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Maria Iwona ŻMIJEWSKA

Institute of Oceanography,
University of Gdańsk
Czołgistów 46
81-378 Gdynia, POLAND

Horizontal and vertical distribution of Copepoda in the southern part of the Drake Passage and in the Bransfield Strait (BIOMASS-SIBEX 1983/1984)

ABSTRACT: During the BIOMASS-SIBEX Antarctic expedition the distribution of Copepoda in three water layers (0—100, 100—300 and 300—500 m) in the Bransfield Strait and southern Drake Passage was studied. Altogether 46 taxa were recorded (Tabs. 1 and 2); the number of taxa increased with depth. Faunistic differences between the Drake Passage and the Bransfield Strait were observed. In some species the age-related splitting of the populations was registered (Figs. 2, 3 and 4). Young generations occupied usually the upper water layers.

Key words: Antarctica, BIOMASS, Copepoda.

1. Introduction

This work was done within the MR-I-29A Project of the Institute of Ecology, and is a continuation of the research (Żmijewska 1985) of the Polish BIOMASS-SIBEX expedition on board of the r/v "Profesor Siedlecki". The pelagic fauna of the investigated region was previously studied in 1981 (Jażdżewski, Kittel and Łotocki 1982) during the BIOMASS-FIBEX stage of research. At that time distinct quantitative and qualitative differences were found between the zooplankton assemblages of the Drake Passage and the Bransfield Strait (Jażdżewski, Kittel and Łotocki 1982, Rakusa-Suszczewski 1983). Of the plankton data obtained during SIBEX 1983/84, only the results pertaining to the plankton collected by the Bongo net from the 0—200 m layer have been published so far (Witek et al. 1985). These authors have given the wet formaline volume of the basic forms

of macrozooplankton and showed their distribution as well. Żmijewska (1985) analysed the quantitative composition of copepods of the group Calanoida.

The purpose of the present work was to analyse the horizontal and vertical distributions, as well as the biology of the dominant species of Copepoda.

2. Materials and methods

70 plankton samples were collected in 30 stations distributed along four transects (A-D) in the southern Drake Passage and in the central and eastern parts of the Bransfield Strait (Fig. 1). Precise position of these

