Bol. Zool. e Biol. Mar., N.S., n.º 30, pp. 245-394, São Paulo, 1973

THE PLANKTONIC COPEPODS OF THE MARCHILE I EXPEDITION AND OF THE «ELTANIN» CRUISES 3-6 TAKEN IN THE SE PACIFIC

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OS COPÉPODOS PLANCTÔNICOS DA EXPEDIÇÃO MARCHILE I E DOS CRUZEIROS 3 A 6 DO "ELTANIN" NO PACÍFICO SULESTE

SUMÁRIO

Foram obtidos 261 espécies de copépodos planctônicos de coletas oblíquas quantitativas da camada superior de 140 m de espessura nas 98 estações visitadas pela expedição Marchile I assim como de 77 amostras do USARP (horizontais e verticais) obtidas ao largo da América do Sul Ocidental. As distribuições horizontal e vertical destas espécies foram determinadas de 22º34' N até 64º54' lat. S no Pacífico SE.

Os grupos de copépodos encontrados nas diferentes massas dágua, a distribuição relativa dos copepóditos e adultos também foram estudados, quando possível. Registraram-se 97 novas ocorrências na área. Além disso foi feito um curto resumo da hidrografia na região e a comparação entre os grupos de copépodos no lado Pacífico e no lado Atlântico ao largo da América do Sul.

A distribuição das espécies massa ao largo do Chile foi estudada.

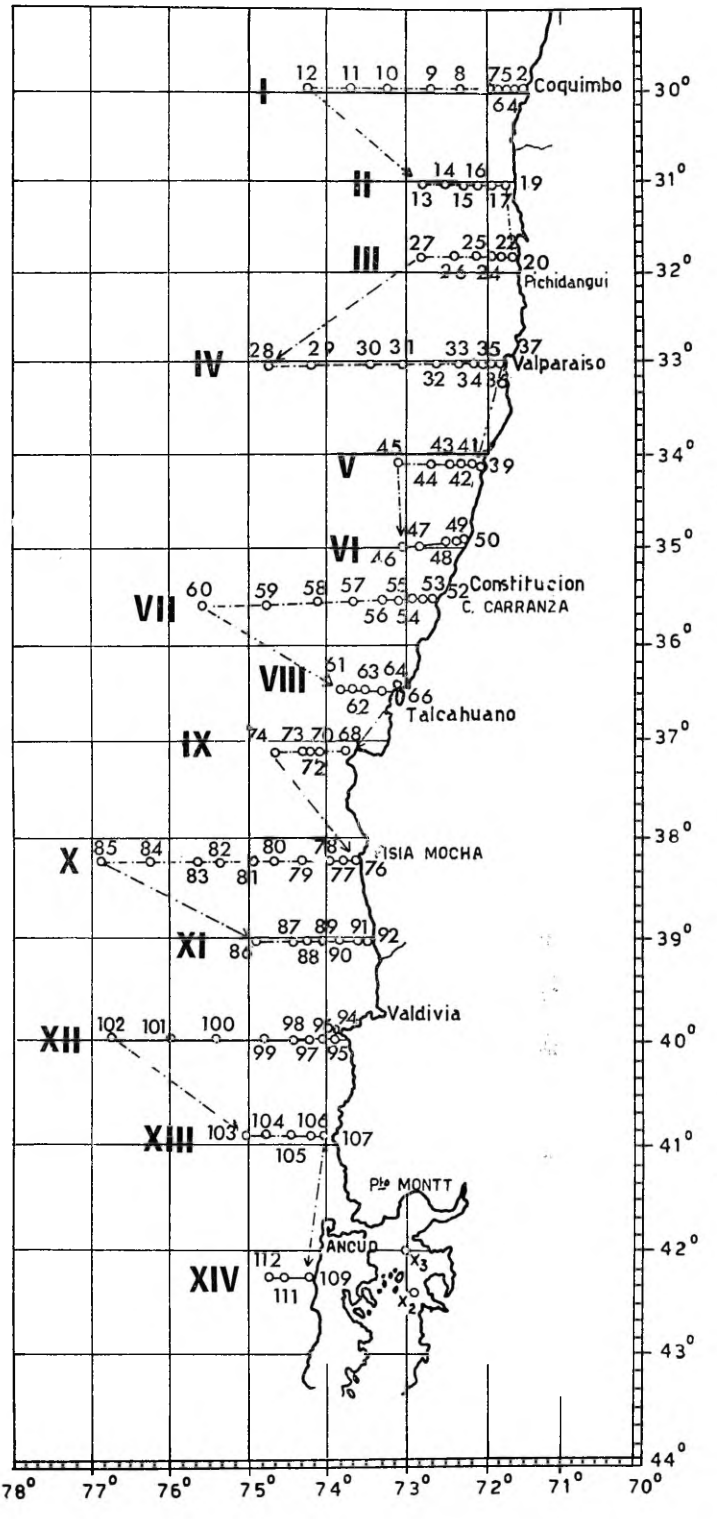
ABSTRACT

Oblique quantitative sampling of the 140 m deep surface layer and horizontal quantitative samples of the surface during the 98 stations visited by the Marchile I expedition as well as 77 USARP samples (horizontal and vertical) taken off West South America yielded 261 species of planktonic copepods. The horizontal and vertical distributions of these species from 22º34' N to 64º54' S lat. in the SE Pacific were determined.

The copepod groups found in the different water masses, the relative distribution of copepodites and adults were also studied, when possible. 97 new occurrences in the area are listed.

Ao Prof. Paulo Sawaya, um dos professores que me iniciaram na pesquisa.

Número especial em homenagem ao Prof. Dr. Paulo Sawaya, no ano jubilar de seu magistério.



1 — Stations occupied during the Marchile I Expedition. Each leg of the treck is indicated by a Roman number.

A short summary of the hidrography of the region and a comparison between the copepod groups on the Pacific side and on the Atlantic side off South America were added.

The quantitative distribution of the mass species off Chile was registered.

INTRODUCTION

In 1962 the "Seminario sobre Biogeografia de los Organismos Marinos" (published in 1964), held at Mar del Plata (Argentina), summarized most of the knowledge about western South American marine biogeography, based also on the work of South American researchers. Beklemishev (1969) in his "Ecology and Biogeography of the Open Sea" cites most of the literature about plankton off South America published in recent years. To this the following papers Björnberg (1968), Boltovskoy (1966), Brodsky (1961, 1964), Fagetti (1968), Fagetti and Fischer (1964), Frost and Fleminger (1968), Gómez (1971), Guillen *et al.* (1971), Heinrich (1971), Hülsemann (1966), Parin (1971), Pineda (1971) and Yamanaka (1969, 1970) should be added with important data on the plankton or on the biogeography of the waters off western South America.

None of these (excepting Heinrich, 1971, and Yamanaka, 1970) refer to the quantitative distribution of copepods or to the relation between the copepod groups and the water masses.

Fagetti (1962) has summarized the studies about plankton copepods off the Chilean coast till 1960. Since then, and up to now few works about the same group have been added, amongst which the most important were the contributions of Brodsky (1964) on Calanidae, of Vidal (1966) who studied the planktonic copepods of the Marchile II expedition, of Hülseman (1966) adding data on the Lucicutiidae, and Heinrich's paper (1971) on the distribution of surface plankton in the area off the north and west of South America. Gómez (1971) wrote about the copepods off Peru, and Yamanaka (1970) on the distribution of Euchaetidae and a few other copepods.

This paper will add to the knowledge on SE Pacific plankton, mostly about the frequency and abundance of copepods in the several water masses observed off the coast of South America. A chapter on the hidrography of the area is added so as to make easy the study of the zoogeography of the several species considered. I am very

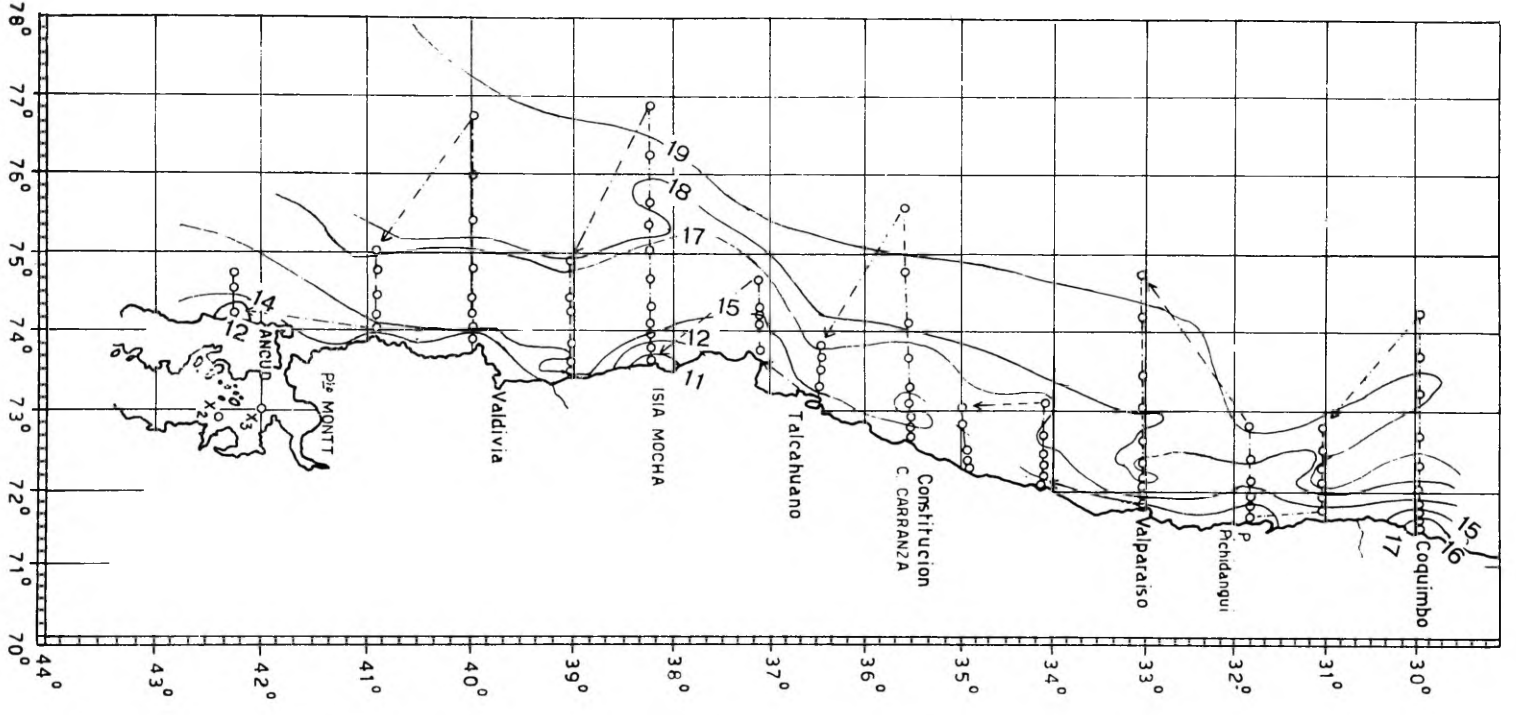
grateful to Dr. L. B. Miranda (Inst. Oceanográfico — Dep. de Física) for the helpful criticism of this chapter.

A fellowship donated by the John Guggenheim Foundation and a grant from the Fundação de Amparo à Pesquisa do Estado de São Paulo were fundamental for the execution of this work.

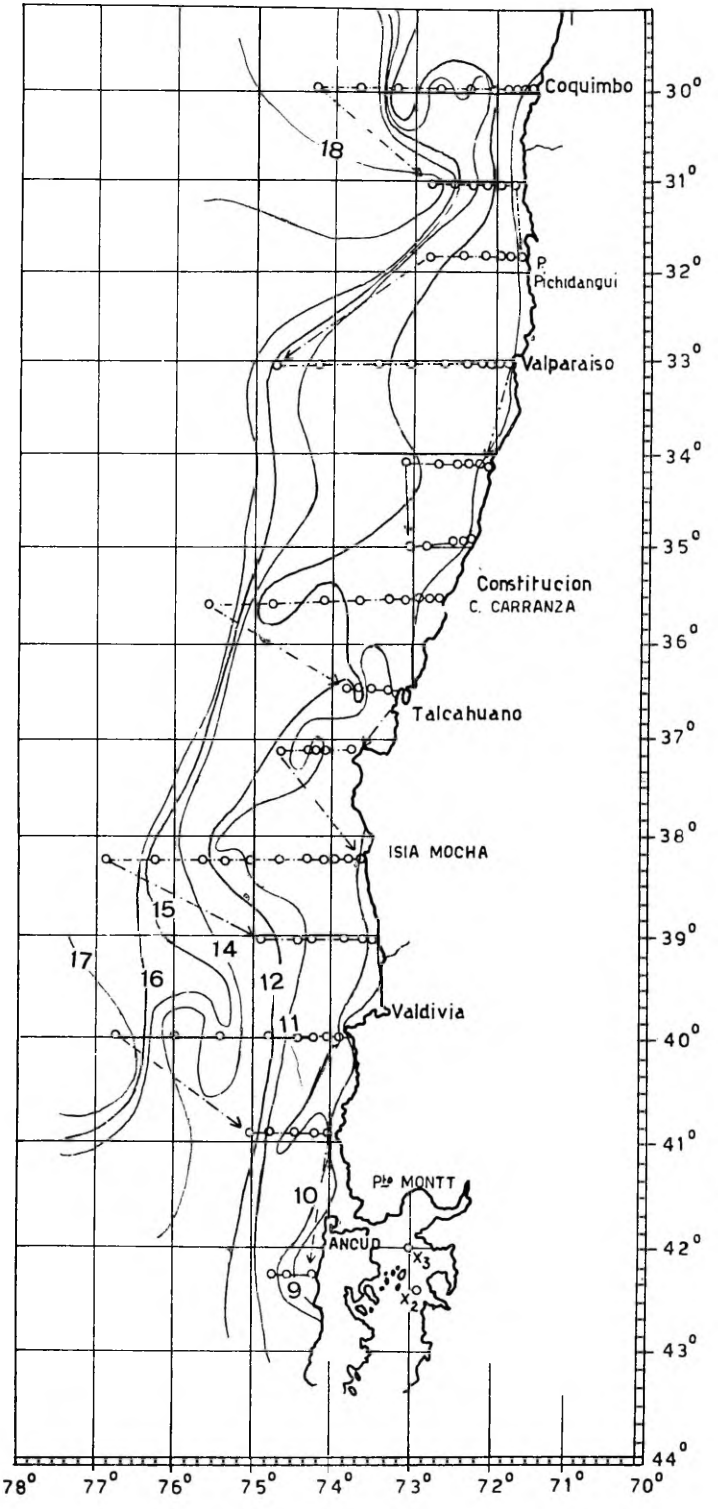
REMARKS ON THE HYDROGRAPHY OF THE AREA

The "Marchile I" expedition, here abbreviated to EMCI, collected samples in Chilean waters during February and March of 1960 from Coquimbo to Chiloe Island (Station List I). The area was surveyed between latitudes 29°57' and 43°S, and from the coast of Chile to 76°55'W (Map I). The highest temperatures (up to 19.80°C at leg 10, station 85) were reported from the surface layers in the western part of the area. The lowest surface temperature (10.8°C) was observed nearer to the coast in the eastern part of the area sampled. The salinity was always below 35‰ at the surface (Map 6); between 34.5 (in the North, farthest away from the coast) and 33.2‰ (south of the area and near to the coast).

