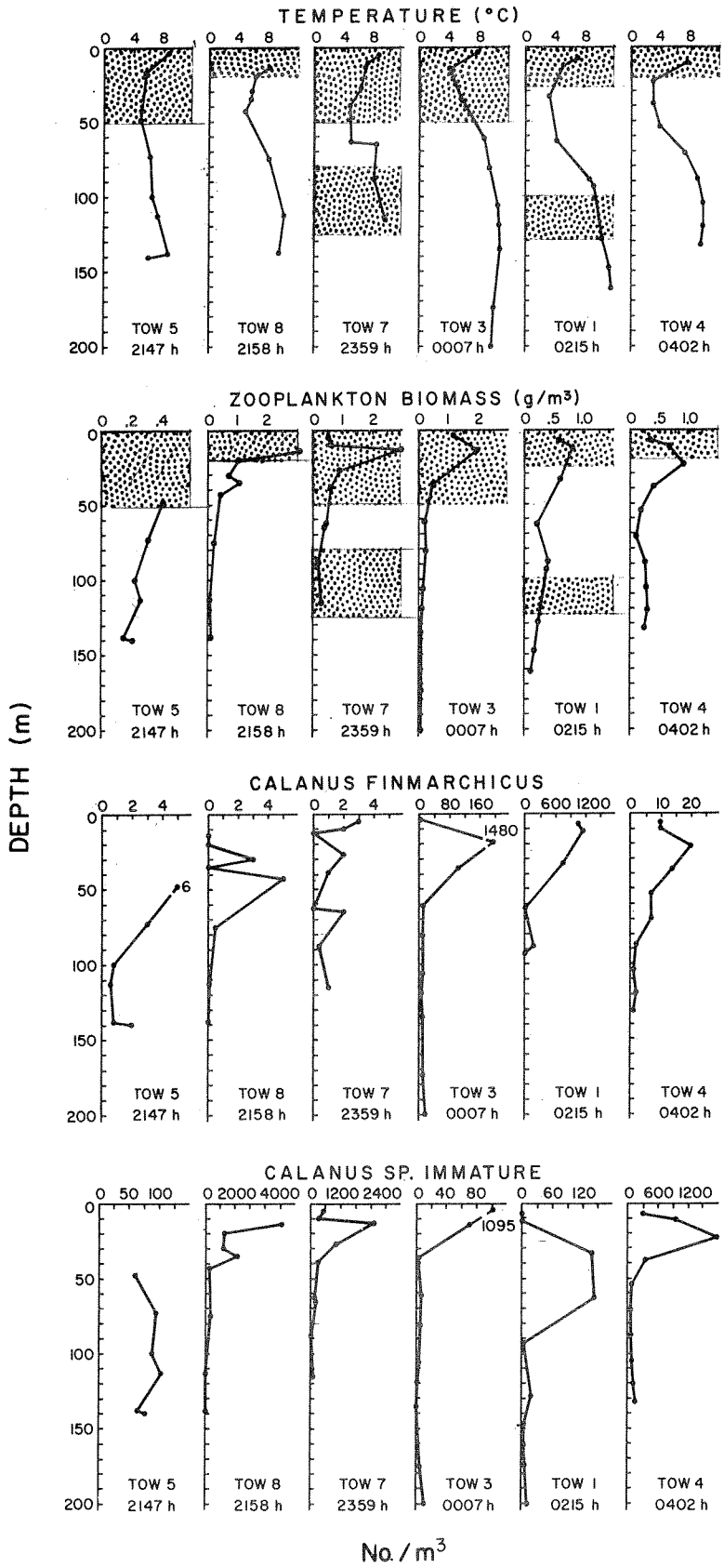


Fig. 2a. Temperature profile, biomass values and numbers of animals of various species per cubic metre with depth on the different stations. The shaded areas represent the position of the major acoustic scattering layers.

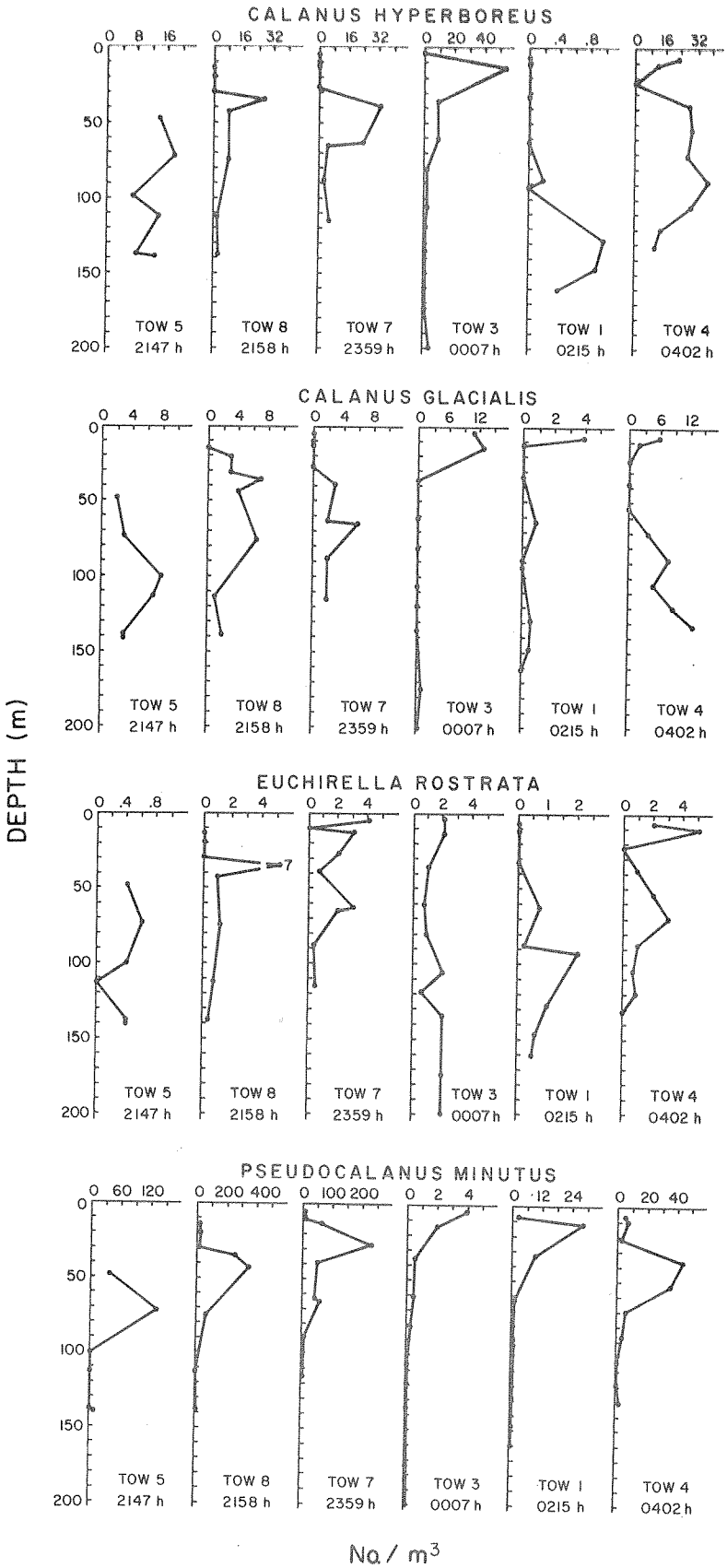

CALANUS HYPERBOREUS
CALANUS GLACIALIS
EUCHIRELLA ROSTRATA
PSEUDOCALANUS MINUTUS
DEPTH (m)
TOW 5 2147 h
TOW 8 2158 h
TOW 7 2359 h
TOW 3 0007 h
TOW 1 0215 h
TOW 4 0402 h
No / m3

Fig. 2b.