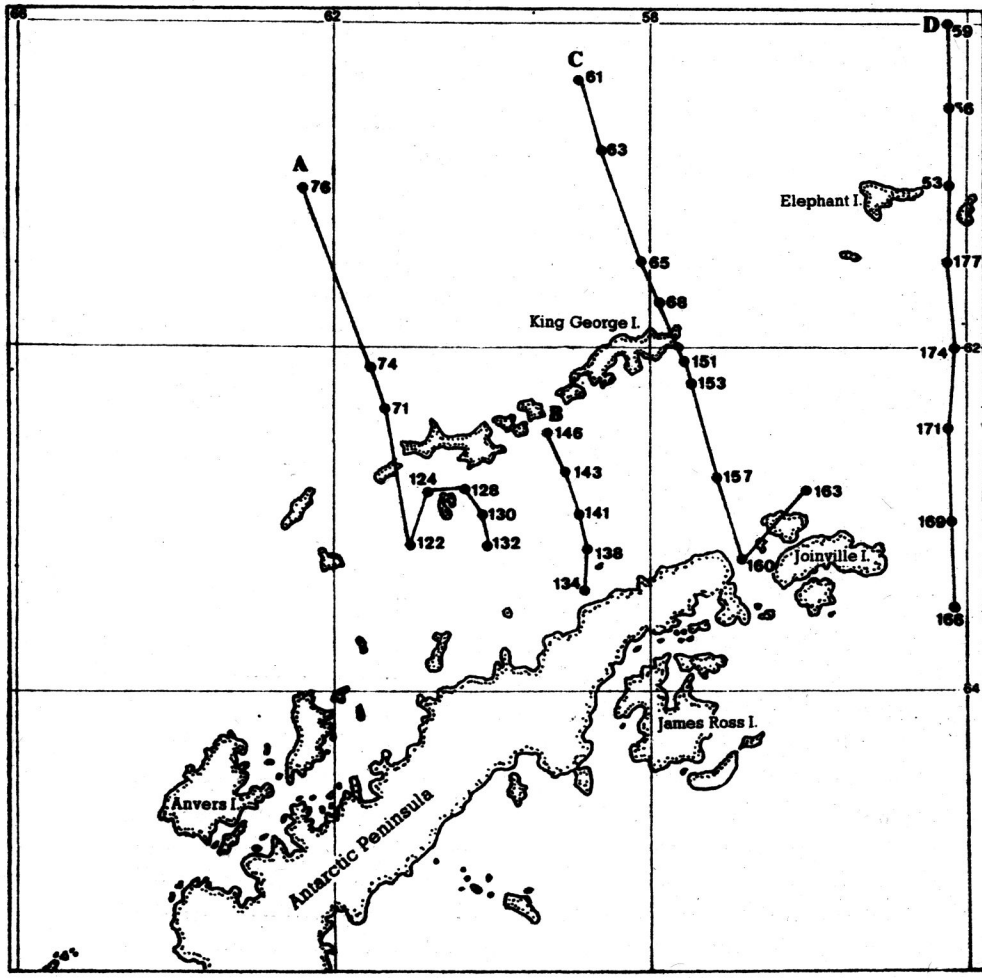

Fig. 1. Positions of sampling stations along four transects (A-D) in the SIBEX research area (1983—84)

stations is given by Rakusa-Suszczewski and Lipski (1985). The research material was obtained by the r/v "Profesor Siedlecki" during the period from 21 Dec. 1983 until 4 Jan. 1984. A self-closing Nansen type gauze plankton net with a mouth diameter of 70 cm (0.385 m^2) and 260 μm mesh size, was used for the collections. Three standard water layers were sampled: 500—300 m, 300—100 m, 100—0 m. In the off shore areas they were: from bottom to 100 m; from 100 m to surface. Small Calanoida of the families Pseudocalanidae, Spinocalanidae and Scolecithricidae, and also the nauplii of Calanoida, as well as all the Cyclopoida were analysed in three subsamples of 1 ml each. The numbers of specimens were related to the quantities of Copepoda in 1000 m^3 of water.

3. Results and discussion

46 taxa of Copepoda were found in the analysed samples; among them 30 species belong to 11 families and three suborders (Table 2). Most frequent and relatively most numerous in the whole research area were the following species of Calanoida: *Calanoides acutus*, *Calanus propinquus*, *Rhincalanus gigas*, *Ctenocalanus vanus*, *Scolecithricella* sp., *Metridia gerlachei*. Among the Cyclopoida dominant were: *Oithona similis*, *O. frigida*, *Oncaea conifera* and *O. curvata*. According to Vervoort (1965) there occur 126 species of Copepoda in the Antarctic; of these 28 species are characteristic for the epipelagic waters. The results of the BIOMASS-FIBEX studies showed the presence of only 19 taxa (Jażdżewski, Kittel and Łotocki 1982). This poor qualitative composition of Copepoda during FIBEX was due to the fact, that samples were not taken below the depth of 300 meters. Hardy and Gunther (1935) observed an increase of the number of species with greater depth, which is supported by the present SIBEX data. 38 species occurred in the 500—300 m layer, and 20 in 100—0 m surface layer (Table 1). Generally copepods in the research area were represented by species typical for the Antarctic waters; nevertheless on the northern edges of the transects in the Drake Passage there occurred typical Subantarctic copepods such as *Calanus simillimus*, *Clausocalanus laticeps* or *Metridia lucens* (Table 2). Their presence was also noted in the Bongo net collections (Żmijewska 1985).

Among Copepoda in the Antarctic waters, the most important role is played by the "interzonal" species, such as *Calanoides acutus*, *Calanus propinquus* and *Rhincalanus gigas* (Mackintosh 1937), which inhabit in winter deeper waters, while in summer stay close to the surface. At the beginning of the Antarctic summer the numbers of these species were not high in the whole research area (Table 2). *Calanoides acutus* occurred at all stations, in three sampling water layers. Highest aggregations of this copepod were found in the Drake Passage at the most northern stations. Maximum