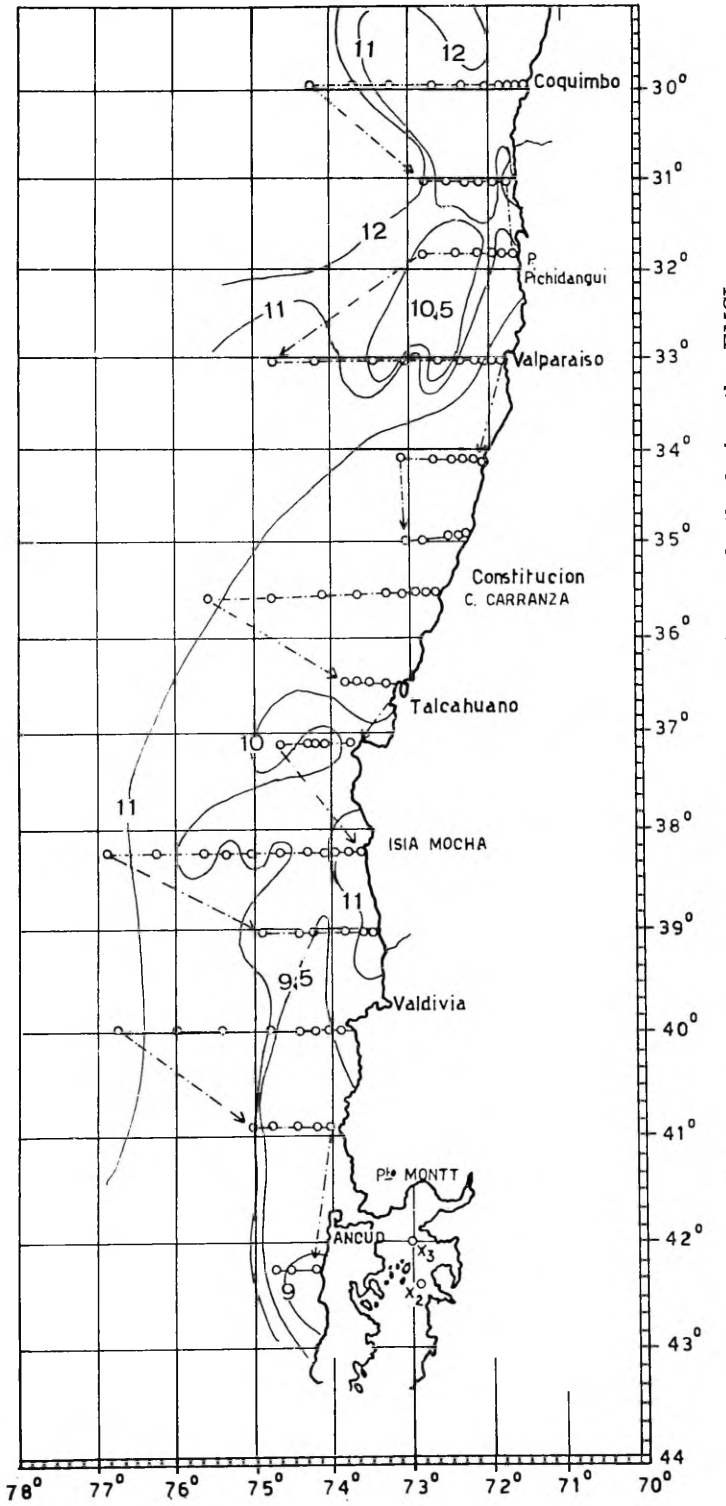
The layer sampled for plankton was from 0-140 m. In the depth of the layer the temperature diminished to 9°C in the South and was as high as 11.85°C to the North and West of the area (see Maps 2 to 5). The salinity at the greatest depth of the water layer sampled for plankton was 34.7‰ from 30°S to 37°S (Map 9). From leg 10 to 14 lower salinities were found in the depths of the layer, varying between 34.7 and 33.2‰ in the South. A shallow thermocline, sometimes as deep as 50 m, but usually not more than 20 m deep, and occurring eastwards from the coast, was present in some stations, delimiting a warmer (19.5 to 17°C) body of surface water from the underlying mixture of Subtropical and Antarctic Intermediate Water. This underlying mixture is called Subantarctic Surface Water, with temperatures between 7 and 17°C and salinities between 35.2 and 34.0‰. The surface water may have more than 17°C, by insolation or when brought from warmer regions by a counter-current. It is called here Warm Surface Water. A phenomenon of shallow upwelling is observed near the coast of Peru and Chile, the effect of southern winds (Burkov *et al.*, 1971; Wirtky, 1963).



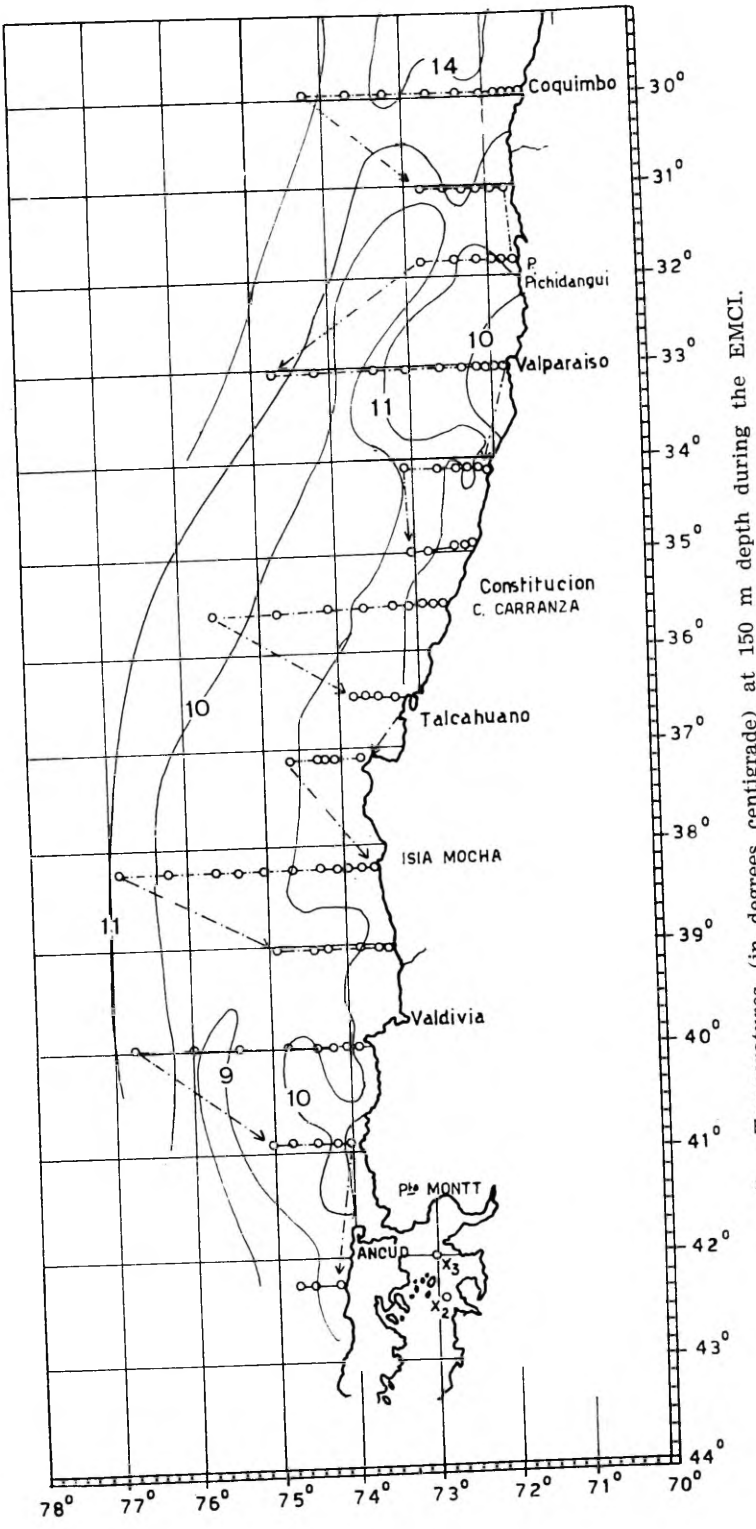
2 — Surface temperatures of the SE Pacific during the Marchile I expedition (in degrees centigrade).



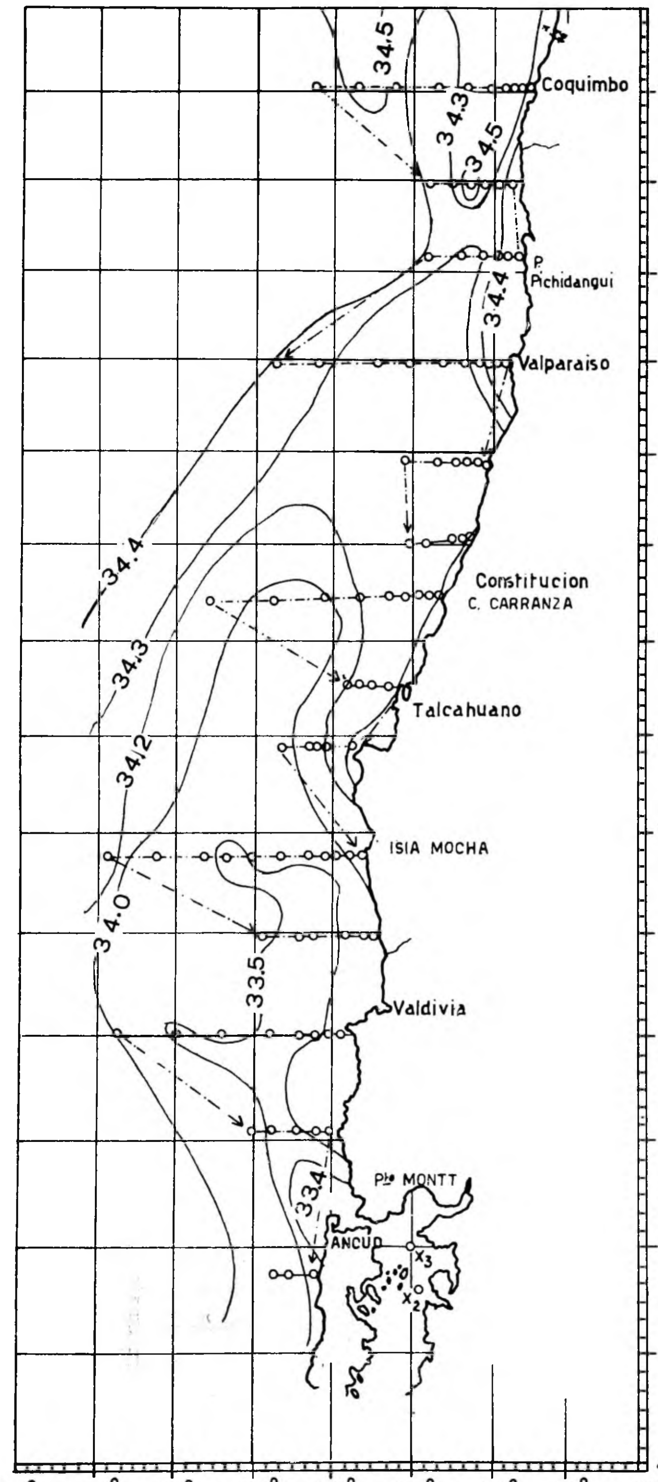
3 — Temperatures (in degrees centigrade) at 50 m depth during the EMCI.