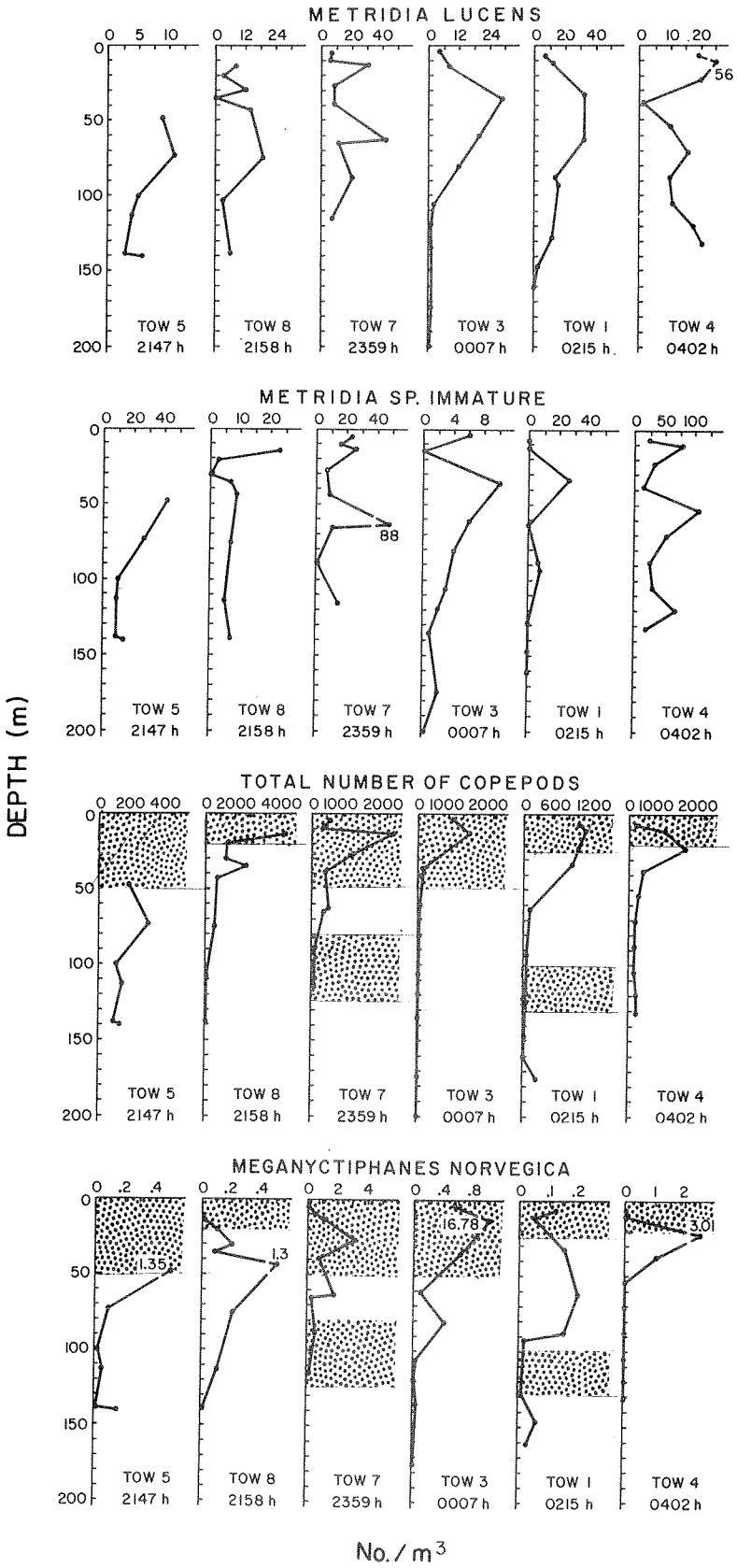

METRIDIA LUCENS
METRIDIA SP. IMMATURE
TOTAL NUMBER OF COPEPODS
MEGANYCTIPHANES NORVEGICA
DEPTH (m)
No./m3
TOW 5 2147 h
TOW 8 2158 h
TOW 7 2359 h
TOW 3 0007 h
TOW 1 0215 h
TOW 4 0402 h
56
88
1.35
1.3
16.78
3.01

Fig. 2c.

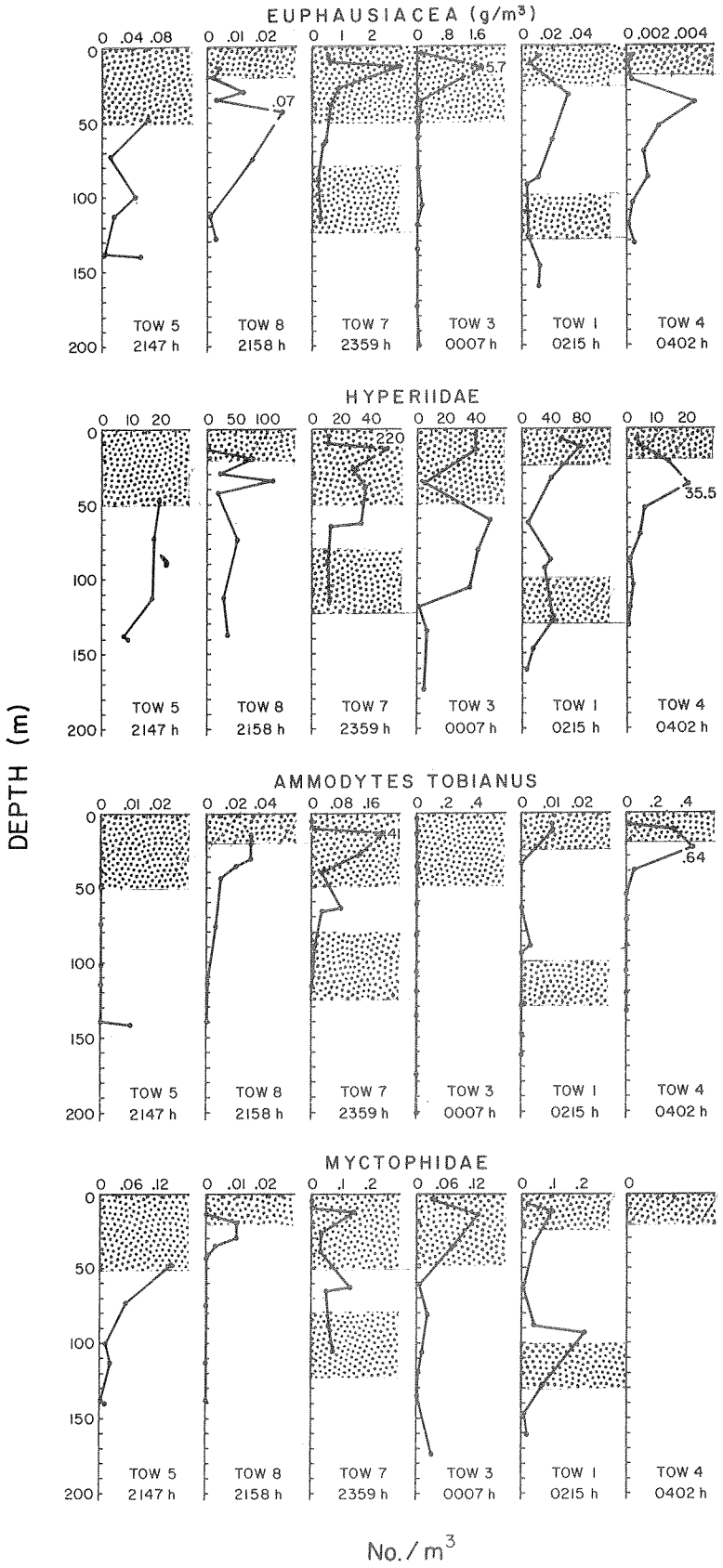

EUPHAUSIACEA (g/m³)
0 .04 .08
0 .01 .02
0 1 2
0 .8 1.6
0 .02 .04
0 .002 .004
.07
5.7
HYPERIIDAE
0 10 20
0 50 100
0 20 40
0 20 40
0 40 80
0 10 20
220
35.5
AMMODYTES TOBIANUS
0 .01 .02
0 .02 .04
0 .08 .16
0 .2 .4
0 .01 .02
0 .2 .4
.41
.64
MYCTOPHIDAE
0 .06 .12
0 .01 .02
0 .1 .2
0 .06 .12
0 .1 .2
0
DEPTH (m)
0
50
100
150
200
TOW 5 2147 h
TOW 8 2158 h
TOW 7 2359 h
TOW 3 0007 h
TOW 1 0215 h
TOW 4 0402 h
No./m³

Fig. 2d.

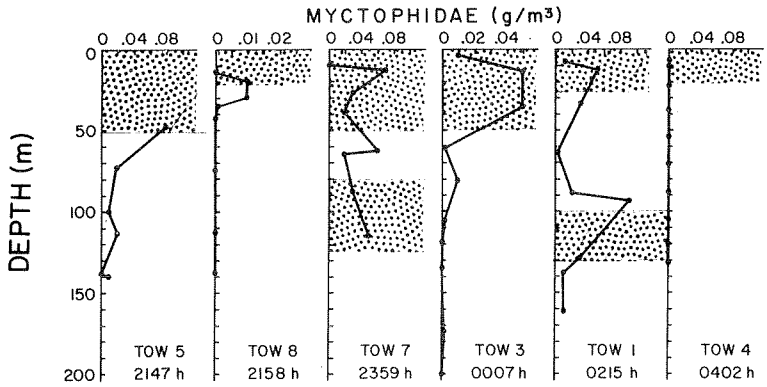

MYCTOPHIDAE (g/m³)
0 .04 .08
0 .01 .02
0 .04 .08
0 .02 .04
0 .04 .08
0 .04 .08
DEPTH (m)
0
50
100
150
200
TOW 5
2147 h
TOW 8
2158 h
TOW 7
2359 h
TOW 3
0007 h
TOW 1
0215 h
TOW 4
0402 h

Fig. 2e.