Table 1

Occurrence of Copepoda in relation to depth

species \ depth	500—300	300—100	100—0
CALANOIDA			
family Calanidae			
Calanus simillimus Giesbrecht, 1902	−	+	+
Calanus propinquus Brady, 1883	+	+	−
Calanoides acutus Giesbrecht, 1902	+	+	+
family Eucalanidae			
Eucalanus sp.	+	−	−
Rhincalanus gigas Brady, 1883	+	+	+
family Pseudocalanidae			
Microcalanus pygmaeus (Sars, 1900)	+	+	+
Clausocalanus laticeps Farran, 1929	+	+	+
Ctenocalanus vanus Giesbrecht, 1888	+	+	+
Drepanopsis sp.	−	+	−
Stephus longipes Giesbrecht, 1888	+	+	+
family Spinocalanidae			
Spinocalanus sp.	−	+	−
family Aetideidae			
Euaetideus bradyi (Scott, 1909)	+	−	−
Euaetideus spp.	+	−	−
Gaidius tenuispinus (Sars, 1900)	+	+	−
Gaidius sp.	+	−	−
Chiridiella sp.	−	+	−
Chiridius polaris Wolfenden, 1911	+	+	−
Euchirella rostromagna Wolfenden, 1911	+	−	−
Euchirella sp.	+	+	−
family Euchaetide			
Euchaeta antarctica Giesbrecht, 1902	+	−	−
Euchaeta biloba Farran, 1929	+	+	−
Euchaeta spp.	+	+	+
family Scolecithricidae			
Racovitzanus antarcticus (Giesbrecht, 1902)	+	+	+
Scolecithricella glacialis (Giesbrecht, 1902)	+	+	+
Scolecithricella spp.	+	+	+
Scaphocalanus sp.	+	+	+
family Metridiidae			
Metridia gerlachei Giesbrecht, 1902	+	+	+
Metridia curcicauda Giesbrecht, 1902	+	−	−
Metridia lucens Boeck, 1863		+	+
Pleuromamma robusta (Dahl, 1894) f. *antarctica* Steuer, 1931	+	+	−
family Heterorhabdidae			
Heterorhabdus austrinus Giesbrecht, 1902	+	+	−
Heterorhabdus farrani Brady, 1918	+	+	−
Heterorhabdus spp.	+	+	−
family Augaptidae			

Quantitative occurrence of Copepoda in the SIBEX research area (ind · 1000^{-3}) — Section A

Species	Date	25.12.1983			24.12.1983				30.12.1983								31.12.1983					
	Station	76			74		71		124	128			130		122			132				
	Depth (m)	500—300	300—100	100—0	300—100	100—0	300—100	100—0	100—0	500—300	300—100	100—0	300—100	100—0	500—300	300—100	100—0	500—300	300—100	100—0
1	*Calanus simillimus*																			
2	*Calanus propinquus*	13	39	52	208		104	208	24		13		39	26	52		26			26
3	*Calanoides acutus*	247	325	104	1065		182	416	401		13	312			13	13	2779	299	182	
4	*Eucalanus* sp.																			
5	*Rhincalanus gigas*	234	883	104	52		156	182	259		13		13			39	312	26	39	26
6	*Microcalanus pygmaeus*			630						455										
7	*Clausocalanus laticeps*		462		2480		2120	780			52							26		
8	*Ctenocalanus vanus*	2597	4045		7792		33767	27273	11792	455	5000		12990		5195	3896	10390		3442	1039
9	*Drepanopsis* sp.																			
10	*Stephus longipes*										494							2857		
11	*Spinocalanus* sp.																			
13	*Euaetideus* spp.																	13		
14	*Chiridius polaris*																			
15	*Gaidius tenuispinus*														52	26		117		
16	*Gaidius* sp.														65					
17	*Chiridiella* sp.																			
18	*Euchirella rostromagna*																		13	
19	*Euchirella* sp.															13				
20	*Euchaeta antarctica*																			
21	*Euchaeta biloba*	13																		
22	*Euchaeta* sp.	65	299		143		65	78		195	39				39	299	26	390	234	
23	*Racovitzanus antarcticus*	26	156		13		13	26					26			78		26	65	
24	*Scolecithricella glacialis*					156					455	52								
25	*Scolecithricella* sp.						156									13				
26	*Scaphocalanus* sp.	78																39		
27	*Metridia gerlachei*		1351	26	5078		2571	935	24	4740	2494		8841		11700	4662	9443	4182	4468	78
28	*Metridia curcicauda*																			
29	*Metridia lucens*	52															78			
30	*Pleuromamma robusta* f. *antarctica*																			
31	*Heterorhabdus austrinus*	65	143												65					
32	*Heterorhabdus farrani*																			
33	*Heterorhabdus* sp.				78										13	65				
34	*Haloptilus oxycephalus*		39						24		13					78		117	13	
35	*Haloptilus ocellatus*														13			13		
36	*Haloptilus* spp.				52															
37	*Paralabidocera antarctica*																			
38	Calanoida (I—V) — varia				18831		12338	20779		195	195				3896		20779		1104	
39	Calanoida nauplii								7075		455	2597								
40	*Oithona similis*		12987	37413	18334	16904	50008	41558	69811		6948	23377	16234	13506		1300	23377	8182		
41	*Oithona frigida*				3896					455	2143				455	2143		8182	4091	2078
42	*Oncaea conifera*									2143	649				1948	649		12857	1753	
43	*Oncaea curvata*				2597				2358	1948	844				12338	6494	2597	18701	11234	
44	*Oncaea* sp.																			
45	*Lubbockia aculeata*																			
46	Harpacticoida																			

Table 2b

Quantitative occurrence of Copepoda in the SIBEX research area (ind · 1000^{-3}m) — Section B