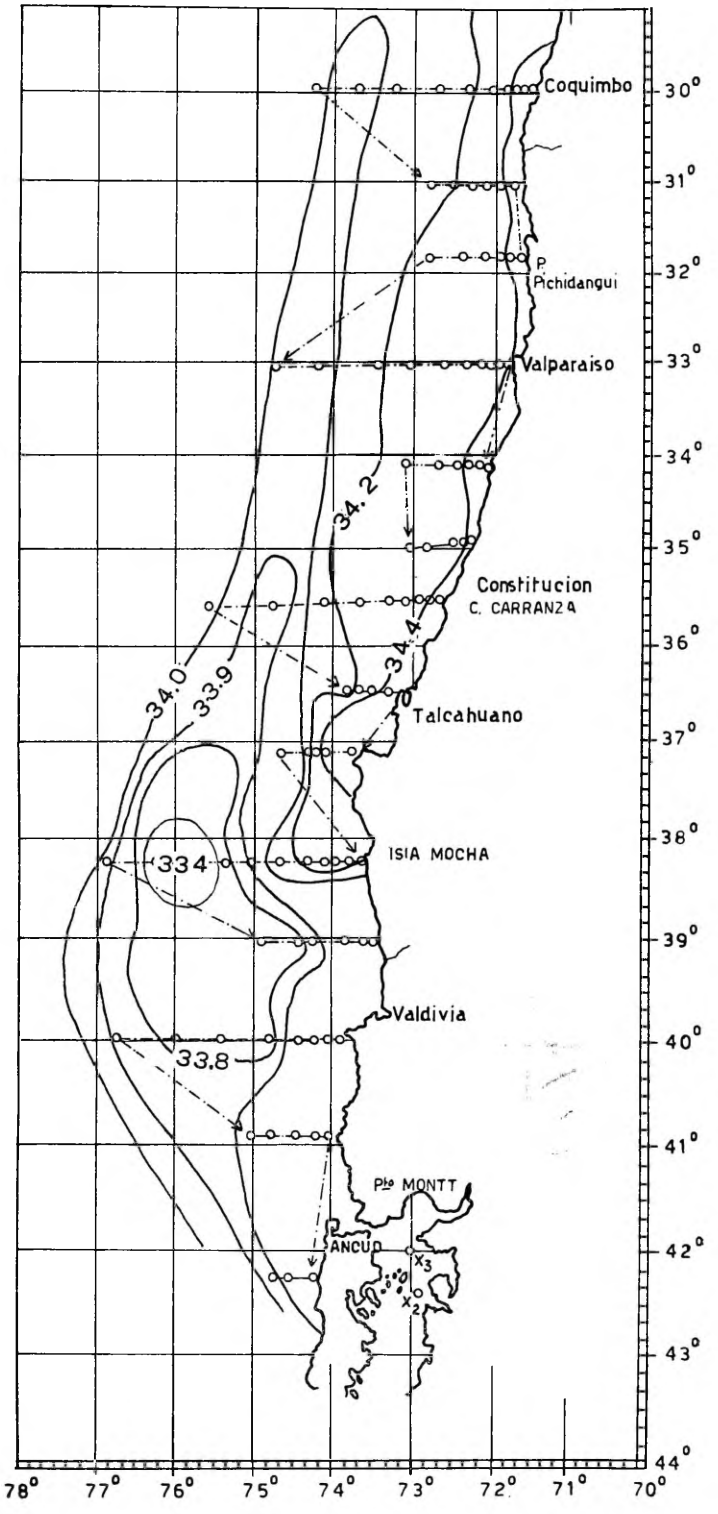
4 — Temperatures (in degrees centigrade) at 100 m depth during the EMCI.



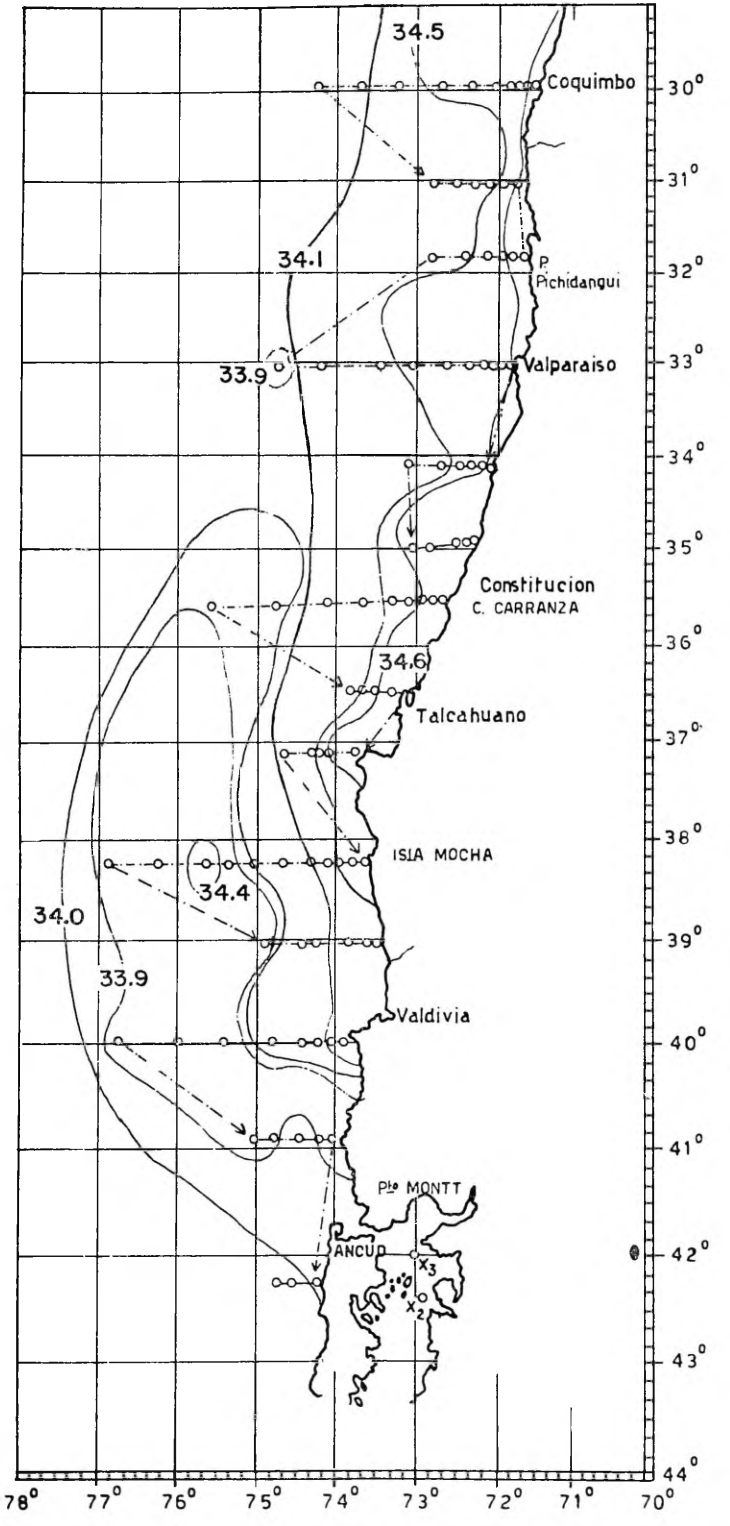
5 — Temperatures (in degrees centigrade) at 150 m depth during the EMCI.



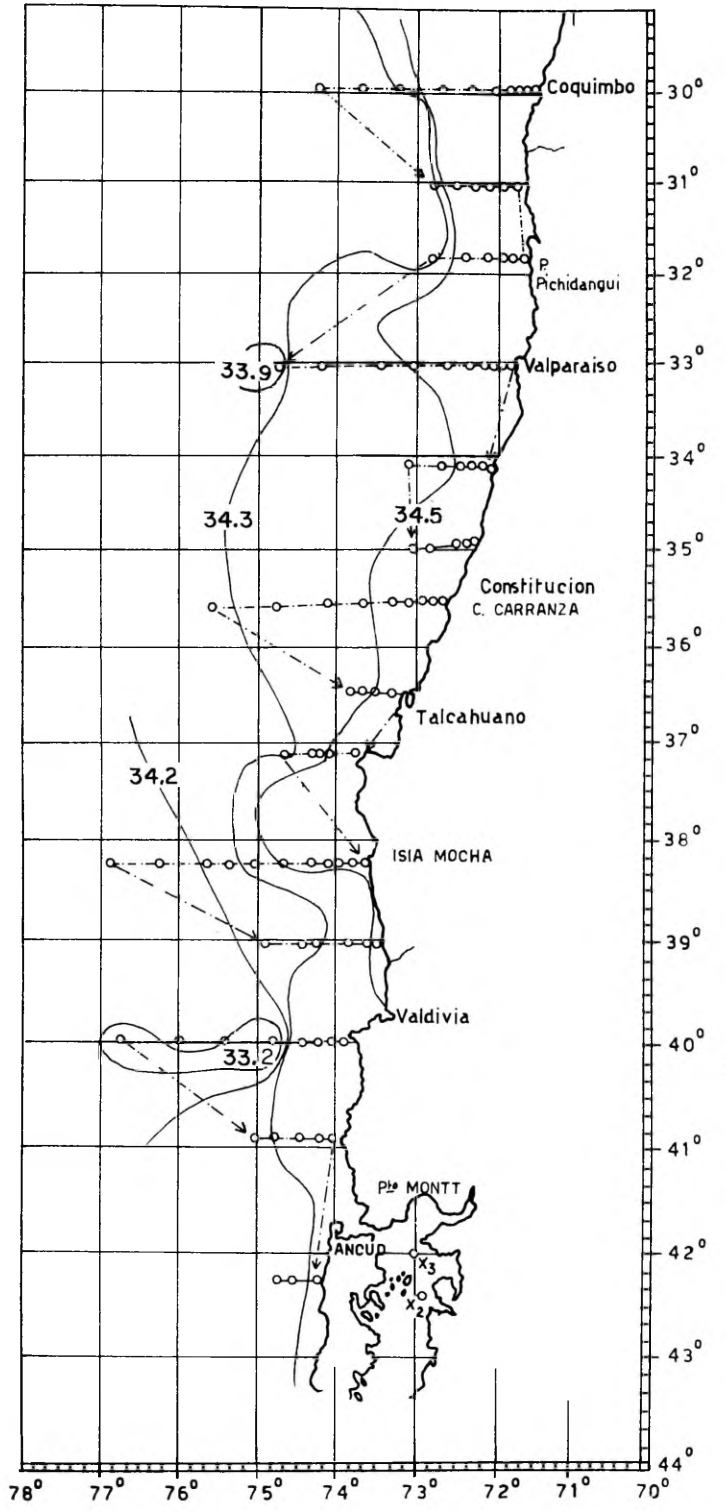
6 — Surface salinity (‰) during the EMCI.



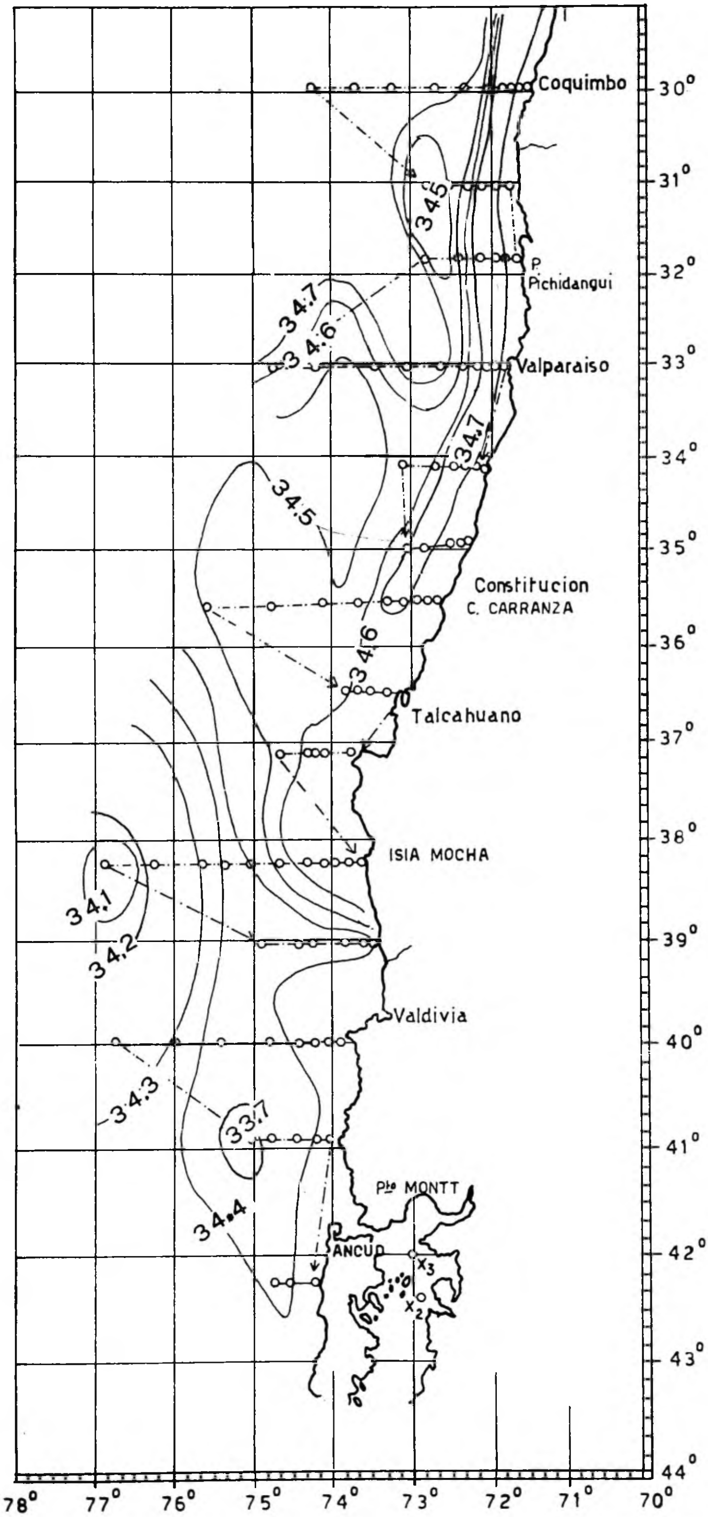
7 — Salinity (‰) at 50 m depth during the EMCI.



8 — Salinity (‰) at 100 m depth during the EMCI.