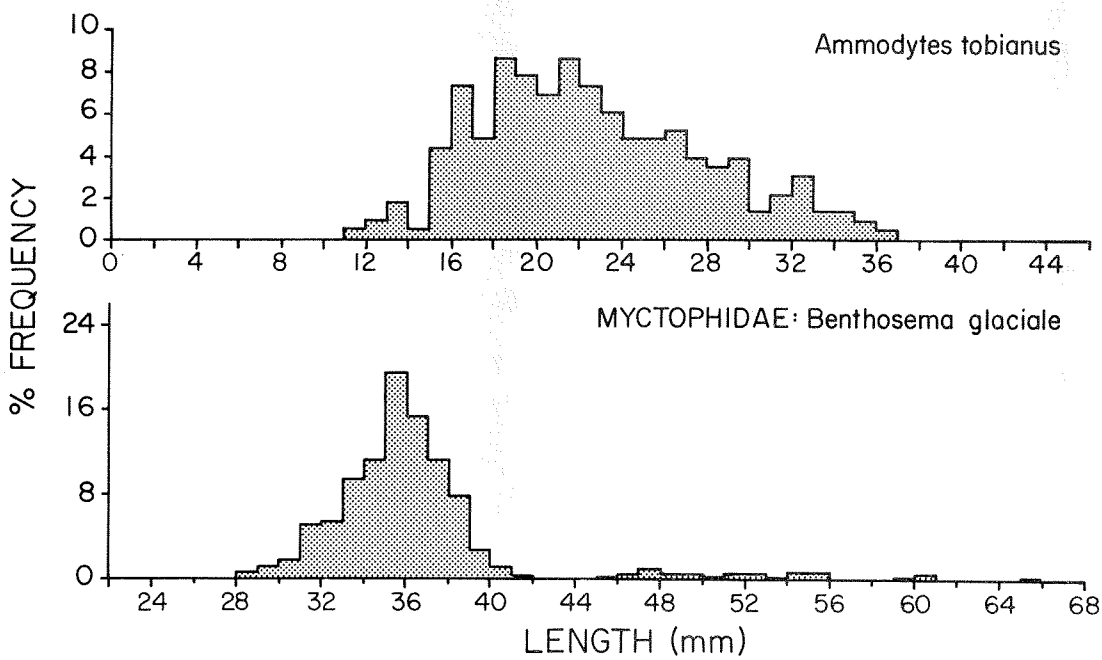


Fig. 3. Length frequency distribution of Ammodytes tobianus and Benthosema glaciale.

Station 4

Station 8

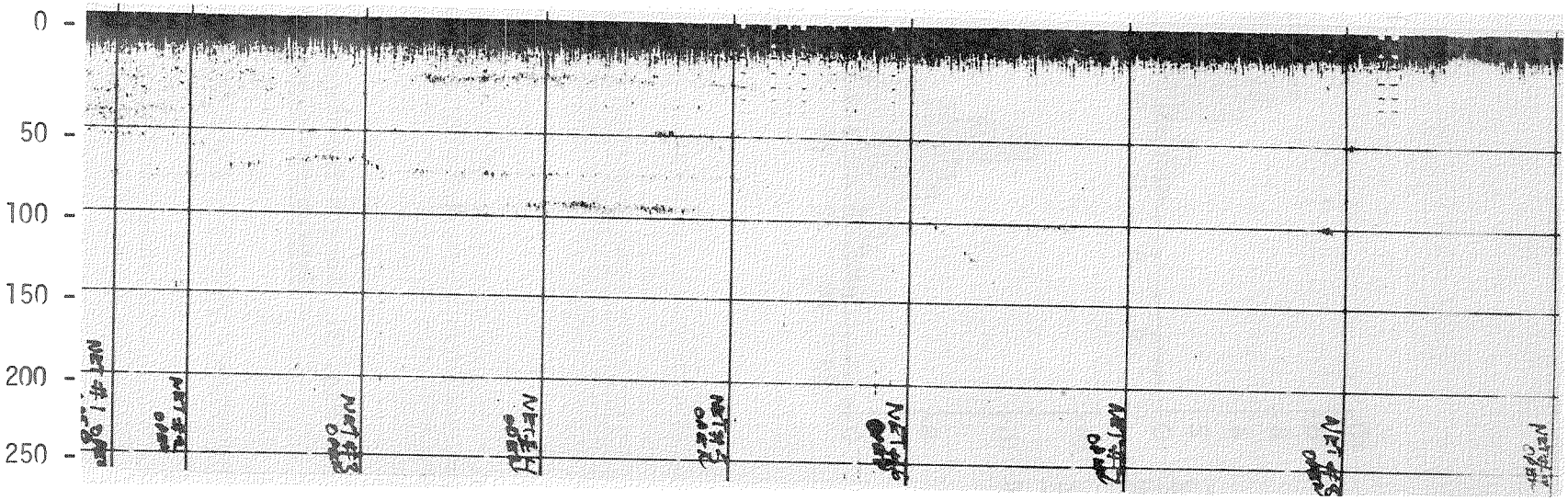
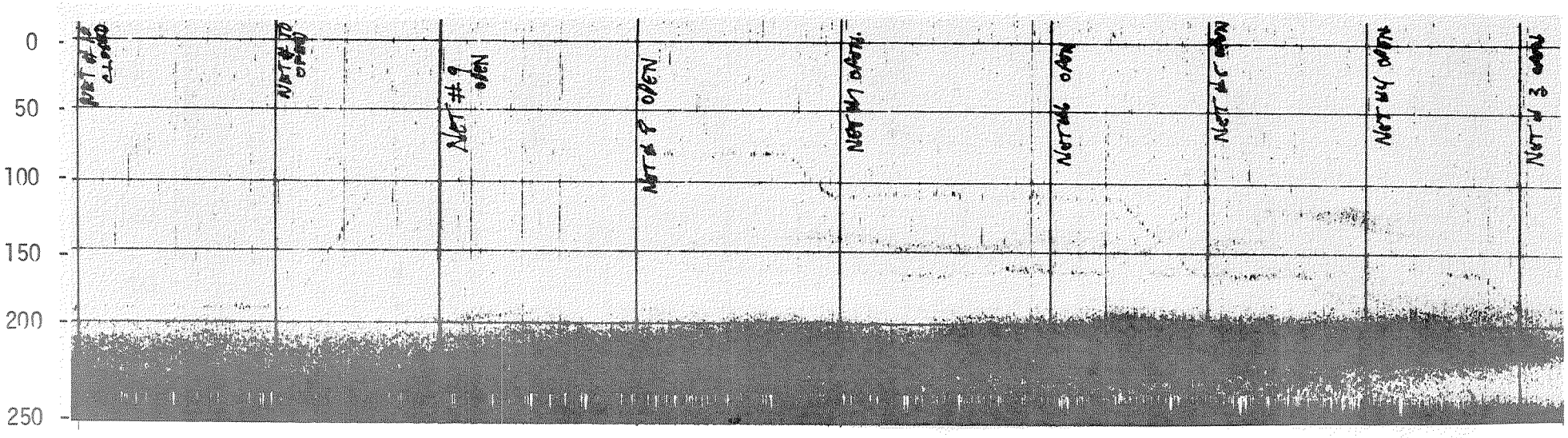


Fig. 4. Echograms taken on the different sampling stations. Vertical lines represent times when the sampling nets were opened. (B-the bottom, depth is in meters).