Species	Date	1.01.1984			31.12.1983							
	Station	146			143			141			138	134
	Depth (m)	500—300	300—100	100—0	500—300	300—100	100—0	500—300	300—100	100—0	100—0	100—0
1												
2			26			65	52	26	91		26	
3		117	65		52	65			52	130	78	72
4												
5		13	52		26	39		13	39		26	
6												
7			91		26	13		13				
8		7013	2597			5844		1299	1299	26	1299	3584
9												
10			649		1745			1683				
11			649			3247						
12												
13												
14												
15					39							
16		13										
17												
18												
19					104							
20												
21												
22		104	442		65	13		247			26	143
23		39	39		13	26						
24					675							
25		13										
26			13		13							
27		12857	6571		4117	8650						556
28								13				
29								13				
30			13									
31												
32												
33												
34					13			13				
35			52									
36			26									
37												
38												
39					1299	1299		1299	649	208	1299	5376
40		2338	5195			25974	14286	3896	19481	7792	18182	10753
41		2338	649		5195	1948		10390			2597	3584
42		8182	649		12987			6494				8961
43		9351	11639			649		61039			14286	17921
44												
45												
46												

Table 2c

Quantitative occurrence of Copepoda in the SIBEX research area (ind·1000^{-3}m) — Section C

Species	Date	22.12.1983			23.12.1983						1.01.1984				2.01.1984				
	Station	61			63		65			68		151	153		157		163		160
	Depth (m)	500—300	300—100	100—0	300—100	100—0	500—300	300—100	100—0	300—100	100—0	100—0	500—300	300—100	100—0	300—100	100—0	300—100	100—0	100—0
1			52	312	26	520													
2			286	1660	2597	1248	13	13	130	109	52	82	13	104	52			142	78	
3		182	7429	26180	1480	67844	117	52	26	150	52	369	52	338	234		312	142	623	
4		13																		
5		1987	2260	6752	1428	8724	52	65	26	55		82	39	23	26				78	
6																				
7			2013	520	1300	520	1110	520	330											
8			9351	5195	11688	7792	1100	390	1039	683		10929	3896	10689	1299	7755				2597
9			104																	
10																				
11																				
12		26																		
13		26								14			13	13						
14																				
15							13			14			65			24				
16																				
17										14										
18		13																		
19					52															
20																				
21		13																		
22		403	364	104	649		91		26	41		123		234						
23		208			52					14				13						
24																				
25		52										1366	208	104				94		
26		13												780						
27		11156	1234		6520	208	6649	78		2549		246	6065	13520	78	1981	208	1462		312
28																				
29		1078	3078		78	312	13						52							
30		39			26															
31																				
		13																		
33		26			208		91						52							
34		130	104		182		13						39	13						
35		26															24			
36													52							
37																		47	78	
38				1948	2597	2597	5844						320					4717		
39			1117	6494	1299	5195								409	1299		5195	2358	2597	
40		5454	21818	76623	24675	40250	649	779	21818	2732	4156	35519	1688	23767	32468	5896	3377	23585		2597
41		1169	1039				1948		1039				5584	38096	6822					
42		1558			3896		2597			1366			2517	390		3538				2597
43		22338			2097		7143			683			10390	16506		20047				
44							646					1039								
45																				
46																				

Quantitative occurrence of Copepoda in the SIBEX research area (ind·1000^{-3}m) — Section D

Species	Date	22.12.1983			21.12.1983		4.01.1984					3.01.1984									
	Station	59			56		53		177			174			171			169		166	
	Depth (m)	500—300	300—100	100—0	300—100	100—0	300—100	100—0	500—300	500—300	100—0	500—300	300—100	100—0	500—300	300—100	100—0	300—100	100—0	300—100	100—0
1																					
2		13	65		13	26	26	78		91	422	13	26	104		117		19		34	468
3		636	26	52	649	26	312	20078	325	221		104	78	1325	422	351	20782		5610	174	9818
4																					
5		195	260		649				130	52	26	13	130	26			26				
6			442									247				753					
7		2260	1250	260	1920		508	1080							4245						
8		3896	8442	6494								3247			3246	1950					
9																					
10																					
11																					
12																					
13																					
14																					
15							26		322			104								174	
16																					
17																					
18																					
19																					
20																					
21										13					94						
22		260	422		234		65	26	346	39		143	182	26	1416			93			
23		39	104		78				22			13	13								
24			39												48						
25		39			649							65					78				
26																				34	
27		7571	4545		1312		584	1351	2359	104		2740	1338	26	10850	766		7369	1247	2602	2182
28															48						
29			39		13		13						13								
30		26																			
31			26				26														
32		208							22			39	13								
33					52																
34		52			26																
35			52					26								13				34	
36																					
37											26				284		2805				
38		10399	1944	1294			234		390	4740		2596	3247	5714	48	195	28571				
39							234					1299					2805				
40		5844	31169	35065	9780		503	15083	390	4740	18701	2597	7792	45714		844	1299	2226	2591	1384	2597
41		6494	1299		1299		1299		909			1948	325		7075	1299		1670		2076	
42		3899					545		390			3247			4425	649					
43		649			1299		234	6494	5195			1390	7468	2078	26887	5195		6679	2597	3460	2597
44													792					556		11765	
45												26								34	
46										13									312		1558