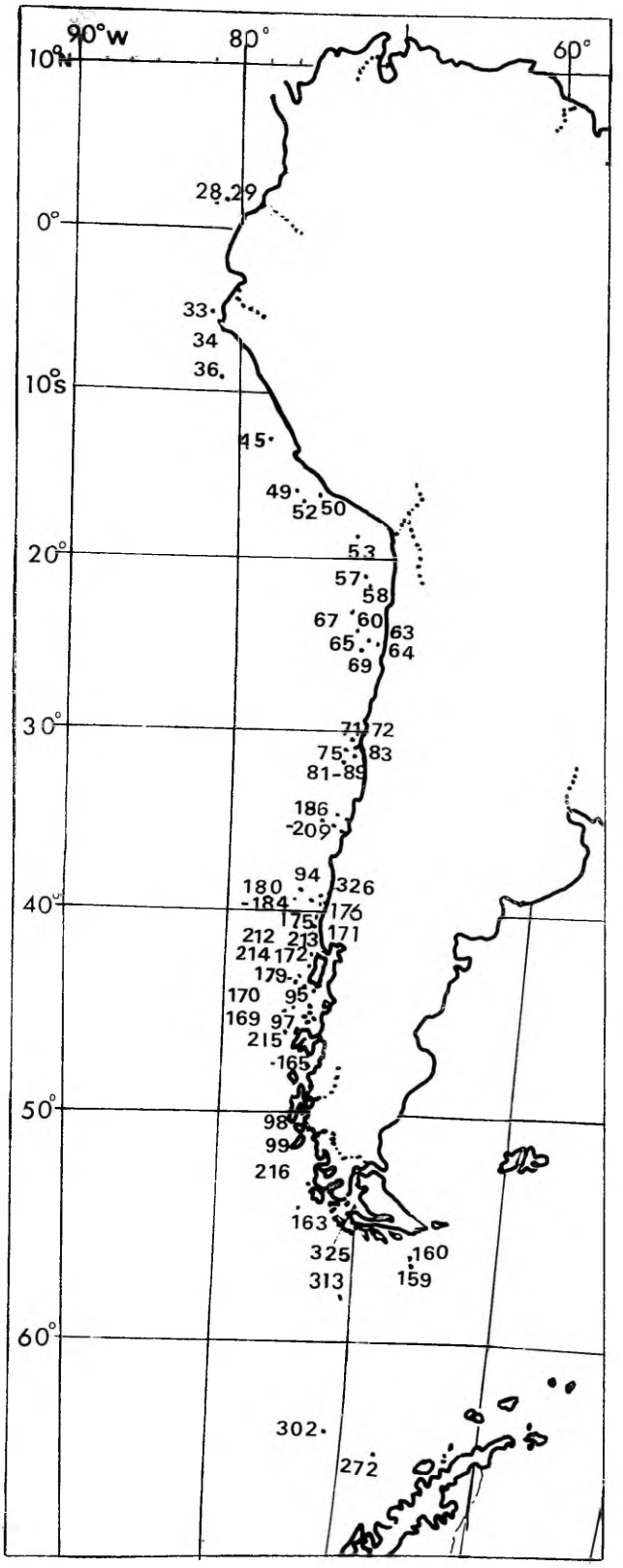
9 — Salinity (‰) at 150 m depth during the EMCI.



10 — Salinity (‰) at 200 m depth during the EMCI.

The water with salinities lower than 34‰ is probably due to the mixture of the outflowing basin or inlet water characterized by very low salinity (see Dahl, 1960 and Pickard, 1971) or by influence of heavy rains and continental water (Fagetti, 1968), and the Subantarctic Surface Water. It occurred between 36° and 42°S Lat. The prevailing winds and currents (see Gunther, 1936) push it out to the West and to the North so that it has the form of a long tongue (Map 7) extending gradually farther away from the coast, and from the region where it is formed. In this area the Low Salinity Water forms a layer 100 m thick, on the surface and near to the coast, sometimes separated from it by the upwelling Subantartic Surface Water, in the last five profiles. It has a lower temperature (9-14°C) than the Warm Surface Water (17°-19.9°C) and it is found further north and west as a wedge between this warmer layer and the deeper more saline and colder Subantarctic Surface Water (see Maps 6-8). This Low Salinity Water is also present in some "Eltanin" stations and it is the preferred habitat of some mass copepod species in the Chilean Sea.

Other samples from the "Eltanin" cruises of the U. S. Antarctic Research Program taken in the same area and further North to almost 2°N and South to almost 55°S (Map 11), in the surface and in deeper layers during July to August 1962 were also studied, so as to complete the general picture of the distribution of Chilean copepods and its relation to the copepod groups occurring in the neighbouring waters. The samples studied and their accompanying data are listed in Station List 2. The waters sampled by the "Eltanin" were the Equatorial Surface and Sub-surface Waters, Subtropical Surface Water, Subantarctic Surface Water, Subantarctic Water, Deep Waters and Bottom Water. The Equatorial Surface Water is characterized by 34.0-34.5‰ salinity and 26-29°C temperature (Murontsev, 1963); the Subsurface Equatorial Water has a salinity from 34.7 to 34.9‰, a temperature from 8° to 15°C, and lies in depths from 100-200 m to 800 m (Sverdrup *et al.*, 1945); the Subtropical Surface Water or ES Pacific Central Water has 34.3‰-35.4‰ salinity and 10°C to 17°C temperature; the Subantartic Surface Water varies between 34.6 and 35.2‰ salinity and 8 to 9°C or higher temperatures as it nears the Subtropical Convergence; the Subantarctic Water varies between 34.2 and 34.4‰ salinity, 3 and 7°C temperature (see Sverdrup *et al.*, 1945 and Murontsev, 1963).



11 — "Eltanin" stations (USARP) where the samples studied here were collected.

The following deep-laying water masses were fished through: Antarctic Intermediate Water, with temperature between 3°C and 7°C and salinity between 34.2 and 34.4‰, in the Subantarctic region, at depths of 1000 m to 1500 m; Deep Water, with salinity from 34.7 to 34.8‰ and temperature from 0°C to 2°C, in depths below 2000 m, in the Subantarctic region; Bottom Water below the Deep Water, with temperature below 0°C and salinity below 34.7‰. Other water masses sampled were Antarctic Circumpolar Water, with salinity a little above 34.7‰ and temperature between 2°C and 0°C, within the Antarctic Convergence; and transition water layers, between those already mentioned. Murontsev (1963) defines the Surface Water of South Temperate Latitudes with salinities between 34.0-34.5‰ and temperature 5-15°C; the Peru Surface Water with temperatures 14-23°C and salinity 34.5-35.5‰.

The circulation of the water masses off the western coast of South America is complicated by various phenomena (see Gunther, 1936; Wirtky, 1963; Burkov *et al.*, 1971):

1) the upwelling (vertical circulation) of cold water (Subantarctic);

2) the consequent formation of surface compensation counter-currents (Subtropical and Equatorial waters);

3) the extent of the north flowing Peru or Humboldt Currents with 2 branches the Coastal and the Oceanic branch which moves away from the coast at about 10°S and forms a divergence with

4) the consequent compensation counter-current pushing Subtropical Water between the 2 branches of the Peru Current to the south;

5) the deep counter-current (felt to 300 or 400 m depth) of subtropical origin, moving South under Subantartic Water.

The samples studied here were mostly taken within the limits of the Coastal branch of the Peru Current and of its counter-current.

The Warm Surface Water is probably part of the Subtropical Water pushed South by the surface counter-current. This tongue of warmer water was observed by Gunther (1936) and seems from the results of the EMCI to reach further south than observed in the "Discovery Expedition" Unfortunately no data on drift were taken during the EMCI.

LIST 1

Stations and the hydrographical data obtained during the Marchile I expedition

Station n.°	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (°C)	Salinity (‰)	Date
2	29°57.4'	71°24.8'	11:19	0 m	16.40	34.22	21/II/60
				25 m	12.10	34.30	
				50 m	11.75	34.37	
				100 m	11.60	34.70	
4	29°57.2'	71°31.0'	16:15	0 m	17.40	34.36	21/II/60
				25 m	11.43	34.47	
				50 m	11.70	34.58	
				100 m	11.27	34.62	
				150 m	10.87	34.66	
				200 m	10.60	34.74	
5	29°57.2'	71°37.0'	19:02	0 m	17.40	34.37	21/II/60
				25 m	12.15	34.40	
				50 m	11.74	34.47	
				100 m	11.40	34.72	
				150 m	10.85	34.33	
				200 m	10.48	34.72	
6	29°56.1'	71°42.2'	22:00	0 m	15.80	34.22	21/II/60
				25 m	13.73	34.23	
				50 m	12.19	34.24	
				100 m	11.50	34.56	
				150 m	11.51	34.79	
7	29°56.1'	71°54.1'	02:23	0 m	17.90	34.28	22/II/60
				25 m	16.05	34.23	
				50 m	14.65	34.18	
				100 m	14.85	34.40	
				150 m	13.70	34.66	
8	29°55.4'	72°14'	07:20	0 m	18.99	34.38	22/II/60
				25 m	17.03	34.28	
				50 m	14.07	34.20	
				100 m	11.95	34.36	
				150 m	10.75	34.50	
9	29°58.5'	72°37.6'	11:50	0 m	19.10	34.41	22/II/60
				25 m	17.96	34.32	
				50 m	14.37	34.24	
				100 m	11.67	34.43	
				150 m	11.55	34.69	

LIST 1 (Continuation)

Station n.º	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
10	29º56.4'	73º10'	17:47	0 m	18.30	34.43	22/II/60
				25 m	15.75	34.31	
				50 m	12.60	34.19	
				100 m	11.55	34.19	
11	29º57'	73º38'	23:09	0 m	19.50	34.56	22/II/60
				25 m	18.60	34.30	
				50 m	15.75	34.04	
				100 m	11.65	34.30	
				150 m	11.24	34.69	
12	29º57'	74º13'	04:55	0 m	19.90	34.35	23/II/60
				25 m	19.50	34.28	
				50 m	15.47	34.22	
				100 m	12.30	34.35	
				150 m	10.74	34.59	
13	31º02.1'	72º48'	22:18	0 m	19.11	34.37	23/II/60
				25 m	19.07	34.33	
				50 m	18.12	34.40	
				100 m	12.41	34.13	
				150 m	10.80	34.32	
14	31º01.6'	72º00.1'	03:10	0 m	—	34.46	24/II/60
				25 m	18.10	34.35	
				50 m	14.14	34.25	
				100 m	11.50	34.16	
				150 m	10.67	34.71	
15	31º02.2'	72º14'	07:20	0 m	18.90	34.51	24/II/60
				25 m	18.35	34.31	
				50 m	14.15	34.17	
				100 m	11.63	34.08	
				150 m	11.60	34.27	
				200 m	10.05	34.01	
16	31º01.5'	72º01.5'	11:35	0 m	19.10	34.41	24/II/60
				25 m	16.70	34.31	
				50 m	13.52	34.21	
				100 m	11.40	34.18	
				150 m	10.85	34.52	
17	31º01'	71º52'	16:05	0 m	—	—	24/II/60
				25 m	16.25	34.66	
				50 m	13.05	34.25	
				100 m	10.40	34.21	
				150 m	10.86	34.55	

LIST 1 (Continuation)

Station n.º	Position Latitude - longitude (S) (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
19	31º02.1' — 71º42.8'	20:27	0 m 25 m 50 m 100 m	16.80 12.40 11.59 11.65	34.31 34.37 34.43 34.60	24/II/60
20	21º51.5' — 71º35.2'	07:05	0 m 25 m	13.83 12.24	34.39 34.42	25/II/60
22	31º51.5' — 71º40.5'	10:54	0 m 25 m 50 m 100 m 150 m	15.80 13.73 12.19 11.50 11.51	34.33 34.39 34.45 34.69 34.10	25/II/60
24	31º50.1' — 71º51.4'	15:35	0 m 25 m 50 m 100 m	16.60 12.84 11.45 11.55	34.42 34.38 34.35 34.66	25/II/60
25	31º51.0' — 73º03.5'	19:15	0 m 25 m 50 m 100 m 150 m	17.00 14.71 12.22 10.70 10.55	34.44 34.44 34.44 34.54 34.79	25/II/60
26	31º49.5' — 72º21'	23:17	0 m 25 m 50 m 100 m 150 m 200 m	18.10 16.60 12.00 10.45 10.85 9.65	34.38 34.23 34.16 34.22 34.56 34.54	25/II/60
27	31º51' — 72º45'	04:30	0 m 25 m 50 m 100 m 150 m	19.20 18.35 13.18 10.50 9.87	34.41 34.29 34.17 34.22 34.39	26/II/60
28	33º06' — 74º45'	22:45	0 m 25 m 50 m 100 m 150 m 200 m	19.49 18.10 14.50 11.40 11.44 10.70	34.41 34.22 34.08 33.99 34.36 34.62	26/II/60

LIST 1 (Continuation)

Station n.º	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
29	33º03'	— 74º10'	04:30	0 m	18.90	34.39	27/II/60
				25 m	18.00	34.16	
				50 m	13.25	34.06	
				100 m	11.30	34.23	
				150 m	10.21	34.44	
30	32º59.5'	— 73º27'	09:54	0 m	18.80	34.38	27/II/60
				25 m	18.40	34.25	
				50 m	12.90	34.13	
				100 m	10.40	34.21	
				150 m	10.30	34.47	
31	33º04.5'	— 73º00'	15:56	0 m	18.30	34.38	27/II/60
				25 m	15.13	34.39	
				50 m	11.14	34.41	
				100 m	11.35	34.71	
				150 m	11.20	34.75	
32	33º04.8'	— 72º37.6'	20:10	0 m	17.80	34.33	27/II/60
				25 m	13.10	34.18	
				50 m	11.70	34.03	
				100 m	10.70	34.37	
				150 m	11.14	34.64	
33	33º05.4'	— 72º20.3'	00:06	0 m	18.00	34.31	28/II/60
				25 m	13.50	34.11	
				50 m	11.60	34.06	
				100 m	11.05	34.40	
				150 m	11.15	34.73	
				200 m	10.65	34.74	
34	33º05.5'	— 72º08.7'	03:17	0 m	17.90	34.41	28/II/60
				25 m	12.70	34.14	
				50 m	11.35	34.06	
				100 m	11.10	34.47	
				150 m	10.97	34.65	
				200 m	10.37	34.69	
35	33º05.5'	— 71º59'	06:15	0 m	18.50	34.41	28/II/60
				25 m	13.35	34.27	
				50 m	11.60	34.22	
				100 m	10.40	34.38	
				150 m	10.85	34.66	

LIST 1 (Continuation)