Station 5



Station 7

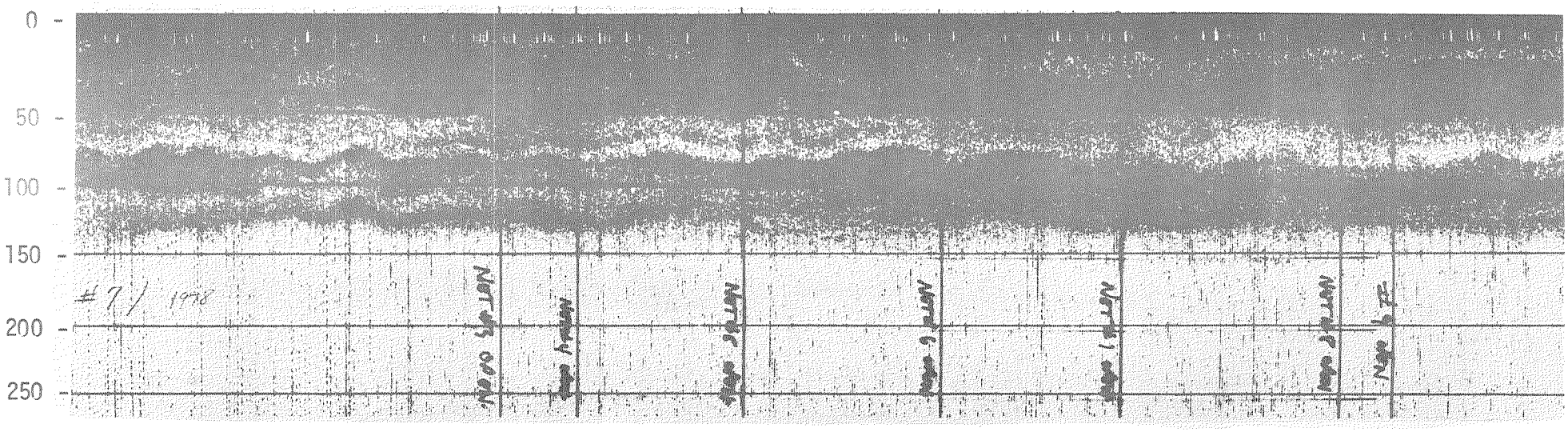
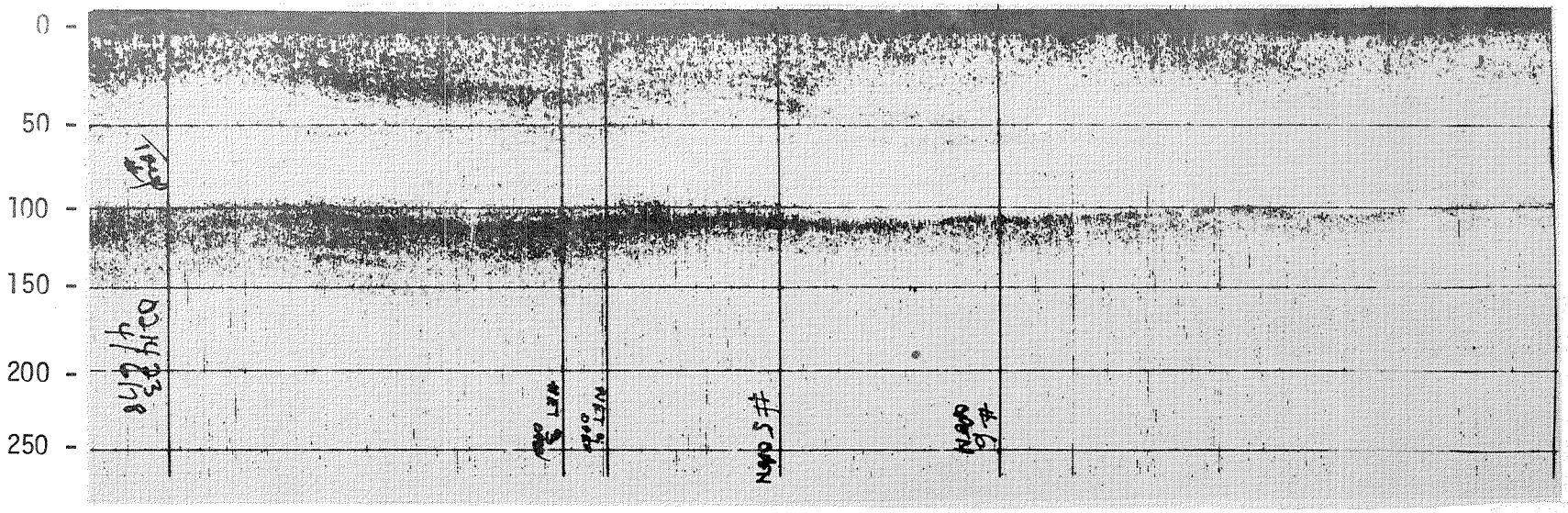


Fig. 4. (continued)

Station 1



Station 3

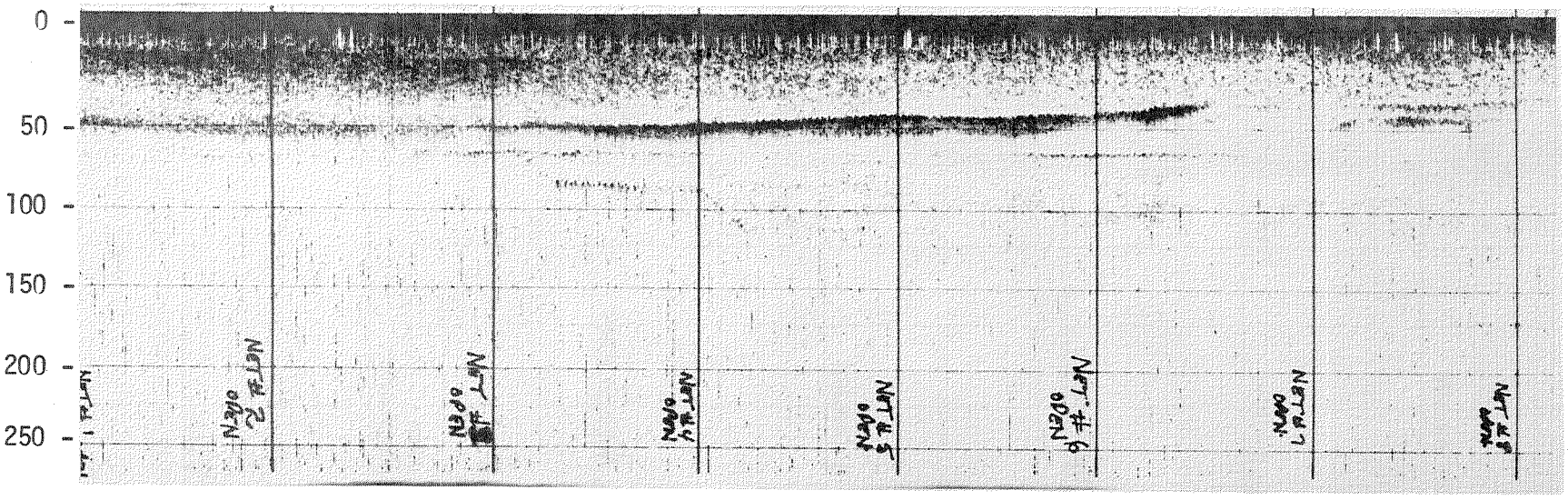


Fig. 4. (continued)

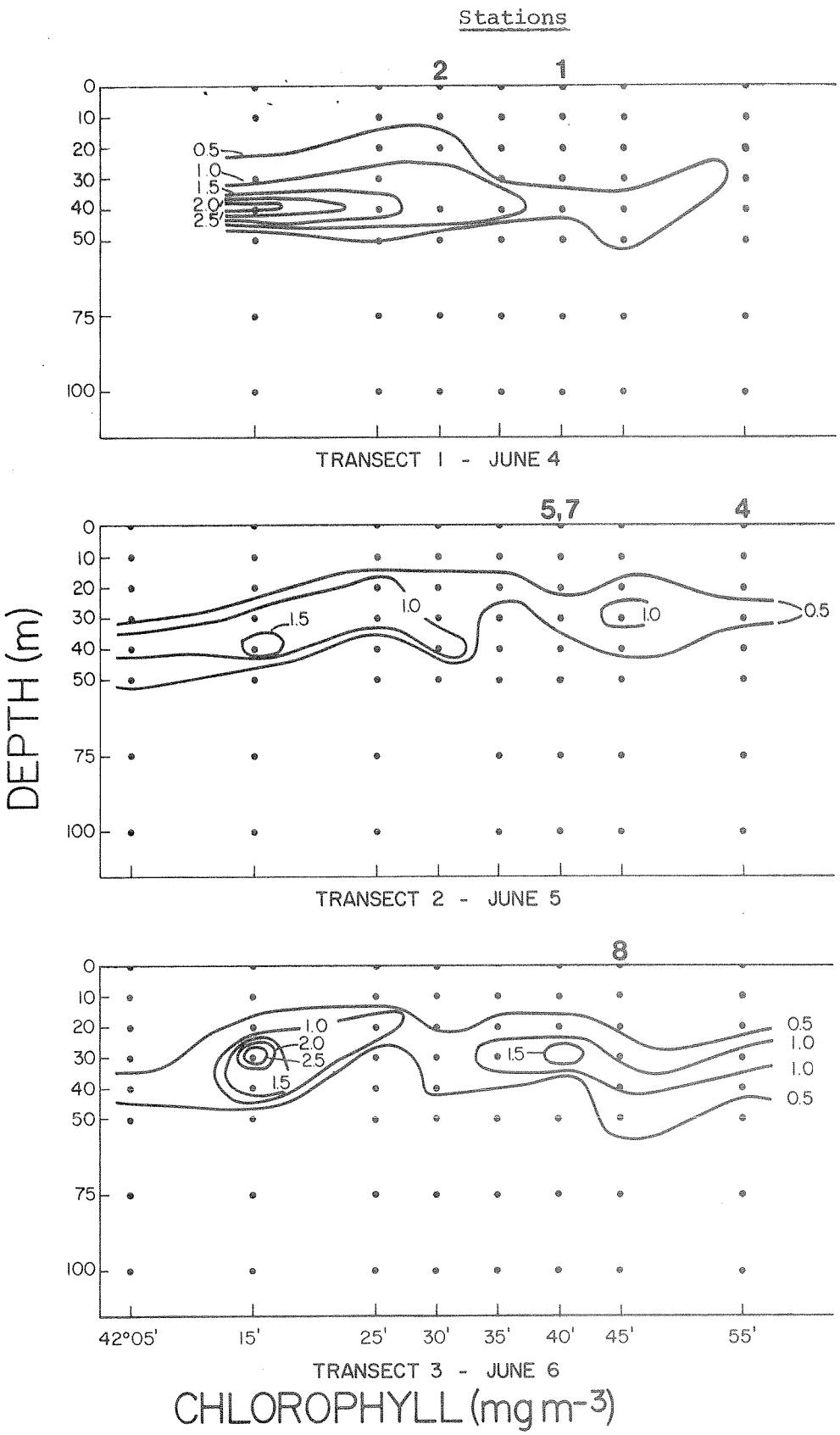


Fig. 5. Vertical distribution of chlorophyll a in the area of the sampling stations (taken from Irwin and Platt 1979).