Table 1 — continued

	500—300	300—100	100—0
Haloptilus oxycephalus Giesbrecht, 1892	+	+	−
Haloptilus ocellatus Wolfenden, 1905	+	+	−
Haloptilus spp.	−	+	+
family Acartiidae			
Paralabidocera antarctica (Thompson, 1898)	+	+	+
CYCLOPOIDA			
family Oithonidae			
Oithona similis Claus, 1896	+	+	+
Oithona frigida Giesbrecht, 1902	+	+	+
family Oncaeidae			
Oncaea conifera Giesbrecht, 1891	+	+	−
Oncaea curvata Giesbrecht, 1902	+	+	+
Oncaea sp.	+	+	+
Lubbockia aculeata Giesbrecht, 1892	+	+	−
HARPACTICOIDA	−	+	+

numbers of *C. acutus* (67844 ind.·1000^{-3}) occurred at station 61 in the 0—100 m layer. High numbers of *C. acutus* were also recorded in the eastern part of the study area, in the off shore surface (0—100 m) waters at Clarence Island (st. 53) and at st. 172 (20078 ind.·1000^{-3}). Large concentration of *C. acutus* in this region was due to the presence of a new generation of this species. A distinct increase of numbers of *C. acutus* towards the euphotic zone was recorded. The new generation was dominant in this zone with a prevalence of the II and III copepodite stages to the north (st. 61) and I—II copepodites to the south (st. 174 and 166). The role of the wintering generation dominated by V copepodite stage and by females clearly increased with greater depth (Fig. 2). It seems, that the splitting of the two generations, new and old, considerably diminishes the food competition between both generations.

As in the case of *C. acutus* the largest assemblages of *Rhincalanus gigas* were observed in the northern part of the Drake Passage (st. 61; 6752 ind.·1000^{-3} in the 100—0 m). Rather high numbers of *R. gigas* were caused by the appearence of nauplii (Fig. 3). This picture is still not very clear, since this copepod, although it leaves the deeper water at the same time as *C. acutus*, has a rate of movement towards the surface much lower compared with that species (Voronina, Vladimirskaja and Żmijewska 1978). In the whole study area the major part of *R. gigas* population (V copepodite and adults) occurred in the 300—100 m layer (Table 2).

The presence of *Calanus propinquus*, the third of the "interzonal" Antarctic copepods, was marked by much smaller numbers compared with those of the former species. Maximum numbers of *C. propinquus* (2597 ind.·1000^{-3}) were recorded from st. 63, in the 300—0 m stratum. Old