Station n.º	Position Latitude - longitude (S) (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
36	33º06' — 71º53'	08:44	0 m	17 75	34.35	28/II/60
			25 m	13.57	34.33	
			50 m	11.65	34.32	
			100 m	10.50	34.41	
			150 m	10.35	34.58	
37	33º05.9' — 71º48'	10:20	0 m	15.15	34.40	28/II/60
			25 m	12.18	34.46	
			50 m	11.67	34.15	
			100 m	11.40	34.64	
39	34º08.1' — 71º02.7'	16:35	0 m	14.60	34.09	3/III/60
			25 m	12.62	34.26	
			50 m	11.55	34.42	
41	34º08.2' — 72º09.1'	20:30	0 m	14.10	34.27	3/III/60
			25 m	11.95	34.33	
			50 m	11.38	34.42	
			100 m	11.23	34.51	
42	34º07.6' — 72º15.5'	22:04	0 m	16.00	34.27	3/III/60
			25 m	12.35	34.34	
			50 m	11.45	34.41	
			100 m	10.99	34.58	
			150 m	10.97	34.76	
43	34º06.2' — 72º28'	01:30	0 m	16.68	34.28	4/III/60
			25 m	12.16	34.29	
			50 m	11.82	34.31	
			100 m	11.25	34.54	
			150 m	11.09	34.64	
44	34º08' — 72º42.4'	05:24	0 m	17.30	34.23	4/III/60
			25 m	13.50	34.12	
			50 m	11.67	34.11	
			100 m	10.65	34.36	
			150 m	9.95	34.45	
45	34º07 7' — 73º01'	09:35	0 m	16.30	34.28	4/III/60
			25 m	17 75	34.15	
			50 m	12.75	34.10	
			100 m	10.37	34.17	
			150 m	10.00	34.47	
			200 m	9.65	34.70	

LIST 1 (Continuation)

Station n.º	Position Latitude - longitude (S) (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
46	34º59' — 73º01'	16:25	0 m 25 m 50 m 100 m 150 m	30.00 12.45 11.20 10.76 10.76	34.05 34.65 34.25 34.75 34.70	4/III/60
47	34º57.4' — 72º51'	20:18	0 m 25 m 50 m 100 m 150 m	15.60 12.40 11.29 10.73 10.93	34.08 34.04 34.70 34.38 34.69	4/III/60
48	34º56' — 72º31.9'	01:36	0 m 25 m 50 m 100 m 150 m	14.05 12.26 11.13 11.15 11.13	34.19 34.20 34.29 34.72 34.74	5/III/60
49	34º56' — 72º20'	04:34	0 m 25 m 50 m 100 m	13.90 11.52 11.52 11.27	34.24 34.34 34.40 34.46	5/III/60
50	34º56' — 72º15.1'	07:07	0 m 25 m 50 m	13.12 11.75 11.37	33.96 34.21 34.46	5/III/60
52	35º33.4' — 72º42'	15:39	0 m 25 m	14.50 11.27	34.43 34.42	5/III/60
53	35º33.7' — 72º46.8'	17:20	0 m 25 m	14.50 11.50	34.29 34.39	5/III/60
54	35º34' — 72º55'	18:54	0 m 25 m 50 m 100 m	15.20 13.85 11.15 11.30	34.16 34.27 34.37 34.66	5/III/60
55	35º34' — 73º03'	20:20	0 m 25 m 50 m 100 m	14.80 12.30 11.13 10.90	34.17 34.15 34.13 34.56	5/III/60

LIST 1 (Continuation)

Station n.°	Position Latitude (S) longitude (W)	Time (h)	Depth	Temperature (°C)	Salinity (‰)	Date
56	35°33.1' — 73°18'	23:22	0 m	16.10	34.19	5/III/60
			25 m	13.70	34.11	
			50 m	11.35	34.12	
			100 m	10.80	34.45	
			150 m	10.65	34.65	
57	35°34' — 73°40'	04:00	0 m	16.80	34.21	6/III/60
			25 m	14.50	34.16	
			50 m	11.87	34.11	
			100 m	10.32	34.26	
			150 m	10.10	34.48	
			200 m	9.79	34.80	
58	35°34' — 74°07'	08:50	0 m	18.65	33.96	6/III/60
			25 m	15.75	34.06	
			50 m	12.51	34.16	
			100 m	10.07	34.26	
			150 m	10.80	34.44	
			200 m	9.30	34.53	
59	35°38' — 74°46'	15:50	0 m	18.90	33.78	6/III/60
			25 m	14.37	33.90	
			50 m	11.70	33.99	
			100 m	10.15	34.08	
			150 m	9.30	34.41	
60	35°35' — 75°33'	21:51	0 m	19.70	34.05	6/III/60
			25 m	18.75	34.05	
			50 m	16.05	34.03	
			100 m	11.09	34.00	
			150 m	10.33	34.28	
61	36°30' — 73°50.4'	09:00	0 m	17.75	34.07	7/III/60
			25 m	17.60	34.12	
			50 m	11.70	34.17	
			100 m	10.65	34.32	
			150 m	10.20	34.48	
			200 m	9.70	34.57	
62	36°32' — 73°41'	14:33	0 m	17.00	34.22	7/III/60
			25 m	14.71	34.16	
			50 m	12.22	34.11	
			100 m	10.70	34.56	
			150 m	10.55	34.42	

LIST 1 (Continuation)

Station n.º	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
63	36º30.5'	73º33.4'	16:40	0 m	16.20	34.28	7/III/60
				25 m	13.15	34.27	
				50 m	10.85	34.26	
				100 m	10.90	34.65	
64	36º31.5'	73º20.2'	19:47	0 m	15.69	34.39	7/III/60
				25 m	12.45	34.44	
				50 m	10.93	34.50	
66	36º32'	73º06'	00:09	0 m	14.40	34.48	8/III/60
				25 m	11.35	34.52	
				50 m	11.04	34.55	
68	37º08.7'	73º38.6'	13:40	0 m	13.80	34.47	10/III/60
				25 m	10.99	34.54	
				50 m	10.82	34.61	
69	37º09.6'	73º41.9'	15:25	0 m	12.57	34.29	10/III/60
				25 m	11.25	34.40	
				50 m	10.90	34.51	
70	37º08'	73º47'	17:17	0 m	13.90	34.25	10/III/60
				25 m	12.30	34.39	
				50 m	10.93	34.53	
				100 m	10.85	34.65	
				150 m	10.70	34.65	
				200 m	10.35	34.69	
72	37º08.9'	74º09'	01:37	0 m	14.20	34.25	11/III/60
				25 m	13.29	34.28	
				50 m	11.42	34.31	
				100 m	10.69	34.52	
				150 m	10.74	34.50	
				200 m	9.75	34.62	
73	37º09'	74º19.5'	04:50	0 m	15.40	—	11/III/60
				25 m	12.95	—	
				50 m	10.68	34.02	
				100 m	10.13	34.22	
				150 m	10.00	34.54	
				200 m	9.99	34.67	
74	37º10'	74º42'	09:10	0 m	15.10	34.06	11/III/60
				25 m	13.25	34.09	
				50 m	11.27	34.11	
				100 m	9.94	34.19	
				150 m	9.47	34.49	
				200 m	9.58	34.54	

LIST 1 (Continuation)

Station n.º	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
76	38º16'	— 73º39'	22:50	0 m	10.80	34.03	11/III/60
				25 m	10.10	34.20	
				50 m	10.14	34.36	
77	38º16'	— 73º47.5'	23:33	0 m	12.10	33.89	11/III/60
				25 m	10.46	34.02	
				50 m	10.33	34.15	
78	38º15.5'	— 73º55.6'	02:48	0 m	14.70	33.67	12/III/60
				25 m	12.30	33.90	
				50 m	10.47	34.14	
				100 m	10.60	34.57	
				150 m	10.37	34.57	
79	38º16'	— 74º06'	04:40	0 m	15.60	33.63	12/III/60
				25 m	13.45	33.95	
				50 m	10.37	34.17	
80	38º16'	— 74º19.5'	07:50	0 m	15.95	33.77	12/III/60
				25 m	11.09	33.89	
				50 m	10.42	34.01	
				100 m	10.72	34.53	
				150 m	10.76	34.57	
				200 m	10.40	34.61	
81	38º15.6'	— 74º40'	11:10	0 m	16.10	33.73	12/III/60
				25 m	14.65	33.85	
				50 m	10.89	33.97	
				100 m	9.88	34.16	
				150 m	9.57	34.41	
				200 m	9.40	34.33	
82	38º17'	— 75º03'	16:03	0 m	18.20	33.56	12/III/60
				25 m	16.55	33.79	
				50 m	12.30	33.87	
				100 m	16.05	33.98	
				150 m	9.56	34.25	
83	38º17'	— 75º40'	22:40	0 m	17.40	33.71	12/III/60
				25 m	16.00	33.72	
				50 m	11.68	33.77	
				100 m	9.85	34.02	
				150 m	9.25	34.23	
				200 m	8.90	34.36	

LIST 1 (Continuation)

Station n.º	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
84	38º17'	— 76º15'	04:30	0 m	18.60	33.68	13/III/60
				25 m	18.60	33.73	
				50 m	14.47	33.78	
				100 m	10.90	33.95	
				150 m	9.80	34.10	
				200 m	9.12	34.29	
85	38º17'	— 76º55'	10:49	0 m	19.80	34.23	13/III/60
				25 m	19.55	34.14	
				50 m	16.50	34.05	
				100 m	11.60	33.98	
				150 m	10.11	34.01	
				200 m	9.65	34.13	
86	39º03'	— 74º55'	03:30	0 m	18.40	33.60	14/III/60
				25 m	18.40	33.72	
				50 m	13.45	33.84	
				100 m	9.95	33.99	
				150 m	9.34	34.33	
				200 m	9.22	34.47	
87	39º03'	— 74º24'	07:30	0 m	15.70	33.51	14/III/60
				25 m	14.75	33.68	
				50 m	11.28	33.86	
				100 m	9.75	34.02	
88	39º03'	— 74º14.5'	10:50	0 m	16.80	33.55	14/III/60
				25 m	14.25	33.68	
				50 m	10.55	33.83	
				100 m	9.70	34.01	
				150 m	9.34	34.33	
				200 m	9.00	34.44	
89	39º03'	— 74º03'	15:53	0 m	16.10	33.60	14/III/60
				25 m	13.25	33.75	
				50 m	10.63	33.91	
				100 m	9.75	34.11	
				150 m	9.44	34.40	
				200 m	9.15	34.48	
90	39º03'	— 73º51'	15:55	0 m	14.40	33.69	14/III/60
				25 m	10.77	33.81	
				50 m	10.10	33.99	
				100 m	10.12	34.49	
				150 m	10.10	34.57	

LIST 1 (Continuation)

Station n.°	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (°C)	Salinity (‰)	Date
91	39°03'	— 73°37'	18:50	0 m	15.10	33.62	14/III/60
				25 m	9.95	33.92	
				50 m	9.93	33.76	
92	39°03'	— 73°23.5'	20:50	0 m	15.10	33.59	14/III/60
				25 m	9.90	34.03	
93	39°58'	— 73°44.8'	08:00	0 m	12.20	33.24	15/III/60
				25 m	9.75	33.73	
				50 m	9.57	34.23	
94	39°59.1'	— 73°47'	10:00	0 m	13.70	33.66	15/III/60
				25 m	10.20	33.94	
				50 m	9.52	34.25	
95	39°59'	— 73°54.5'	11:43	0 m	14.60	33.64	15/III/60
				25 m	10.88	33.77	
				50 m	10.15	33.91	
				100 m	9.52	34.22	
96	39°59.9'	— 74°01.5'	13:50	0 m	15.30	33.54	15/III/60
				25 m	11.65	33.73	
				50 m	10.17	33.92	
				100 m	9.65	34.00	
				150 m	9.39	34.42	
97	39°58.6'	— 74°12.4'	16:18	0 m	16.65	33.57	15/III/60
				25 m	13.65	33.74	
				50 m	10.73	33.91	
				100 m	9.77	34.01	
				150 m	9.59	34.35	
				200 m	9.80	34.59	
98	39°58.9'	— 74°27'	19:00	0 m	16.00	33.54	15/III/60
				25 m	13.85	33.37	
				50 m	10.85	33.19	
				100 m	9.36	34.02	
				150 m	9.16	34.56	
				200 m	9.86	34.57	
99	39°58.9'	— 74°49'	23:00	0 m	16.80	33.58	15/III/60
				25 m	16.98	33.71	
				50 m	12.21	33.83	
				100 m	10.13	34.21	
				150 m	9.35	33.28	
				200 m	9.21	34.41	

LIST 1 (Continuation)

Station n.°	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (°C)	Salinity (‰)	Date
100	39°58.5'	— 75°28.2'	04:00	0 m	18.40	33.66	16/III/60
				25 m	18.30	33.74	
				50 m	15.75	33.82	
				100 m	10.88	33.95	
				150 m	9.70	34.09	
				200 m	9.47	34.42	
101	39°59'	— 76°00'	09:15	0 m	18.40	33.57	16/III/60
				25 m	18.28	33.71	
				50 m	13.90	33.85	
				100 m	10.44	33.94	
				150 m	9.29	34.06	
				200 m	8.90	34.31	
102	39°59'	— 76°48'	15:28	0 m	18.40	33.86	16/III/60
				25 m	18.25	33.87	
				50 m	17.56	33.90	
				100 m	11.50	33.91	
				150 m	10.20	33.93	
103	40°53.4'	— 75°04.2'	06:17	0 m	17.30	33.73	17/III/60
				25 m	17.30	33.82	
				50 m	13.35	33.91	
				100 m	10.16	33.97	
				150 m	9.65	34.20	
				200 m	9.13	34.37	
104	40°53.5'	— 74°47'	10:20	0 m	14.80	33.57	17/III/60
				25 m	13.35	33.74	
				50 m	10.59	33.90	
				100 m	9.54	34.12	
				150 m	9.23	34.43	
105	40°53.5'	— 74°27'	15:25	0 m	15.30	33.61	17/III/60
				25 m	11.40	33.79	
				50 m	9.65	33.96	
				100 m	9.55	33.08	
				150 m	9.15	34.28	
				200 m	8.85	34.49	
106	40°55.4'	— 74°12.5'	19:40	0 m	15.00	33.65	17/III/60
				25 m	12.90	33.82	
				50 m	10.50	33.94	
				100 m	9.50	34.20	
				150 m	10.39	34.02	