Table 1. List of all species collected and identified.

Cnidaria	Hydrozoa unidentified
	Agalma elegans
	Nanomia cara
	Stephanoma
	Dimophyes arctica
	Lensia conoidea
	Medusae
Ctenophora	Unidentifiable
Gastropoda	Limacina helicina
	Limacina retroversa
	Clione sp.
	Clione limacina
	Paedoclione dolioformis
Bivalvia	Unidentified
Cephalopoda	squid
Polychaeta	Tomopteris sp.
	Spiophanes sp.
Ostracoda	Conchoecia sp.
	Conchoecia acuticosta
	Conchoecia elegans
	Conchoecia obtusata
Copepoda	Aetideus armatus
	Calanus sp.
	Calanus sp. immature
	Calanus finmarchicus
	Calanus hyperboreus
	Calanus glacialis
	Candacia armata
	Chirundia streetsii
	Clausocalanus acruicornis
	Euchaeta sp.
	Euchaeta sp. immature
	Euchaeta norvegica
	Euchirella rostrata
	Gaidus tenuispinus
	Heterohabdus sp.
	Heterohabdus sp. immature
	Heterohabdus norvegica
	Metridia sp.
	Metridia sp. immature
	Metridia longa
	Metridia lucens
	Nannocalanus minor
	Oithona atlantica
	Oncaea conifera
	Oncaea venustra
	Pleuromamma sp.
	Pleuromamma sp. immature
	Pleuromamma borealis
	Pleuromamma robusta
	Pleuromamma xiphias
	Psuedocalanus minutus
	Rhincalanus sp.
	Rhincalanus nasutus
	Scolecithricella sp.
	Scolecithricella sp. immature
	Scolecithricella minor
	Scottocalanus persecans
	Tisbe sp.
Mysidacea	Unidentified
	Euchaetomera sp.
Isopoda	Microniscid larvae
Amphipoda	Unidentified
	Gammaridae unidentified
	Ampelisca mexicana
	Eurythenes obesus
	Hyperiidae unidentified
	Parathemisto sp.
	Parathemisto gaudichaudii
Euphausiacea	Euphausiacea unidentified
	Euphausia krohnii
	Meganyctiphanes sp.
	Meganyctiphanes norvegica
	Nematoscelis megalops
	Stylocheiron maximum
	Thysanoessa sp.
	Thysanoessa sp. zoea
	Thysanoessa inermis
	Thysanoessa longicaudata
	Thysanoessa longicaudata zoea
	Thysanoessa raschii
	Thysanoessa acutifrons
Decapoda	Unidentified
	Pontophilus norvegica
	Caridon sp.
	Dichelopandalus sp.
	Pandalus montaqui
	Sergestes sp.
	Sergestes arcticus
	Acanthephyra sp.
	Acanthephyra pelagica
	Gennadas elegans
	Gennadas valens
Chaetognatha	Unidentified
	Eukrohnia fowleri
	Eukrohnia hamata
	Sagitta sp.
	Sagitta elegans
	Sagitta maxima
	Sagitta tasmanica
Urochordata	Ascidiacea unidentified
Osteichthyes	Ammodytes sp.
	Ammodytes tobianus
	Anarhichas
	Barrucudina
	Gadidae
	Merluccius bilinearis
	Myoxocephalus
	Nemichthyes scolopaceus
	Primnothorus
	Sebastes marinus
	Stomias
	Urophycis chuss
	Benthosema glaciale

Table 2. List of number per cubic metre of each species in each sample taken on the stations; the time and depth of each sample is given plus the mean water temperature at the sample depth and the station position. The total biomass represents all zooplankton under 10 mm length.

ZOOPLANKTON DATA - SCOTIAN SHELF

DATE: June 4, 1978 LAT.: 42°39.3'N LONG.: 63°22.5'W

STN 1

SAMPLE	1	2	3	4	5	6	7	8	9	10
TIME	0215	0216	0220	0224	0228	0238	0241	0245	0250	
DEPTH	0-7	7-16	16-50	50-75	75-110	110-146	146-147	147-175	175-0	
TEMPERATURE	7.06	5.10	3.16	4.10	9.09	10.17	11.19	11.41	8.58	
VOLTAGE[2]	-	-	-	-	-	-	-	-	-	
S_v(dB)	-	-	-	-	-	-	-	-	-	
AMPHIPODA										
Parathemisto gaudichaudi	10.5	4.7	2.4	1.6	3.3	2.0	.4	.7	6.2	
Parathemisto sp.	41.0	71.0	36.0	6.0	26.0	39.0	13.0	5.0	32.0	
Gammaridae			.004							
BIVALVIA										
Unidentified									.4	
CALANOIDA										
Aetideus armatus					.2	.4	.1	.1	.4	
Calanus finmarchicus	1046.0	1150.0	740.0		13.0	.1	4.0	2.0	169.0	
Calanus glacialis	4.0			.9		.6	.5			
Calanus hyperboreus						1.0	.9	.4	2.0	
Calanus sp. immature			138.0	144.0	3.0	18.0	4.0	4.0	50.0	
Euchaeta norvegica	11.0		14.0	3.0	1.0	1.0	.7	.4	2.0	
Euchirella rostrata				.7	2.0	1.0	.6	.5	.4	
Heterohabdus norvegicus				.4	.2	.3				
Metridia lucens	7.0	12.0	33.0	33.0	16.0	12.0	3.0	.6	14.0	
Metridia sp. immature			27.0		8.0			1.0	7.0	
Nannocalanus minor					.4	.6	.1	.1		
Pleuromamma borealis					1.0		.1	.2		
Pleuromamma robusta					.2	.1	.5	.1	.8	
Pleuromamma sp. immature							.1			
Pleuromamma xiphias							.1			
Pseudocalanus minutus	2.0	28.0	9.0	1.0	1.0	.1	.4	.2	7.0	
Scolecithricella minor				7.0	2.0	2.0	.9	.6	3.0	
CHAETOGNATHA										
Eukrohnia fowleri						.1				
Eukrohnia hamata				.1	.2					
Sagitta elegans					.2					
Sagitta tasmanica					.2	.1				
Unidentified					.2		.1	.01	.8	
CYCLOIPOIDA										
Oithona atlantica					.2		.3		2.0	
DECAPODA										
Sergestes sp.	.004	.01	.01		.004	.004			.01	
EUPHAUSIACEA										
Meganyctiphanes norvegica	.1	.1	.1	.2	.02	.01	.1	.03	.5	
Nematoscelis megalops	.03	.01	.1	.1	.1	.1	.1	.1	.1	
Stylocheiron maximum								.01		
Thysanoessa inermis			.004							
Thysanoessa longicaudata	4.0	3.0	2.0	8.0	10.0	12.0	1.0	.6	7.0	
Thysanoessa sp. zoea								.1		
Unidentified	4.0			2.0	7.0	4.0		.3	.4	

SAMPLE	1	2	3	4	5	6	7	8	9	10
CASTROPODA										
Clione sp.	.004	.006	.004	3.0	4.0	11.0	1.0	.4	3.0	
Limacina retroversa	7.0	26.0	2.0				.1		1.0	
HYDROZOA										
Nanomia cara						*		*		
MYSIDACEA										
Euchaetomera sp.						.004				
OSTEICHTHYES										
Ammodytes tobianus	.01	.01							.003	
Merluccius bilinearis	.004									
Myctophidae	.02	.10	.04	.005	.21	.07	.01	.02	.04	
Primnothorus						.002		.01	.01	
Stomias							.01			
Urophycis chuss	.004									
OSTRACODA										
Conchoecia acuticosta								.1		
Conchoecia elegans							.1			
Conchoecia obtusata						.1	.1			
POLYCHAETA										
Tomopteris sp.						.004				
SCYPHOZOA										
Unidentified medusae							.003			
TOTAL BIOMASS (g/M^3)	.553	.770	.625	.197	.352	.207	.146	.094	.372	
MYCTOPHIDAE (g/M^3)	.008	.051	.025	.002	.089	.029	.007	.006	.024	
EUPHAUSIACEA (g/M^3)	.015	.003	.027	.024	.003	.004	.004	.006	.009	
COPEPODA ($\#/M^3$)	1070.0	1190.0	961.0	190.0	48.2	37.2	16.3	10.2	257.6	