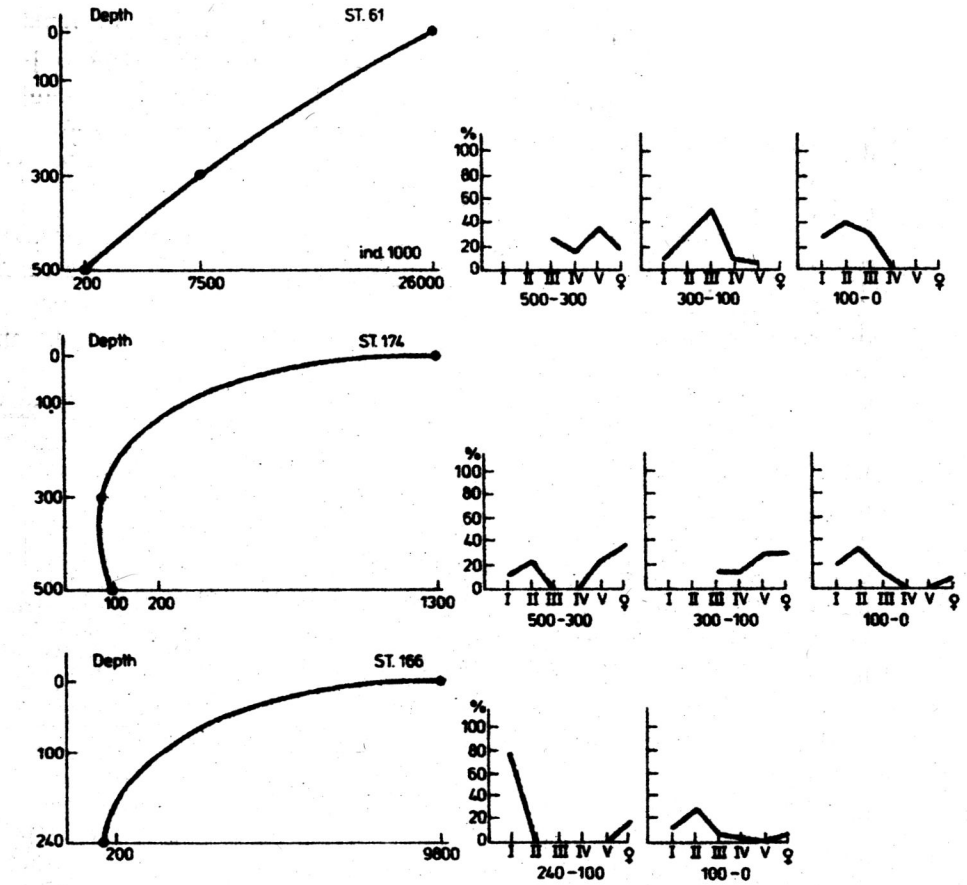

Fig. 2. Vertical distribution and population structure of *Calanoides acutus* in the SIBEX research area

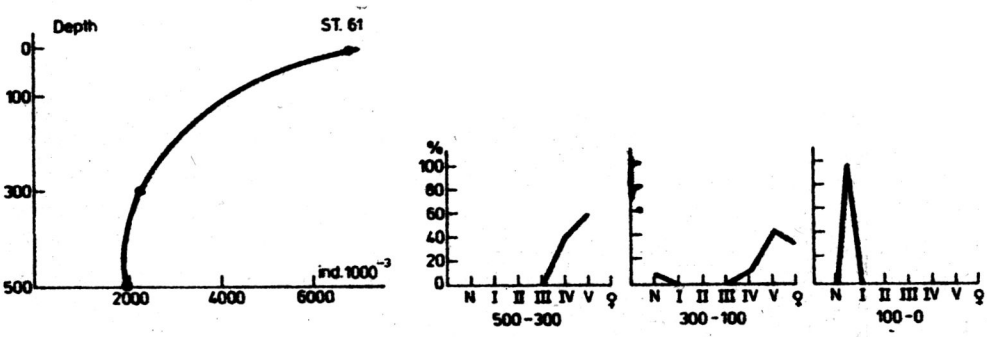

Fig. 3. Vertical distribution and population structure of *Rhincalanus gigas* in the SIBEX research area

generation was dominant. It was composed mainly of V copepodites, females and to a lesser degree of the IV copepodite stage. In the northern part of the study area only small numbers of the I — III copepodites were caught and at station 65 (300—100 m) a female bearing a spermatophore was found. This showed that the process of fertilization had not yet ended, and the reproduction had just begun.

Metridia gerlachei was characteristic of the pelagic fauna in the Bransfield strait. Its abundance increased from north towards the south of the research area (Table 2). Maximum numbers occurred at st. 146 (12857 ind. $\cdot 1000^{-3}$; 500—300 m). In the whole area this copepod occupied, first of all, the waters below 100 m (Table 2). Similar results of *M. gerlachei* distribution were reported during BIOMASS-FIBEX (Jażdżewski, Kittel and Łotocki 1982). The presence of the first copepodite stages of this species (Fig. 4) indicates an early commencement of the reproduction period compared with that at the end of summer as observed by Vervoort (1965). Also the studies in the coastal zone of the Indian Ocean Sector of the Antarctic revealed the dominance of the III and IV copepodite stages in February, which indicated that reproduction had taken place much earlier (Żmijewska 1983).

The usual constituents of the pelagic fauna in the present study area were also the copepods of the genus *Euchaeta* (Table 2). These typically predacious animals inhabited mainly the 500—300 m water layer. The population consisted mainly of the youngest copepodites I and II, and also of the IV and V-th copepodite stages.

Rather often, but in small quantities, the animals of the genera *Heterorhabdus* and *Haloptilus* were found in deeper water strata (Table 2).