LIST 1 (Continuation)

Station n.º	Position Latitude (S)	longitude (W)	Time (h)	Depth	Temperature (ºC)	Salinity (‰)	Date
107	40º54'	— 74º04.1'	22:30	0 m	13.90	33.69	17/III/60
				25 m	12.40	33.83	
				50 m	10.50	33.95	
				100 m	9.44	33.18	
				150 m	9.26	33.42	
109	42º16.5'	— 74º15'	18:27	0 m	12.10	33.47	18/III/60
				25 m	10.91	33.68	
111	42º16.5'	— 74º32.5'	22:18	0 m	14.55	33.37	18/III/60
				25 m	12.05	33.58	
				50 m	9.94	33.93	
				100 m	9.14	34.11	
				150 m	9.00	34.39	
112	42º16.5'	— 74º45'	00:18	0 m	14.85	33.14	19/III/60
				25 m	13.00	33.75	
				50 m	10.30	33.91	
				100 m	9.15	34.08	
				150 m	9.10	34.34	
				200 m	9.00	—	
X_2	42º24'	— 72º57'	11:28	—	—	—	21/III/60
X_3	42º00'	— 73º00.5'	14:55	—	—	—	21/III/60

LIST 2

Position and data accompanying the "Eltanin" samples

Station number	Latitude	Longitude	Date (1962)	Sampling range (m) to 0 m	Bottom depth (m) at position	Local time (h)	Minutes fishing	Gear	Nearest hydrographic station	Water mass sampled
	N	W								
28	02°35' 02°35'	81°15' 81°16'	3 June	6	2965 2965	1130 1230	60	1/2 m pl. net. 20 mesh	E-3-2	E+C
29	02°34'	81°16'	3 June	92	ca. 2965	ca. 1230 ca. 1330	—	1/2 m pl. net. 20 mesh	E-3-2	E+ESS
	S	W								
33	07°45'	81°41'	7 June	Surf.	4758 4850	0045 0115	30	IKMWT	E-3-4 E-3-5	PS
34	07°45' 07°48'	81°37' 81°23'	7 June	683	4941 5051	0215 0530	123	IKMWT	E-3-4 E-3-5	PS or E
36	08°24' 08°23'	81°04'	7 June	Surf.	ca. 6039	1305 1405	60	1/2 m pl. net. 20 mesh	E-3-4 E-3-5	PS
38	08°05' 08°00'	81°09' 81°07'	8 June	5746 5948	5948 5746	1857 2345	110	Menzies Trawl	E-3-5 E-3-6	E+SA+AI+B
43	13°19' 13°14'	78°04' 78°07'	12 June	5234 5314	5325 5197	1810 2400	120	Menzies Trawl	E-3-6 E-3-7	SA+C AI+B
45	13°15' 13°22'	78°06' 78°12'	12 June	11	5774	2028 2128	60	1/2 m pl. net. 20 mesh	E-3-5 E-3-6	PS
48	14°11' 14°08'	77°08' 77°09'	13 June	3883 4004	3883 4004	1153 1650	118	Menzies Trawl	E-3-7 E-3-8	B+D

LIST 2 (Continuation)

Station number	Latitude	Longitude	Date (1962)	Sampling range (m) to 0 m	Bottom depth (m) at position	Local time (h)	Minutes fishing	Gear	Nearest hydrographic station	Water mass sampled
	S	W								
49	16°02'	76°50'	14 June	11	2776	1052 1152	60	1/2 m pl. net. 20 mesh	E-3-7 E-3-8	PS
50	16°12' 16°10'	74°41' 74°41'	15 June	2599 2858	2888 2260	0436 0748	90	Menzies Trawl	E-3-8 E-3-10	AI+UD+LD
52	16°30' 16°31'	74°36' 74°33'	15 June	1162	5307 3257	1030 1405	120	10' Blake Trawl	E-3-8 E-3-10	SST+SS+PS AI+D
53	18°19' 18°21'	73°26' 73°02'	16 June	2057	4355 4575	1320 1745	120	10' Blake Trawl	E-3-10 E-3-12	E+ESS+UD
57	21°10' 21°09'	72°44' 72°44'	18 June	6	4590 4443	0850 0950	60	1/2 m pl. net.	E-3-10 E-3-12	ESS
58	23°12' 23°27'	71°30' 72°33'	19 June	1980	5988 4301	1750 2330	120	10' Blake Trawl	E-3-12 E-3-14	AI+D+B
60	23°21' 23°19'	72°49' 72°49'	20 June	4	3660	0320 0420	60	1/2 m pl. net.	E-3-12 E-3-14	PS+ESS+SAS
61	23°32' 23°34'	72°37' 72°34'	20 June	306	3493 3733	1300 1445	60	10' Blake Tr.	E-3-14 E-3-15	PS+C
63	25°44' 25°43'	70°58' 70°58'	21 June	1863 1965	1830 1965	0825 0932	—	Phleger Corer	E-3-14 E-3-15	UD
64	25°43' 25°43'	70°58' 70°58'	21 June	5	ca. 1876 ca. 2033	0835 1035	120	1/2 m pl. net.	E-3-14 E-3-15	SAS+UD+AI

LIST 2 (Continuation)

Station number	Latitude	Longitude	Date (1962)	Sampling range (m) to 0 m	Bottom depth (m) at position	Local time (h)	Minutes fishing	Gear	Nearest hydrographic station	Water mass sampled
	S	W								
65	25°43' 25°42'	71°07' 71°07'	21 June	3149 3257	3321	1950 2320	120	Menzies Trawl	E-3-15 E-3-16	SAS+UD+AI
67	25°42'	71°22'	22 June	5783 5797	5942 5861	0610	120	Menzies Trawl	E-3-15 E-3-16	B
69	25°43'	71°07'	21 June	11	3440 3212	2000 2100	60	1/2 m pl. net.	E-3-15 E-3-16	STS+ESS+PS
71	31°05' 31°06'	71°44' 71°47'	24 June	179 187	192 176	1221 1250	15	Menzies Trawl	E-3-16 E-3-18	SAS+C
72	31°07' 31°08'	71°49' 71°49'	24 June	878 933	970 805	1400 1445	15	Menzies Trawl	E-3-16 E-3-18	STS+AI
75	31°10' 31°14'	71°56' 71°58'	24 June	1932 3142	1834	1630 1840	60	Phleger Corer	E-3-16 E-3-18	AI+D
					Cruise 4					
81	32°05' 32°04'	72°58' 72°58'	5 July	less than 2	—	1003 1103	60	1/2 m pl. net	1	SAS
83	32°01' 31°58'	72°58' 72°56'	5 July	3256	— 4606	1315 1600	8	Emery rock sampler	1	LD
84	31°55' 31°54'	72°55' 72°44'	5 July	— —	4634 —	ca. 2000 ca. 2146	0	Petersen grab	1	LD

LIST 2 (Continuation)

Station number	Latitude	Longitude	Date (1962)	Sampling range (m) to 0 m	Bottom depth (m) at position	Local time (h)	Minutes fishing	Gear	Nearest hydrographic station	Water mass sampled
	S	W								
85	32°02' 32°01'	72°40' —	6 July	less than 18	ca. 5929 ca. 5915	1745 1845	60	1/2 m pl. net	1	SAS
87	32°03' 32°01'	72°41' 72°42'	6 July	5929	5889 5911	1630 1950	60	Menzies Trawl	1	LD+B
89	32°01' 32°00'	72°40' 72°39'	6 July	less than 2	ca. 5907 ca. 5896	1915 1945	30	1/2 m pl. net	1	SAS
94	39°02' 39°02'	75°39'	8 July	less than 9	4154 4154	2200 2205	5	1/2 m pl. net	1	SAS
95	46°15' 46°15'	76°23' 76°21'	10 July	less than 18	2827 2807	1958 2100	60	1/2 m pl. net	1	SAS+C+SA
97	46°15' 46°35'	76°18' 76°25'	10–11 July	1830	2782 3038	2200 0240	120	IKMWT	1	UD
98	51°07'	77°40' 77°39'	12 July	6	ca. 3865 3865	0608 0708	60	1/2 m pl. net	1	SAS
99	51°30' 51°43'	77°35' 77°36'	12 July	ca. 1208 1219	3848	1020 1415	120	IKMWT	1	SAS+AI+UD
160	56°12' 56°10'	66°12' 66°11'	19–20 Aug.	less than 13	1391 924	2350 0030	40	Clarke-Bumpus net	17-18	PF
163	54°54' 54°57'	75°50' 75°49'	21 Aug.	less than 13	3962 3971	1620 1720	60	Clarke-Bumpus net	18-19	SA+PF

LIST 2 (Continuation)

Station number	Latitude	Longitude	Date (1962)	Sampling range (m) to 0 m	Bottom depth (m) at position	Local time (h)	Minutes fishing	Gear	Nearest hydrographic station	Water mass sampled
	S	W								
164	51°09' 51°09'	76°17' 76°15'	23 Aug.	less than 13	3038 2024	1305 1510	125	Clarke-Bumpus	20-21	SAS
165	47°26' 47°03'	76°40' 76°17'	24 Aug.	ca. 732	ca. 3440 3444	1035 1740	360	IKMWT	20-21	SA
169	44°41' 44°45'	76°04' 73°39'	25 Aug.	ca. 366	—	1445 2110	360	IKMWT	21-22	SA
170	44°46' 44°45'	75°35' 75°33'	25 Aug.	less than 15 m	1583	2315 2355	40	1/2 m pl. net	21-22	LS
171	42°33' 42°30'	75°58' 75°58'	26 Aug.	less than 13	ca. 3556 ca. 3559	1948 2210	142	Clarke-Bumpus net	23	LS
172	42°29' 42°25'	75°58' 75°59'	26–27 Aug.	less than 33	ca. 3559 ca. 3565	2240 0040	120	Clarke-Bumpus net	23-24	LS
175	40°46' 40°54'	76°48' 75°56'	27 Aug.	ca. 2893	3623 3730	0915 1840	365	IKMWT	23-24	LS
176	39°20' 39°19'	74°34' 74°30'	28 Aug.	less than 13	ca. 2864 ca. 2496	0420 0520	60	Clarke-Bumpus net	23-24	LS
180	39°20' 39°19'	74°27' 74°06'	28 Aug.	less than 33	1922 1922	0630 0715	45	1/2 m pl. net	23-24	LS
182	39°20' 39°20'	74°06' 74°05'	28 Aug.	less than 13	1546 —	0915 0945	30	Clarke-Bumpus net	23-24	LS

LIST 2 (Continuation)

Station number	Latitude	Longitude	Date (1962)	Sampling range (m) to 0 m	Bottom depth (m) at position	Local time (h)	Minutes fishing	Gear	Nearest hydrographic station	Water mass sampled
	S	W								
183	39°20' 39°20'	74°06' 74°05'	28 Aug.	less than 33	1546 —	0915 0945	30	1/2 m pl. net	23-24	LS
184	39°03' 39°01'	75°35' 75°38'	28 Aug.	less than 13	3935 3989	2200 2400	120	Clarke-Bumpus net	23-24	SAS
185	34°55' 34°52'	75°00' 74°58'	30 Aug.	less than 20	4118 —	0140 0415	155	1/2 m pl. net	24-25	SAS
186	34°55' 34°52'	75°00' 74°58'	30 Aug.	less than 33	4118 —	0140 0450	155	Clarke-Bumpus net	24-25	SAS
188	34°48' 34°46'	74°54' 74°52'	30 Aug.	less than 20	ca. 4127 ca. 4028	0750 0940	110	1/2 m pl. net	25	SAS
189	34°48' 34°46'	74°54' 74°52'	30 Aug.	less than 33	ca. 4127 ca. 4028	0750 0940	110	Clarke-Bumpus net	25	SAS
191	35°28' 35°27'	73°40' 73°39'	31 Aug.	less than 20	ca. 2807 ca. 2324	0030 0115	45	1/2 m pl. net	25	SAS
192	35°28' 35°27'	73°40' 73°39'	31 Aug.	less than 33	ca. 2807 ca. 2324	0030 0115	45	Clarke-Bumpus net	25	SAS
194	35°30' 35°28'	73°36' 73°34'	31 Aug.	less than 20	1684 —	0200 0240	40	1/2 m pl. net	25	SAS
195	35°30' 35°28'	73°36' 73°34'	31 Aug.	less than 33	1684 —	0200 0240	40	Clarke-Bumpus net	25	SAS

LIST 2 (Continuation)

Station number	Latitude	Longitude	Date (1962)	Sampling range (m) to 0 m	Bottom depth (m) at position	Local time (h)	Minutes fishing	Gear	Nearest hydrographic station	Water mass sampled
	S	W								
197	35°31' 35°33'	73°29' 73°25'	31 Aug.	less than 20	ca. 1254	0405 0435	30	1/2 m pl. net	25	SAS
198	35°31' 35°33'	73°29' 73°25'	31 Aug.	less than 33	ca. 1254	0405 0435	30	Clarke-Bumpus net	25	SAS
200	35°36' —	73°18' —	31 Aug.	less than 20	970 —	0538 —	—	1/2 m pl. net	25	SAS
201	35°36' —	73°18' —	31 Aug.	less than 33	970 —	0538 —	—	Clarke-Bumpus net	25	SAS
206	35°48' 35°48'	73°04' 73°05'	31 Aug.	less than 20	ca. 214 ca. 216	1025 1045	20	1/2 m pl. net	25	SAS
207	35°48' 35°48'	73°04' 73°05'	31 Aug.	less than 33	ca. 216 ca. 214	1025 1045	20	Clarke-Bumpus net	25	
208	37°29' 37°30'	73°55' 73°55'	11 Sept.	957	957 957	1830 1900	0	Campbell grab	1	AI
209	37°27' —	73°52' —	11 Sept.	46 183	ca. 439 —	2205 —	4	1/2 m pl. net	1-2	SAS+SA
212	41°01' 41°01'	74°58' 74°58'	12 Sept.	183	2159 —	ca. 2300 2315	—	1/2 m pl. net	1-2	SAS+SA
213	41°05' 41°10'	74°54' 75°01'	13 Sept.	ca. 606	ca. 1804 —	0335 ca. 0530	60	IKMWT	1-2	SA+AI
214	42°07' 42°08'	74°32' 74°32'	13 Sept.	145	145 145	1515 1630	60	40' otter trawl	1-2	SAS