* fragmented

ZOOPLANKTON DATA - SCOTIAN SHELF

DATE: June 4, 1978 LAT.: 42°25'N LONG.: 63°25'W

STN 2

SAMPLE	1	2	3	4	5	6	7	8	9	10
TIME	2117	2121								
DEPTH	0-6	6-25								
TEMPERATURE	11.11	8.61								
VOLTAGE^2	-	.001								
S_v(dB)	-	-								
AMPHIPODA										
Parathemisto gaudichaudi	.107	.115								
CNIDARIA										
Medusae		.006								
DECAPODA										
Sergestes sp.		.003								
EUPHAUSIACEA										
Meganyctiphanes norregica	.015	.148								
Nematoscelis megalops	.092	.353								
GASTROPODA										
Clione sp.		.009								
OSTEICHTNYES										
Merluccius bilinearis		.003								
Myctophidae	.003									
Myatophid larvae	.324	.334								
UROCHORDATA										
Ascidacea		.003								
TOTAL BIOMASS (g/M^3)	.227	.222								
MYCTOPHIDAE (g/M^3)	.001	-								
EUPHAUSIACEA (g/M^3)	.002	-								

ZOOPLANKTON DATA - SCOTIAN SHELF

DATE: June 5, 1978 LAT.: 42°30.5'N LONG.: 63°25'W

STN 3

SAMPLE	1	2	3	4	5	6	7	8	9	10
TIME	0007	0011	0016	0021	0025	0030	0035	0040	0045	0050
DEPTH	0-7	7-20	20-52	52-71	71-90	90-118	118-120	120-150	150-200	200
TEMPERATURE	7.59	4.05	5.70	8.53	9.36	10.34	10.52	10.72	9.98	9.62
VOLTAGE[2]	-	-	-	-	-	-	-	-	-	-
S_v(dB)	-	-	-	-	-	-	-	-	-	-
AMPHIPODA										
Ampelisca mexicana									.05	
Euthenes obesus							.03			
Parathemisto gaudichaudi	5.3	.5	1.2	2.4	4.4	3.1	.9	.9	.6	.1
Parathemisto sp.	33.0	38.0	4.0	46.0	36.0	32.0	10.0	6.0	4.0	
CALANOIDA										
Aetideus armatus			.3			.3		.2	.2	
Calanus finmarchicus		1475.0	113.0	10.0	9.0	11.0	7.0	10.0	11.0	.8
Calanus glacialis	11.0	13.0							1.0	.3
Calanus hyperboreus		54.0	9.0	.9	2.0	2.0	.4	1.0	1.0	4.
Calanus sp. immature	1095.0	69.0	2.0	6.0	5.0	3.0	.8	.4	5.0	11.0
Candacia armata			.3							
Chirudina streetsii									.1	.1
Clausocalanus arcuicornis				.2						
Euchaeta norvegica		13.0	1.0	.5	.3	.2	.1		.3	.1
Euchirella rostrata	2.0	2.0	1.0	.7	.9	2.0	.6	2.0	2.0	2.0
Gaidus tenuispinus									.3	.7
Heterohabdus norvegicus				.9	.6	.1	.1	.1	.2	.4
Metridia longa					.2			.1	.1	.1
Metridia lucens	4.0	8.0	29.0	20.0	12.0	2.0	1.0	1.0	.9	.4
Metridia sp. immature	6.0	6.0	10.0	6.0	4.0	3.0	2.0	.9	2.0	.3
Nannocalanus minor				.9	.8	.8	.2	.2	.2	.1
Pleuromamma borealis	2.0			.5	.8	1.0	.3	.3	.2	.1
Pleuromamma robusta	2.0	2.0	.8	2.0	.5	.5	.5	.6	.8	2.0
Pleuromamma sp. immature				.2	.2					
Pseudocalanus minutus	4.0	2.0	.5	.5	.3	.1		.1	.1	.1
Scolecithricella minor			2.0	6.0	2.0	2.0	1.0	1.0	1.0	1.0
Scolecithricella sp. immature				.7						
Scottocalanus persecans										.1
CARIDEA										
Acanthephyra pelagica							.03			.003
CHAETOGNATHA										
Eukrohnia hamata									.2	.1
Sagitta maxima								.1	.2	.2
Sagitta tasmanica		2.0	.5							
Sagitta sp.				.2			.2			
Unidentifiable	2.0		.3	.2	.3	.4	.1	.2	*	.1
CTENOPHORA										
Unidentified									.003	
CYCLOPOIDA										
Oithona atlantica	2.0			.7		.1	.2	.1	.9	.2
Oithona conifera										.1
Oncaeavenustra					.1				.1	

SAMPLE	1	2	3	4	5	6	7	8	9	10
DECAPODA										
Acanthephyra sp.										.003
Gennadas valens										.02
Sergestes arcticus										.01
Sergestes sp.	.3	.01	.03	.02				.01	.003	.003
Unidentified		.03	.004		.02	.02				
EUPHAUSIACEA										
Euphausia krohnii	.004			.2						
Meganyctiphanes norvegica	.5	16.8	.6	.1	.1	.04		.1	.1	.02
Meganyctiphanes sp.							.1			
Nematoscelis megalops	.06	.02	.1	.1	.2	.1		.1	.1	.04
Thysanoessa longicaudata			8.0	6.0	4.0	3.0	1.0	1.1	.9	.5
Thysanoessa sp. zoca			.3			.1	.2	.2	.4	
Thysanopoda acutifrons								.1		
Unidentified	2.0	1.0	6.0	8.0	4.0	2.0	.6	.3	.05	.2
GASTROPODA										
Clione sp.	2.0	.004			.8	5.0	2.0	.7	.2	.4
Limacina retroversa	26.0		1.0			.1			.05	.1
Paedoclione dolioformis							.1			
HYDROZOA										
Agalma elegans									.1	
Dimophyes arctica									.05	*
Nanomia cara									*	
Stephanoma sp.									.1	
Unidentified									*	
ISOPODA										
Microniscid larvae								.05		
MOLLUSCA										
Squid			.004							
MYSIDACEA										
Unidentified	1.0									
ISTEICHTHYES										
Myctophidae	.03	.12	.07	.004	.02	.01			.003	
Nemichthyes scolopaceus								.003		
OSTRACODA										
Conchoecia sp.									.1	
Conchoecia acuticosta						.1		.1		.2
Conchoecia elegans							.1		.2	
Conchoecia obtusata									.1	
POLYCHAETA										
Tomopteris sp.						.003				
SCYPHOZOA										
Unidentified medusae						.01				
TOTAL BIOMASS (g/M^3)	1.154	1.935	.476	.213	.252	.156	.107	.070	.077	.063
MYCTOPHIDAE (g/M^3)	.009	.048	.047	.002	.009	.002	-		.002	
EUPHAUSIACEA (g/M^3)	.025	.573	.095	.016	.010	.008	-	.003	.004	.005
COPEPODA ($\#/M^3$)	1128.0	1644.0	168.9	56.7	38.7	28.1	12.4	18.0	27.4	23.9

** Largebugs not counted
* fragmented

ZOOPLANKTON DATA - SCOTIAN SHELF

DATE: June 5, 1978 LAT.: 42°56.2'N LONG.: 63°23.3'W

STN 4

SAMPLE	1	2	3	4	5	6	7	8	9	1.
TIME	0402	0406	0410	0414	0418	0422	0426	0430	0434	0438
DEPTH	0-7	7-15	15-30	30-45	45-62	62-80	80-95	95-114	114-125	125-139
TEMPERATURE	-	7.33	2.76	2.84	3.78	7.22	8.73	9.45	9.57	9.1
VOLTAGE[2]	-	-	-	-	-	-	-	-	-	-
S_v(dB)	-	-	-	-	-	-	-	-	-	-
AMPHIPODA										
Parathemisto gaudichaudi	.9	2.1	13.6	.6	.7	.6	.4	1.2	.7	.5
Parathemisto sp.	3.0	2.0		35.0	5.0	4.0	1.0	1.0	.5	.4
CALANOIDA										
Aetideus armatus				.9				.2	1.0	
Calanus finmarchicus	12.0	10.0	20.0	14.0	7.0	7.0	2.0	1.0	4.0	.8
Calanus glacialis	6.0	2.0				4.0	8.0	5.0	9.0	13.0
Calanus hyperboreus	23.0	12.0		29.0	30.0	28.0	39.0	30.0	14.0	11.0
Calanus sp. immature	296.0	960.0	1766.0	354.0	77.0	59.0	73.0	81.0	110.0	143.0
Euchacta sp. immature		2.0			1.0					
Euchirella rostrata	2.0	5.0		.9	2.0	3.0	1.0	.7	.9	
Heterohabdus norvegicus									.5	
Heterohabdus sp.								.2		
Heterohabdus sp. immature						.9				
Metridia longa	1.0		3.0			2.0	4.0	3.0	2.0	9.0
Metridia lucens	19.0	56.0	20.0	.9	10.0	16.0	10.0	11.0	18.0	22.0
Metridia sp. immature	25.0	79.0	34.0	16.0	108.0	55.0	27.0	32.0	71.0	21.0
Pleuromamma borealis		2.0								
Pleuromamma robusta						.5			.5	
Pleuromamma sp. immature	.6						.3			.4
Pseudocalanus minutus	5.0	7.0	3.0	44.0	36.0	6.0	4.0	1.0	.9	3.0
Rhincalanus nasutus										.8
Rhincalanus sp.									.5	
Scolecithricella minor	2.0	2.0			26.0	8.0	6.0	2.0	5.0	5.0
CARIDEA										
Caridon sp.				2.0						
CHAETOGNATHA										
Eukrohnia fowleri						.2				
Eukrohnia hamata					.5	.5			.5	
Sagitta elegans								.2		
Sagitta maxima										.4
Sagitta sp.	1.0									
Sagitta tasmanica							.5			
Unidentified	.6		7.0			.2	.3			
CTENOPHORA										
Unidentified			.02							
CYCLOPOIDA										
Oithona atlantica		2.0			8.0	.9	.3	1.0		5.0
DECAPODA										
Dichelopandalus sp.	.01									
Pandalus montagui							.004			.003
Sergestes sp.	.01									