Among the Calanoida with a small body size, *Ctenocalanus vanus* played the most important role both with respect to the numbers of individuals and to the frequency. The population structure of the species was characterized by a high contribution of females and older copepodites, while in the northern area there were copepodites I to III. *Clausocalanus laticeps* was typical of the Drake Passage. *Clausocalanus* sp., and probably mainly *C. laticeps*, was also one of the most frequent copepod species in this area during BIOMASS-FIBEX (Jażdżewski, Kittel and Łotocki 1982). As stated by Vervoort (1965) *C. laticeps* is characteristic of the Subantarctic, however, Ramirez and Dinofiro (1976) found it in large abundance in the Antarctic waters.

Copepods of the genus *Scolecithricella* were the common components of the zooplankton during SIBEX (Table 2). *S. glacialis* was represented by older copepodites, adult forms and by the youngest copepodite stages (Table 2, Copepoda (I—V) — varia).

Rather interesting was the distribution of *Paralabidocera antarctica* which was recorded exclusively from the south-eastern part of the region influenced

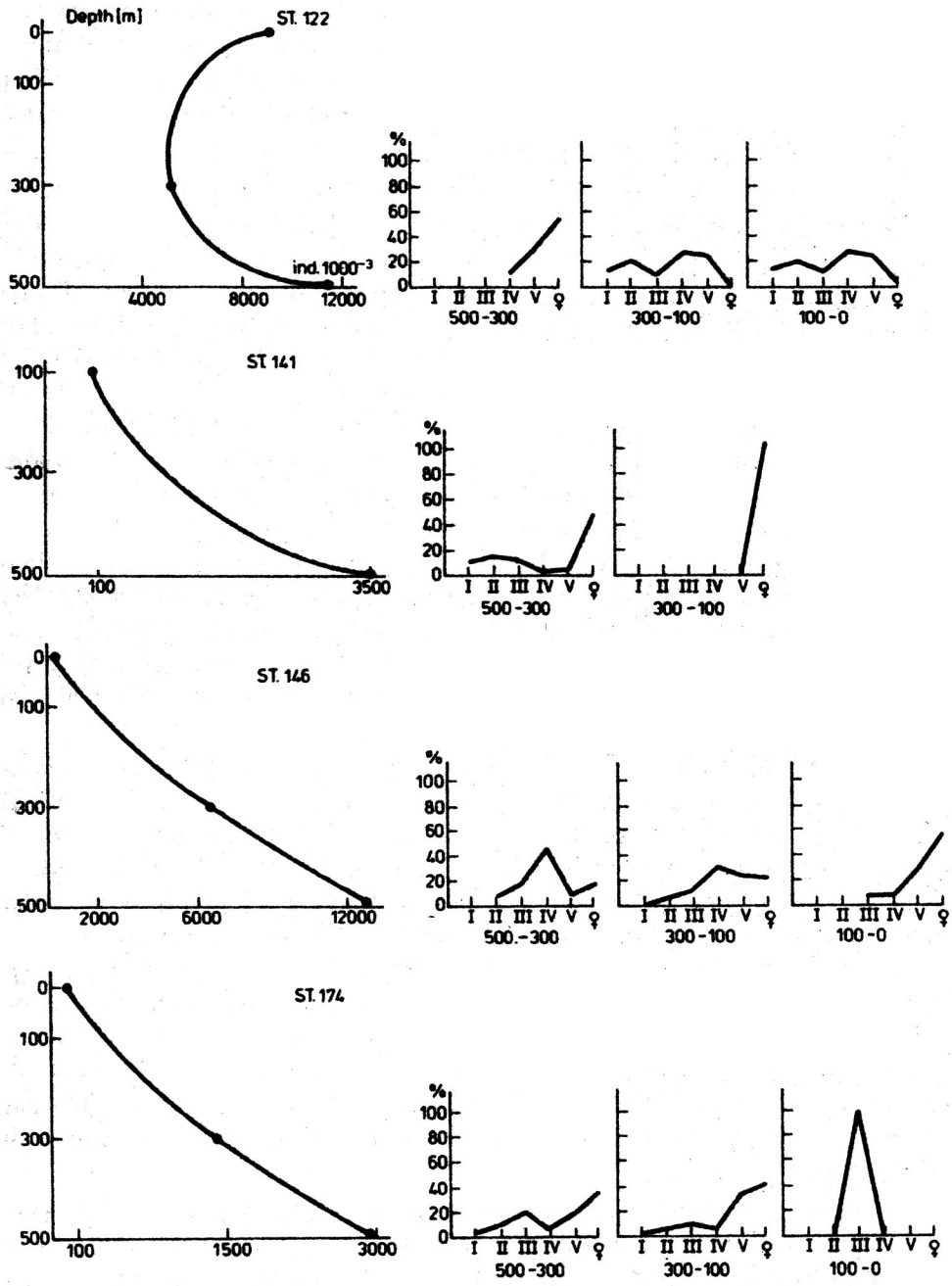

Fig. 4. Vertical distribution and population structure of *Metridia gerlachei* in the SIBEX research area

by an inflow of the Weddell Sea water (Table 2). The population consisted of only adult forms, mainly males, and inhabited the surface waters.