LIST 2 (Continuation)

Station number	Latitude	Longitude	Date (1962)	Sampling range (m) to 0 m	Bottom depth (m) at position	Local time (h)	Minutes fishing	Gear	Nearest hydrographic station	Water mass sampled
	S	W								
215	45°01' 45°19'	76°33' 76°30'	14 Sept.	ca. 1219	3184 3186	1445 1840	119	IKMWT	1-2	SAS+AI+UD
216	52°53' 52°55'	75°36' 75°36'	16 Sept.	1190 1263	1263 1190	1600 1845	117	Menzies Trawl	1-2	SAS+AI+UD
272	64°54' 64°54'	68°21' 68°18'	21 Oct.	412	412 —	1540 1705	60	Menzies Trawl	13-14	A+D
302	63°05' 63°01'	71°32' 71°28'	29–30 Oct.	188	3843 3865	2315 0145	130	IKMWT	21-22	A+D
313	58°00' 57°49'	70°40' 70°46'	4 Nov.	802	3880 3649	0010 0250	96	IKMWT	26-27	A
325	56°06' 56°09'	71°14' 71°37'	7 Nov.	983	1717 4280	1526 1900	60	IKMWT	28	
				Cruise 6						
326	38°09' 38°30'	74°31' 74°37'	25 Nov.	1691 2072	3715	0940 1450	120	IKMWT	1	

Abbreviations used: A = Antarctic Water; AI = Antarctic Intermediate Water; B = Bottom Water; C = Coastal Water; D = Deep Water; E = Equatorial Surf. Water; ESS = Equatorial Subsurface Water; IKMWT = Isaacs-Kidd--Mid-Water-Trawl; LD = Lower Deep Water; LS = Low Salinity Water; PF = Polar Front; pl = plankton; PS = Peru Surface Water; SA = Subantarctic Water; SAS = Subantarctic Surface Water; SS = Subtropical Subsurface Water; SST = Subtropical Surface Water; STS or SST = Subtropical Surface Water; Surf. = surface; UD = Upper Deep Water.

METHODS

Details about the methods used for zooplankton sampling during the Marchile I expedition can be found in Fagetti and Fischer (1964, 141-144). Dr. Fagetti kindly separated the copepods from subsamples of the total hauls and sent them to me for studying. I am also grateful to Dr. Fagetti for all the hydrographical data accompanying the samples. The methods used during the "Eltanin" cruises can be found in Savage and Caldwell (1965) and the hydrographical data accompanying some of the samples are obtainable from Friedman (1964). Dr. Mohr and Dr. Savage kindly sent me the samples here used of the U.S.A.R.P for the study of the copepods.

The specimens in each EMCI sample were identified to species when possible. They were then counted. The number of copepods per minute of hauling was calculated. When the water was sampled quantitatively in vertical hauls from 140 m to the surface and horizontally at the surface in the same position, it was possible to deduce whether a species was concentrated at the surface or not. Migrating species were discovered by comparing the average of all the night occurrences with the average of all the day occurrences at the surface, and by comparing these with the average of the occurrences of the species per minute in the subsurface layer. Only the samples of the Marchile I expedition are comparable because they were all caught with the same kind of net, and quantitatively.

To correlate biology with hydrography of the waters sampled, the available data on temperature and salinity observed at the U.S.N.S. Eltanin hydrographic stations (Hood *et al.*, 1963; Friedman, 1964) were used to give an idea of the distribution of water masses at the biological stations (Savage and Caldwell, 1965) where the species were caught.

On comparing the EMCI profiles of salinity and temperature with the occurrence of the species at the same stations it was sometimes possible to determine whether one of those two or if both environmental factors influenced the distribution of certain species.

CALANOIDA

FAMILY CALANIDAE

Calanus australis Brodsky 1959, *C. simillimus* Giesbrecht 1902, *C. propinquus* Brady 1883, *C. tonsus* Brady 1883, *C. tenuicornis* Dana

1849, *Neocalanus robustior* (Giesbrecht 1888), *N. gracilis* (Dana 1849), *Calanoides patagoniensis* Brady 1883, *C. acutus* (Giesbrecht, 1902), *Undinula vulgaris* Dana 1849, *U. darwini* (Lubbock 1860), and *Nannocalanus minor* (Claus 1863) occurred in the samples studied here.

Brodsky (1961) also found *Calanus chilensis* Brodsky 1959 in the East South Pacific off the American continent, but this species did not occur in our material.

The most numerous and frequent species of Calanidae in the area studied was *Nannocalanus minor,* and the next most abundant were *Calanus australis, C. patagoniensis,* and *C. tonsus. C. tenuicornis* was amongst the most frequent. They all occurred in temperate waters. The Undinulae were very numerous only in warm Equatorial waters ("Eltanin" samples 28, 29, 43, 53). *Neocalanus robustior* ("Eltanin" samples 65, 69, 84) and *N. gracilis* ("Eltanin" samples 49, 61; EMCI samples numbers 7, with 10.7/min; 8, with 0.2/min; 9, with 20.0/min; 12, with 1.9/min; 13, with 2.7/min and 14, with 2.4/min) also occurred in oceanic waters containing some layers with temperatures above 16°C. *C. simillimus* ("Eltanin" samples 67, 325), *C. propinquus* ("Eltanin" samples 160, 163, 313) and *C. acutus* ("Eltanin" samples 163, 272 and 302) are known Antarctic Water species.

Calanus magellanicus Dana 1849 described from a female collected off Patagonia (see Fagetti, 1962) was considered "unidentifiable" by Giesbrecht (1892) and does not belong to the genus *Calanus* because of its rudimentary fifth leg.

Nannocalanus minor, C. australis, C. propinquus, C. tonsus and *C. carinatus* occur off Argentine (Ramírez, 1970, 1971) in the West Atlantic Ocean, in waters similar to those found off Chile. *Neocalanus gracilis* was also found in one sample of warmer water off Argentine (Ramírez, 1969). Off Brazil, in surface waters, usually with temperatures higher than 18°C, the following Calanidae were found: *C. tenuicornis, N. minor, N. gracilis, N. robustior, U. vulgaris.* Thus, excepting for *C. carinatus* (Atlantic), and *U. darwini* (Pacific) the remaining species are common to waters on both sides of the South American Continent.

Calanid nauplii were present in the EMCI surface samples: 5(180/min), 70(10/min), 95 (1/min), 104 (1/min), 109(4/min). The following 0-140 m EMCI samples contained nauplii: 5(0.7), 26(0.7).

Calanid copepodites were found in the EMCI surface samples (n.° in brackets = n.° of specimens per minute hauling): 6(10), 7(90), 8(100), 12(10), 16(260), 19(130), 26(10), 29(60), 31(2), 44(180), 49(1), 59(20), 70(110), 73(6), 77(2), 79(1), 84(490), 86(10), 98(10), 99(30), 102(17), 104(2), 107(3), 109(3). In the 0-140 m layer the following EMCI samples contained copepodites: 2(8.2), 6(5), 7(7.1), 10(132.7), 12(3.5), 14(8), 16(8), 17(7.6), 19(7.6), 26(0.7), 33(38.4), 35(13.3), 41(3.7), 42(23), 43(14.2), 44(215.3), 45(0.7), 47(0.7), 53(7.2), 61(10), 72(17.6), 73(0.9), 78(46.9), 80(23), 83(6.2), 84 (0.9), 89(1), 90(2.3), 95(0.8), 96(7.6), 98(10), 103(1.1), 107(10). The highest percentage of samples containing juveniles was found at the surface at night. At the surface numbers higher than 100/min were more frequent than in the 0-140 m layer. The nauplii occurred also more frequently at the surface, than in the subsurface layer.

From the distribution map of *C. australis* and *C. patagoniensis* off Chile, it is apparent that one species has a tendency of excluding the other. There are three calanid mass species: while *C. patagoniensis* and *C. australis* apparently prefer colder waters, *N. minor* seems to live more frequently in slightly warmer environments (where there are layers of water with more than 17°C temperature). Of these three species, *C. patagoniensis* is the species living nearest to the coast, *C. australis* is the next nearest, and *N. minor* is oceanic.

Calanoides acutus (Giesbrecht 1902), in "Eltanin" samples 272, 302, is mostly a Drake Passage and Antarctic copepod (see Andrews 1966).

Calanus australis Brodsky 1959

Material and occurrence: It occurred (number of specimens per minute of hauling in brackets) in the oblique hauls of the following EMCI samples (numbers out of brackets): 2(14.1), 4(430 7), 5(291.0), 6(228.1), 8(10), 9(8), 10(25), 17(7.6), 19(15.3), 22(13), 24(137.0), 26(1.5), 27(2.3), 34(1.5), 36(2.8), 37(15), 39(62.5), 41(2.5), 42 (115.3), 43(7.1), 44(23), 45(0.7), 48(1.5), 49(0.7), 53(2.7), 80 (23.0), 81(92.3), 82(0.7), 83(18.7), 84(0.9), 88(23), 90(2.3), 95(0.8), 97(7.6), 98(10.0), 99(46.6), 100(7.6), 102(30), 103(5.5), 107(150), 109(30), 111(2), 112(7).

At the surface the species (number of specimens per minute hauling in brackets) was present at the EMCI stations (out of brackets):

2(0.2), 4(20), 6(1410), 9(137.5), 37(8), 41(219), 42(3), 43(70), 49(1), 77(1), 81(3), 83(5), 99(10), 103(90), 104(2), 111(2), 112(21), X_2 (1230), X_3(320). "Eltanin" samples containing the species: 33, 34, 36, 38, 43, 45, 50, 52, 53 (females and males), 58 (females and males), 72 (females and males), 83, 84, 94, 169, 170, 172, 175, 176, 180, 184 (females), 197 (females and juveniles), 209, 212 and 213.

Frequency: *C. australis* was present in 55.7% of the total number of EMCI samples collected in the 140 m layer and in 19.6% of the samples taken at the surface. The following table gives the average number and the frequency of the species in the samples taken during the day and during the night in the 140 m layer and at the surface.

TABLE I

Distribution of *C. australis* (average number of specimens per minute of hauling and frequency in the samples collected by day and by night)

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Percent of samples containing the species	20.0	20.4	58.3	38.5
Average number of specimens per minute of hauling	37.2	174.2	467.2	183.1

Based on the above data there seems to be a vertical migration of this species to the surface during the night, and a concentration of specimens in the 140 m-0 m layer during the day. Considering the samples in which adults and/or juveniles occur, the following results are obtained:

1) in the 140-0 m layer, 59% of the samples taken by day and 60% taken at night contained only juveniles; 17 6% (collected by day) and 10% (taken at night) had both adults and juveniles; 10% contained only adults at night.

2) at the surface, 85.7% of the samples taken during the day had juveniles; 36.3% contained juveniles at night; 65.1% of the night samples contained adults; 14.1% of the day samples contained adult females.

Thus, there seems to be a migration of adults to the surface at night. Juveniles are dominant at the surface during the day and apparently migrate to the deeper layers at night. Males were found at the surface only at night, alone or with females. At night they were also found a little more frequently (20% of the samples) in the 140-0 m layer than during the day (17.6% of the samples).

Abundance: The largest numbers were found in surface samples by day (1230/min) and by night (1410/min). Numbers per minute higher than 100 were found in samples taken from Subantarctic Water with Warm Surface Water and in samples of Warm Surface Water. In the northern part of the area surveyed, *C. australis* was 6 times present in numbers larger than 100/min in the stations next nearest to the coast. Southward it appeared in high numbers 1230/min and 320/min in the Ancud Gulf waters. From 38°S to 41°S it was distributed in a wide area, almost to longitude 77°W, sometimes in stations farthest from the coast in numbers less than 30/min.

Remaining occurrence and discussion: *Calanus australis* was also amongst the most frequent (76.2% frequency) species registered by Vidal (1966) during the Marchile II expedition, which sampled the waters North to the Chilean area studied during the EMCI. The temperature in which the species occurred varied between 15.10 and 17 70°C.

In the "Eltanin" samples *C. australis* was present in Subtropical Surface and Equatorial Subtropical Surface Water during the night, off Peru at stations 33, 34, 38, 45, 50 and 53. It also occurred in large numbers at station 170, by night, off Chonos Archipelago at about 45°S and at the stations between 35° and 42°30'S mostly at night.

In the 140-0 m layer where *C. australis* occurred, the extreme temperatures were 8.94° at the greatest depth sampled, and 19.2°C at the surface.

C. australis was found 9 times in Low Salinity surface waters with temperatures between 12.1 and 12.3°C and in salinites between 33.898 and 33.293‰, and 7 times in Subantarctic Surface Waters. Brodsky (1967) found *C. australis* in the Southern Hemisphere waters with temperatures between 7° and 15° and only at one station with temperature 21°C. The surface temperatures of the waters in which it was found during the Marchile I and II expeditions varied from 12.1° to 19.1°C.

Calanus tonsus Brady 1883

Material and occurence: "Eltanin" surface water samples 94, 169, 197 (from Subantarctic Water) and 170, 171, 172, 176, 180 (from Low Salinity Water); "Eltanin" deep-water samples 52, 58, 97, 99, 165, 175, 213, 215, 216, 313, 325; EMCI samples 112(20/min) from the surface.

Frequency and abundance: It occurred more frequently in Low Salinity Water at night, and during the day, from 39°02'S to 44°46'S. lat. off Chile. The other samples in which it was found were always taken from Subantarctic Surface Water, Antarctic Intermediate Water or Subantarctic Water.