SAMPLE	1	2	3	4	5	6	7	8	9	10
EUPHAUSIACEA										
Meganyctiphanes norvegica		.003	3.0	1.0	.004	.003	.004			.003
Nematoscelis megalops	.01		.01	.01	.004			.01	.01	.003
Thysanoessa inermis	.01			.004	.01	.003	.02	.01		
Thysanoessa longicaudata	1.0		10.0	5.0	.5	.2			2.0	.8
Thysanoessa raschii	.01									
Thysanopoda acutifrons									.5	
Unidentified			3.0			.2		.2		
GASTROPODA										
Clione sp.	2.0		3.0	.9		.5	.3			
Limacina retroversa	1.0	5.0	3.0			.5	.5			
Paedoclione dolioformis			3.0							
HYDROZOA										
Agalma elegans								.2		
Dimophyes arctica										*
Unidentified						.003		.004	.003	*
MYSIDACEA										
Unidentified								.2		
OSTEICHTHYES										
Ammodytes tobianus	.02	.31	.64	.05					.003	
Ammodytes sp.	.3									
Gadidae									.5	
OSTRACODA										
Conchoecia acuticosta	.6							1.0	.5	.8
Conchoecia elegans								.2	.5	.8
Conchoecia obtusata								.2	.5	.4
POLYCHAETA										
Tomopteris sp.								.004		.003
SCYPHOZOA										
Unidentified medusae	.01									
TOTAL BIOMASS (g/M^3)	.345	.649	.903	.401	.182	.114	.255	.278	.300	.241
MYCTOPHIDAE (g/M^3)	–	–	–	–	–	–	–	–	–	–
EUPHAUSIACEA (g/M^3)	.0008	.00003	.0003	.0046	.0016	.0012	.0017	.0004	.0001	.0005
COPEPODA ($\#/M^3$)	391.6	1139.0	846.0	459.7	305.0	190.3	174.6	168.1	237.3	234.1

* fragmented

ZOOPLANKTON DATA - SCOTIAN SHELF

DATE: June 5, 1978 LAT.: 42°40'N LONG.: 63°24'W

STN 5

SAMPLE	1**	2**	3**	4	5	6	7	8	9	10
TIME	2147	2150	2154	2158	2202	2206	2211	2217	2222	
DEPTH	0-4	4-28	28-55	55-40	40-100	100	100-125	125-150	150-30	
TEMPERATURE	8.56	5.54	4.96	4.94	6.13	6.41	7.16	8.49	6.00	
VOLTAGE[2]	-	-	-	-	-	-	-	-	-	
S_v(dB)	-	-	-	-	-	-	-	-	-	
AMPHIPODA										
Parathemisto gaudichaudi				1.3	.5	1.5	2.0	.4	.6	
Parathemisto sp.				18.0	17.0	6.0	15.0	7.0	8.0	
CALANOIDA										
Aetideus armatus								.4		
Calanus firmarchicus				6.0	3.0	.8	.6	.8	2.0	
Calanus glacialis				2.0	3.0	8.0	7.0	3.0	3.0	
Calanus hyperboreus				14.0	18.0	7.0	14.0	8.0	13.0	
Calanus sp. immature				61.0	94.0	86.0	103.0	64.0	77.0	
Euchaeta norvegica				.4		.2		.4	1.0	
Euchaeta sp. immature				.7	3.0	.6	.4			
Euchirella rostrata				.4	.6	.4		.4	.4	
Heterohabdus norvegicus							.4	.4		
Metridia longa				22.0	10.0	3.0	7.0	7.0	10.0	
Metridia lucens				9.0	11.0	5.0	4.0	3.0	6.0	
Metridia sp. immature				42.0	27.0	10.0	9.0	9.0	14.0	
Nannocalanus minor								.2		
Pleuromamma borealis				.4	.6	.4				
Pleuromamma robusta				4.0	.6	1.0	.8		1.0	
Pleuromamma sp. immature								1.0		
Pseudocalanus minutus				36.0	131.0	1.0	.4	1.0	9.0	
Scolecithricella minor				5.0	19.0	4.0	2.0	3.0	6.0	
CARIDEA										
Acanthephyra pelagica							.003			
Pontophilus norvegicus									.2	
CHAETOGNATHA										
Eukrohnia hamata							.4	.4		
Sagitta elegans				2.0						
Unidentifiable									.2	
CTENOPHORA										
Unidentified				.003			.003			
CLYCLOPOIDA										
Oithona atlantica					9.0		.8		.8	
DECAPODA										
Sergestes sp.				.01	.01	.01	.01	.01	.01	
EUPHAUSIACEA										
Meganyctiphanes sp. zoea						.2				
Meganyctiphanes norvegica				1.4	.1	.02	.05	.01	.2	
Nematoscelis megalops				.01	.1	.04	.2	.03	.04	
Thysanoessa longicaudata					2.0			.6	.8	
Thysanoessa longicaudata zoea					.6					

STN 5

SAMPLE	1	2	3	4	5	6	7	8	9	10
GASTROPODA										
Clione sp.				5.0	32.0	21.0	22.0	7.0	15.0	
Limacina helicina					1.0				.2	
Limacina retroversa				18.0	2.0	.4		.6	.4	
Paedoclione dolioformis						1.0	2.0			
HYDROZOA										
Unidentified				.003	.02	.01		.003		
OSTEICHTHYES										
Ammodytes tobianus									.01	
Barracudina							.003			
Myctophidae				.14	.05	.01	.02		.01	
OSTRACODA										
Conchoecia elegans								.2		
POLYCHAETA										
Pomopteris sp.					.01	.01				
SCYPHOZOA										
Unidentified medusae				.003	.005				.003	
TOTAL BIOMASS (g/M^3)	-	-	-	.406	.308	.225	.262	.152	.213	
MYCTOPHIDAE (g/M^3)	-	-	-	.077	.022	.007	.016		.005	
EUPHAUSIALEA (g/M^3)	-	-	-	.064	.015	.004	.015	.003	.009	
COPEPODA ($\#/M^3$)	-	-	-	202.9	329.8	127.4	149.4	101.6	143.2	

** sample not analysed.

ZOOPLANKTON DATA - SCOTIAN SHELF

DATE: June 5, 1978 LAT.: 42°40'N LONG.: 63°24'W

STN 7

SAMPLE	1	2	3	4	5	6	7	8	9	1
TIME	2359	0004	0027	0030	0034	0039	0044	0049	0051	
DEPTH	0-5	0-20	0-25	25-27	27-50	50-75	75-100	100-130	130-0	
TEMPERATURE	8.64	7.08	6.82	6.25	4.79	4.86	8.00	9.50	8.40	
VOLTAGE[2]	-	-	-	-	-	-	-	-	-	
S_v(dB)	-	-	-	-	-	-	-	-	-	
AMPHIPODA										
Parathemisto gaudichaudi	5.3	6.7	9.6	3.2	.2	2.3	1.5	1.7	2.6	
Parathemisto sp.	6.0	5.0	211.0	24.0	36.0	31.0	9.0	10.0	10.0	
Unidentifiable		1.0								
CALANOIDA										
Aetideus armatus								.3		
Calanus finmarchicus	3.0	2.0		2.0	1.0		.4	1.0	2.0	
Calanus glacialis					3.0	2.0	2.0	2.0	6.0	
Calanus hyperboreus					33.0	23.0	3.0	6.0	5.0	
Calanus sp. immature	515.0	329.0	2532.0	1009.0	302.0	186.0	44.0	75.0	229.0	
Euchaeta norvegica	3.0	3.0		7.0	3.0	2.0	.8	1.0		
Euchaeta sp. immature									.6	
Euchirella rostrata	4.0		3.0	2.0	.7	3.0	.4	.5	2.0	
Metridia longa	5.0	3.0	3.0	2.0	31.0	170.0	23.0	9.0	17.0	
Metridia lucens	6.0	5.0	30.0	8.0	8.0	42.0	20.0	7.0	11.0	
Metridia sp. immature	23.0	16.0	26.0	7.0	9.0	88.0	.7	15.0	11.0	
Pleuromamma borealis								.8	.6	
Pleuromamma robusta					.7	2.0	.4	2.0	2.0	
Pleuromamma sp. immature							2.0		3.0	
Pseudocalanus minutus	.9	.5	59.0	226.0	43.0	38.0	4.0	2.0	52.0	
Scolecithricella minor	.9		10.0	98.0	5.0	1.0	5.0	6.0	57.0	
CHAETOGNATHA										
Eukrohnia hamata							.2			
Sagitta elegans		1.0		7.0	1.0					
Sagitta maxima							.2	.3		
Sagitta sp.				.1						
Sagitta tasmanica	2.0	.5	3.0				.2			
Unidentifiable				3.0						
CYCLOPOIDA										
Oithona atlantica					2.0	5.0	1.0		6.0	
DECAPODA										
Sergestes articus									.3	
Sergestes sp.	.003	.03	.1	.003	.02	.003	.01	.01	.01	
EUPHAUSIACEA										
Euphausia krohnii	.03	.02	.01			.02			.001	
Meganyctiphanes norvegica	.05	.6	1.0	3.1	.8	1.9	.1	.2	.3	
Nematoscelis megalops	.002					.5	.1	.1	.2	
Thysanoessa longicaudata		.5	3.0	10.0	5.0	6.0	.6	.5	2.0	
Unidentifiable	.9	.5					.4			
GASTROPODA										
Clione limacina						.8				
Clione sp.	3.0	3.0	.01	10.0	5.0	27.0	19.0	17.0	19.0	
Limacina retroversa	49.0	12.0	63.0	18.0	5.0	7.0	5.0	1.0	15.0	
Paedoclione dolioformis		.5							.6	