The remaining species of Calanoida occurred irregularly, in small quantities, mainly in the 500—300 m layer (Table 2).

Species of the suborder Cyclopoida were found in greater numbers than any other copepods (see also Rakusa-Suszczewski 1983). Among them *Oithona similis* occurred in the greatest numbers with a maximum of more than 70000 ind.·1000^{-3} in the northern part of the Drake Passage and in the neritic area of the South Shetlands (about 70000 ind.·1000^{-3}). There was a tendency of the decrease of the abundance with depth as well as to the lower contribution of this species in the south-eastern part of the research area (Table 2). The population structure of *O. similis* was little differentiated with the dominance of IV—V copepodites and adults represented mainly by females; gravid females were absent.

Oithona frigida occurred everywhere, but its greatest aggregation was noted in the Bransfield Strait, with maximum numbers (nearly 40000 ind.·1000^{-3}) at st. 153. The age structure of *O. frigida* did not differ from that of *O. similis*.

Also *Oncaea conifera* belonged to the species which occurred in highest numbers in the Bransfield Strait. Maxima of nearly 13000 ind.·1000^{-3} were recorded from stations 132 and 143. These copepods concentrated mainly in the 500—300 m layer (Table 2). *O. conifera* was represented by older copepodites and by females and males. Copulating animals were observed in the Drake Passage.

Oncaea curvata was found in the whole area, but was more abundant in the Bransfield Strait. Maximum (more than 30000 ind.·1000^{-3}) was noted at st. 141. Abundance of this species increased with deeper waters, a phenomenon observed also by Jażdżewski, Kittel and Łotocki (1982) during the BIOMASS-FIBEX studies. The population structure was characterized by a high contribution of the adult forms. Also females with spermatophores were encountered which indicated a greater advancement of development as compared to the other representatives of Cyclopoida.

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5. Streszczenie

Materiał stanowiły próby planktonowe zebrane w okresie od 21.12.1983 do 4.01.1984 r. Próby pobierano siecią planktonową typu Nansena, z trzech warstw: 500—300 m, 300—100 m i 100—0 m. Stwierdzono bogaty skład jakościowy (46 taksonów Copepoda) oraz wzrost liczby gatunków wraz z głębokością (Tab. 1). Widłonogi reprezentowane były głównie przez gatunki typowo antarktyczne (*Calanoides acutus*, *Calanus propinquus*, *Rhincalanus gigas*, *Ctenocalanus vanus*). W Cieśninie Drake'a rejestrowano formy subantarktyczne (*Calanus simillimus*, *Metridia lucens*). Z gatunków „interzonalnych" najczęściej i najliczniej występował *C. acutus*, którego największe skupienia stwierdzono w północnej i wschodniej części badanego rejonu (Tab. 2). Wysoka koncentracja tego gatunku we wczesnym okresie wegetacji związana jest z masową obecnością nowego pokolenia. Stwierdzono rozwarstwienie populacji. W górnej warstwie występowała młoda generacja, głębiej — ubiegłoroczna (Rys. 2). *C. propinquus* i *R. gigas* pod względem liczebności jak i stopnia rozwoju ustępowały *C. acutus*. Trzon populacji *R. gigas* znajdował się na głębokości 300—100 m, a najmłodsze pokolenie nowej generacji — nauplii — występowały w warstwie powierzchniowej (Rys. 3). Gatunkiem typowym dla Cieśniny Bransfielda był *Metridia gerlachei* (Tab. 2). Liczebność tego gatunku rosła wraz z głębokością, a obecność kopepoditów I świadczy o zaawansowanym rozwoju nowego pokolenia (Rys. 4). Do typowych form fauny antarktycznej należą: *C. vanus*, a także widłonogi z rodzaju *Scolecithricella* (Tab. 2). Widłonogi z grupy Cyclopoida stanowiły najbardziej reprezentatywny i liczny składnik zooplanktonu (Tab. 2). *Oithona similis* był typowym gatunkiem Cieśniny Drake'a, natomiast *O. frigida* — Cieśniny Bransfielda, podobnie jak *Oncaea conifera* i *O. curvata*. Stwierdzono różnice w rozmieszczeniu pionowym Cyclopoida: górne warstwy wód zasiedlał *O. similis*, głębsze — *O. conifera*. Gatunki z rodzaju *Oncaea* wyprzedzały w rozwoju gatunki z rodzaju *Oithona*.