STN 7

SAMPLE	1	2	3	4	5	6	7	8	9	10
HYDROZOA										
Unidentified								*		
OSTEICHTHYES										
Merluccius bilinearis	.003									
Ammodytes tobianus	.06	.08	.41	.13	.03	.08	.01		.03	
Ammodytes sp.				2.00						
Anarchichadidae								.01		
Myctophidae	.01	.07	.14	.03	.03	.13	.06	.07	.05	
Stomias			.003	.01						
SCYPHOZOA										
Unidentified medusae						.003			.001	
TOTAL BIOMASS (g/M^3)[1]	.519	.591	2.896	.895	.620	.452	.203	.298	.375	
MYCTOPHIDAE (g/M^3)	.003	.028	.071	.025	.018	.062	.034	.054	.022	
EUPHAUSIACEA (g/M^3)	.004	.009	.110	.170	.101	.207	.014	.020	.052	
COPEPODA ($\#/M^3$)	560.8	358.5	2663.0	1361.0	441.4	562.0	106.7	127.6	404.2	

* fragmented

ZOOPLANKTON DATA - SCOTIAN SHELF

DATE: June 6, 1978 LAT: 42°46.2'N LONG: 63°25'W

STN 8

SAMPLE	1	2	3	4	5	6	7	8	9	10
TIME	2158	2200	2205	2208	2213	2217	2221	2225	2229	
DEPTH	0-14	14-25	25-35	35	35-50	50-100	100-125	125-150	150-0	
TEMPERATURE	8.14	6.28	5.80	5.59	4.80	8.06	10.02	9.32	8.00	
VOLTAGE[2]	-	-	-	-	-	-	-	-	-	
S_v(dB)	-	-	-	-	-	-	-	-	-	
AMPHIPODA										
Parathemisto gaudichaudi	1.0	6.6	1.2	8.1	.9	1.7	2.9	1.6	.6	
Parathemisto sp.		68.0	21.0	101.0	17.0	41.0	25.0	34.0	59.0	
CALANOIDA										
Calanus finmarchicus			3.0		5.0	1.0	.1			
Calanus glacialis		3.0	3.0	7.0	4.0	3.0	1.0	2.0	10.0	
Calanus hyperboreus				27.0	8.0	7.0	2.0	3.0	9.0	
Calanus sp. immature	5066.0	1319.0	1235.0	2190.0	350.0	49.0	23.0	44.0	765.0	
Euchaeta sp. immature		3.0	7.0	7.0	3.0	.2	.4	.2	3.0	
Euchirella rostrata				7.0	.9	.2	.7	.4	2.0	
Heterohabdus nervegicus							.1	.2		
Metridia longa	8.0	9.0	24.0	20.0	6.0	7.0	7.0	15.0	30.0	
Metridia lucens	8.0	3.0	12.0	14.0	10.0	3.0	6.0	28.0		
Metridia sp. immature	23.0	3.0		7.0	9.0	9.0	5.0	7.0	5.0	
Nannocalanus minor								.4		
Pleuromamma borealis					.9	.2				
Pleuromamma robusta						.6		.2		
Pleuromamma robusta immature							.3			
Pleuromamma sp. immature						.6	.1			
Pseudocalanus minutus	31.0	29.0	12.0	250.0	345.0	3.0	2.0	10.0	172.0	
Scolecithricella minor	85.0	5.0	19.0	115.0	16.0	2.0	.2	1.0	28.0	
CARIDEA										
Pontophilus norvegicus						.2				
CHAETOGNATHA										
Eukrohnia fowleri								.2		
Eukrohnia hamata							.2			
Sagitta maxima							.1	.2		
Unidentifiable		6.0	1.0				.1	.2	2.0	
CYCLOPOIDA										
Oithona atlantica				14.0	.9	2.0	.1	2.0	16.0	
DECAPODA										
Sergestes sp.					.003					
EUPHAUSIACEA										
Meganyctiphanes norvegica	.02	.1	.1	.1	1.3	.3	.1	.02	.2	
Nematoscelis megalops		.04	.01						.01	
Thysanoessa inermis								.003		
Thysanoessa longicaudata zoea								.2		
Thysanoessa longicaudata	8.0			.01	.02	.7	1.0	.2	7.0	
Thysanoessa raschii									2.0	
Unidentifiable			1.0				.2		3.0	

STN 8

SAMPLE	1	2	3	4	5	6	7	8	9	10
GASTROPODA										
Clione sp.			1.0		5.0	12.0	2.0	3.0	3.0	
Limacina retroversa	8.0	3.0	7.0		.9		.3	.2	16.0	
Paedoclione dolioformis						.2			5.0	
HARPACTICOIDA										
Tisbe sp.			1.0	7.0	.9	.4	.2			
HYDROZOA										
Lensia conoidea								*		
OSTEICHTHYES										
Ammodytes tobianus	.03	.03	.03	.02	.01	.003			.01	
Myctophidae		.01	.01	.003						
Primnothorus							.003			
POLYCHAETA										
Spiophanes sp.				7.0						
SCYPHOZOA										
Unidentified medusae						.003				
TOTAL BIOMASS (g/M^3)	3.055	1.030	.713	1.062	.449	.169	.099	.138	.299	
MYCTOPHIDAE (g/M^3)		.006	.007	.001						
EUPHAUSIACEA (g/M^3)	.0036	.0024	.0024	.0034	.072	.012	.0013	.0034	.023	
COPEPODA ($\#/M^3$)	5221.0	1374.0	1316.0	2651.0	763.6	95.2	45.2	91.4	1068.0	

* fragmented

Table 3. Mean length ± standard deviation for *Ammodytes tobianus* and *Benthosema glaciale* collected in all samples. * - only one animal in the sample.

Sample Number

Time	Station	1	2	3	4	5	6	7	8	9	10	Combined
					Ammodytes tobianus							
0402	4	18 ±4	18 ±5	18 ±3	19 ±5					18*		18 ±4
2158	8	19 ±3	19 ±6	24 ±3	24 ±8	23 ±6	27*			21 ±3	19 ±3	21 ±4
2147	5									24 ±8		24 ±8
2359	7	24 ±4	27 ±5	25 ±5	21 ±7	25 ±4	24 ±4	28 ±6		24 ±4		25 ±5
0215	1	17 ±1	16*							23*		18 ±3
					Benthosema glaciale							
2158	8		35 ±2	39 ±6	33*							34 ±2
2147	5				38 ±5	37 ±3	40 ±10	40 ±9		38 ±1		38 ±5
0215	1	34 ±1	36 ±3	38 ±6	35*	35 ±3	35 ±2	60*	34 ±1	40 ±10		36 ±6
2359	7	35 ±3	35 ±2	35 ±5	39 ±7	37 ±8	35 ±4	35 ±2	38 ±11	34 ±3		35 ±6
0007	3	34 ±3	35 ±2	40 ±8	35*	35 ±3	32 ±1			35*		36 ±5

Table 4. Numbers of major groups of animals and zooplankton biomass per square metre to the maximum depth sampled. * Stations with incomplete sample series.

Animal Group

Station No.	Maximum Depth	Gastropods	Ostracods	Copepods	Amphipods	Euphausiids	Decapods	Chaetognaths	Non-myctophid Osteichthys	Myctophiids	Cnidaria	Zooplankton Biomass
4	139	239	75	66748	1066	397	30	168	20		4	48.1
8	150	1061		123648	5157	238	10	101	2	0.2	0.1	82.3
5*	150	3832	5	34306	2439	245	0	100	4	5	2	45.1
7	130	4441	0	109968	8159	561	5	182	23	9	0.1	113.0
1	175	974	7	58952	5212	1629	0.7	38	0	13	1	59.5
3	200	424	26	39234	4069	1444	6	120	0	5	13	67.6
2*	25	0.2	0	4742	4	10	0.06	0	0.06	8	0.2	5.6