Brodsky (1964, 1967), in his graphs and maps gives 30°S as the northernmost, and 55°S lat. as the southernmost occurrence of the species. The approximate temperature limits are 5° to 15°C (Brodsky, 1964), more or less the same as for *C. patagoniensis,* which occupies the same area off Chile, but ranging further north.

C. tonsus was amongst the 3 most numerous copepods in 7 "Eltanin" samples. The specimens were caught with the Clarke-Bumpus and the 1/2 m plankton nets, during July and August.

From the data of the literature (Brodsky, 1964 and others), and from the data obtained here it is not certain whether the sporadic occurrence of *C. tonsus* is due to the time of the year or to the selectivity of the collecting instrument used.

More sampling off the South of Chile will also prove whether the mass presence of *C. tonsus* alternates with the maximum abundance of *C. patagoniensis* or if both occur together, probably occupying different ecological niches because of size.

Calanus tenuicornis Dana 1849

Material and occurrence: It occurred in the following EMCI samples caught by oblique hauls passing through the upper 140 m (numbers of stations followed by number of specimens per minute hauling, in brackets): 2(8.2), 5(25), 6(2.5), 7(7.1), 8(8), 9(6), 10(13.4), 12 (6.1), 13(11.1), 15(66.6), 17(46.1), 19(30.7), 22(3), 24(30.7), 31

Thus, there seems to be a migration of adults to the surface at night. Juveniles are dominant at the surface during the day and apparently migrate to the deeper layers at night. Males were found at the surface only at night, alone or with females. At night they were also found a little more frequently (20% of the samples) in the 140-0 m layer than during the day (17.6% of the samples).

Abundance: The largest numbers were found in surface samples by day (1230/min) and by night (1410/min). Numbers per minute higher than 100 were found in samples taken from Subantarctic Water with Warm Surface Water and in samples of Warm Surface Water. In the northern part of the area surveyed, *C. australis* was 6 times present in numbers larger than 100/min in the stations next nearest to the coast. Southward it appeared in high numbers 1230/min and 320/min in the Ancud Gulf waters. From 38°S to 41°S it was distributed in a wide area, almost to longitude 77°W, sometimes in stations farthest from the coast in numbers less than 30/min.

Remaining occurrence and discussion: *Calanus australis* was also amongst the most frequent (76.2% frequency) species registered by Vidal (1966) during the Marchile II expedition, which sampled the waters North to the Chilean area studied during the EMCI. The temperature in which the species occurred varied between 15.10 and 17 70°C.

In the "Eltanin" samples *C. australis* was present in Subtropical Surface and Equatorial Subtropical Surface Water during the night, off Peru at stations 33, 34, 38, 45, 50 and 53. It also occurred in large numbers at station 170, by night, off Chonos Archipelago at about 45°S and at the stations between 35° and 42°30'S mostly at night.

In the 140-0 m layer where *C. australis* occurred, the extreme temperatures were 8.94° at the greatest depth sampled, and 19.2°C at the surface.

C. australis was found 9 times in Low Salinity surface waters with temperatures between 12.1 and 12.3°C and in salinites between 33.898 and 33.293‰, and 7 times in Subantarctic Surface Waters. Brodsky (1967) found *C. australis* in the Southern Hemisphere waters with temperatures between 7° and 15° and only at one station with temperature 21°C. The surface temperatures of the waters in which it was found during the Marchile I and II expeditions varied from 12.1° to 19.1°C.

Calanus tonsus Brady 1883

Material and occurence: "Eltanin" surface water samples 94, 169, 197 (from Subantarctic Water) and 170, 171, 172, 176, 180 (from Low Salinity Water); "Eltanin" deep-water samples 52, 58, 97, 99, 165, 175, 213, 215, 216, 313, 325; EMCI samples 112(20/min) from the surface.

Frequency and abundance: It occurred more frequently in Low Salinity Water at night, and during the day, from 39°02'S to 44°46'S. lat. off Chile. The other samples in which it was found were always taken from Subantarctic Surface Water, Antarctic Intermediate Water or Subantarctic Water.

Brodsky (1964, 1967), in his graphs and maps gives 30°S as the northernmost, and 55°S lat. as the southernmost occurrence of the species. The approximate temperature limits are 5° to 15°C (Brodsky, 1964), more or less the same as for *C. patagoniensis,* which occupies the same area off Chile, but ranging further north.

C. tonsus was amongst the 3 most numerous copepods in 7 "Eltanin" samples. The specimens were caught with the Clarke-Bumpus and the 1/2 m plankton nets, during July and August.

From the data of the literature (Brodsky, 1964 and others), and from the data obtained here it is not certain whether the sporadic occurrence of *C. tonsus* is due to the time of the year or to the selectivity of the collecting instrument used.

More sampling off the South of Chile will also prove whether the mass presence of *C. tonsus* alternates with the maximum abundance of *C. patagoniensis* or if both occur together, probably occupying different ecological niches because of size.

Calanus tenuicornis Dana 1849

Material and occurrence: It occurred in the following EMCI samples caught by oblique hauls passing through the upper 140 m (numbers of stations followed by number of specimens per minute hauling, in brackets): 2(8.2), 5(25), 6(2.5), 7(7.1), 8(8), 9(6), 10(13.4), 12 (6.1), 13(11.1), 15(66.6), 17(46.1), 19(30 7), 22(3), 24(30.7), 31

(44.6), 32(7.1), 36(2.8), 37(4), 39(25.0), 42(30.5), 44(15.3), 45 (7.8), 46(3.0), 47(3), 48(8.4), 54(1.6), 56(5.3), 61(19.3), 62(3.5), 63(69.2), 78(46.9), 80(15 6), 81(23.0), 82(2.3), 83(12.5), 88(84.6), 90(0 7), 91(75), 95(2.5), 98(10), 99(26.6), 101(46.6), 102(30), 104 (0.9), 106(4.0), 107(40). At the surface it was present in the following stations: 25(3), 31(2.0), 42(8), 49(1.0), 77(2), 102(1). "Eltanin" sample: 215.

Frequency: It occurred only six times in surface samples, four times at night and twice during the day. In the oblique hauls through the 140 m upper layer, it was present in 49% of the total number of samples and in 61% of the samples taken by day with an average of 23/min; and in 41% of the samples with an average of 6.7/min collected by night (the samples caught by twilight included). Thus it seems that *C. tenuicornis* does not migrate to the surface. Perhaps there is migration from a deeper layer to the subsurface by day.

TABLE II

Distribution of adults and juveniles of *C. tenuicornis* (average number/min) at the surface and in the 0-140 m layer during the day and at night

Layer sampled		Surface		0-140 m	
Time		Day	Night	Day	Night
Average n.° of specimens per min of hauling	Females	1	1	2	9.1
	Males	—	1	6.1	2.7
	Copepodites	—	1	10.0	6.0

During the hours of light there were more juveniles (25 occurrences) in the 140 m layer. Females were caught in 10 samples and males were present in 3 samples. At night there was a smaller frequency of juveniles (in 7 samples); females and males were found in 5 samples. The sex-ratios were 100%, 33% (twice), 50%, 3.1%, 125%.

Abundance: The highest numbers, occurred in the 140 m layer (84.6/min) during the day. At night the highest number was 66.6/min in the 140 m layer.

Discussion and remaining distribution:

Heinrich (1957, 1961) when studying the vertical distribution of *C. tenuicornis* in the North West Pacific, found the species concentrated in the 25 to 100 m deep layer from 04:00 to 15:25 o'clock, and from 19:30 to 21:00 o'clock. In our samples it was also concentrated in the upper 150 m during the day. At night in probably migrates to deeper waters.

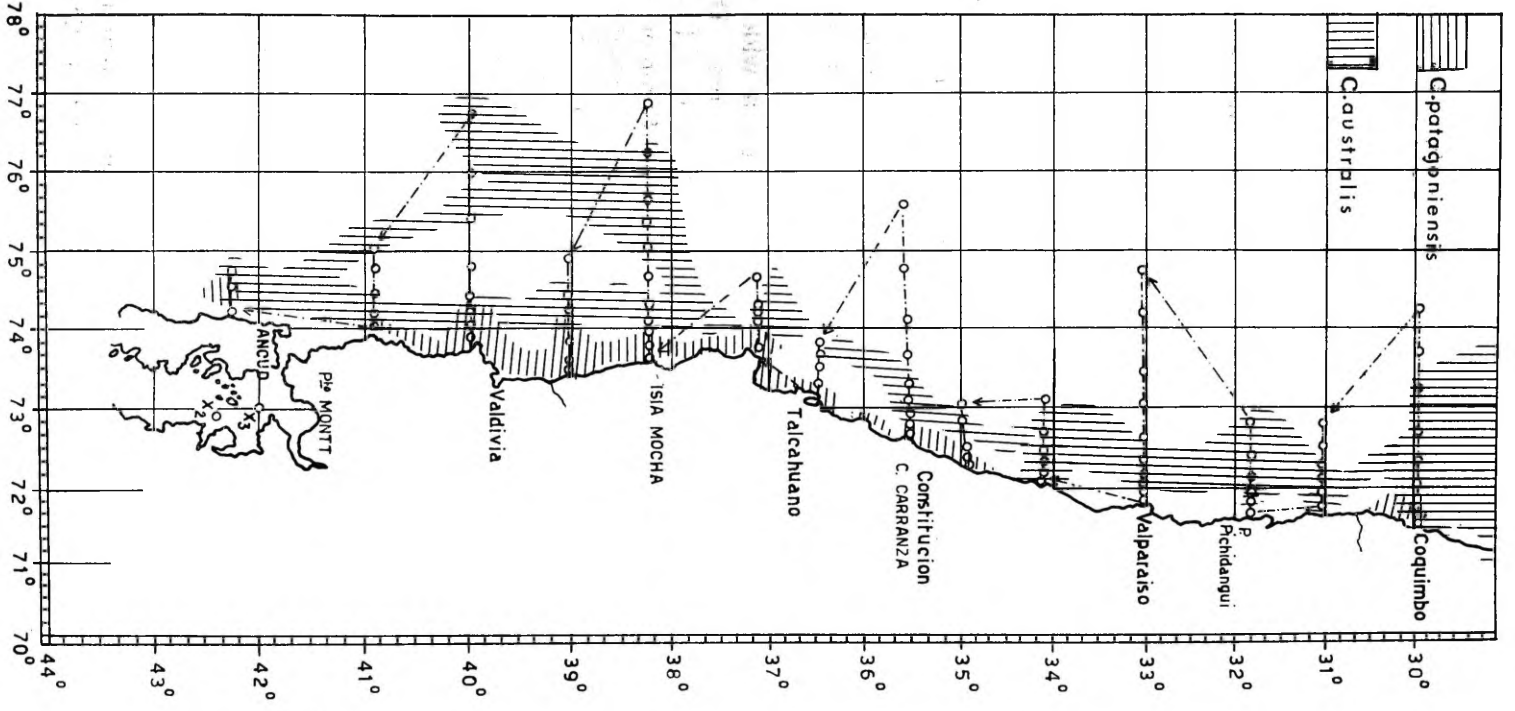
Vidal (1966) found it less frequently in the area further north off Chile. During the Marchile I expedition the highest number of specimens and frequency occurred in the northern part of the area sampled. Heinrich (1960) registered larger numbers per square meter of *C. tenuicornis* at about 30° lat. S and N in the Central Pacific area. It is also at about this latitude off Chile that the greatest abundance of the species occurred.

According to Bowman (1955) *C. tenuicornis* has a wide north range, and occurs both in neritic and in oceanic waters. Though considered a warm water cosmopolite, it really lives in subsurface cooler waters. In the Helenic seas it is rare during Summer and a common Winter species. There it seems to perform a seasonal migration, living near the surface during the cold period and sinking to deeper layers in the warmer season (Apostolopoulou, 1971). Mullin (1969) also found that *C. tenuicornis* occurred below 50 m during a certain time of the year. The same was observed here during March and April.

Mullin (1969) found a greater frequency of females and juveniles in the surface layer. Males occurred in deeper layers.

Brodsky (1967) studied samples taken off Chile and off the Antarctic, and the limits of temperature for the species was then between 8° and 30°C. The sizes above 2.4 mm (probably *C. lighti*) were found in the lowest temperature and the smallest (1.5 mm) between 25 and 27°C.

Deevey & Brooks (1971) found *C. tenuicornis* all the year round, but in larger numbers during Spring-Summer in the Sargasso Sea.



12 — Distribution of *Calanus australis* and *Calanus patagoniensis* off Chile based on EMCI data.

Calanoides patagoniensis Brady 1883
(Map 1)

Material and occurrence: In the following obliquely hauled EMCI samples (numbers out of brackets) the numbers (between brackets) of specimens per minute of hauling was: 5(0.7), 50(15), 52(78.1), 63(330 7), 64(91), 66(220), 68:69(9418.1), 70(100), 74(892.3), 75: 76(22.5), 77(1660), 78(46.9), 79(7.4), 82(0.7), 89(0 7), 91(712.2), 92(900), 93:94(1040), 95(4.1), 96(7.6), 97(23.0), 111(147). In the EMCI surface samples the numbers of specimens per minute hauling was: 64(6), 68:69(2), 72(0.1), 70(14), 77(3.0), 92(720.0), 100(1.0), 111(310.0).

Frequency: Not very frequent. It occurred in 30.7% of the samples collected during the day (with an average of 1050.6/min) and in 17.5% of the samples taken by night (with an average of 310.9/min) in the 140 m-0 m layer. At the surface it occurred usually at night in 9.1% of the samples examined.

Samples containing only females occurred twice, and in the remaining surface samples males, females and juveniles were present. Females and juveniles were present in 13 samples taken through the upper 140 m layer. Males were found in 9 samples.

Abundance: It was very abundant (in 10 samples, more than 100 animals per minute). The largest number by day (9418/min) occurred quite near to the coast at EMCI stations 68-69, and all the other large numbers, with one exception, were always present in stations near to the coast in shallower waters. The larger number by night occurred at EMCI station 77(1660/min).

Brodsky (1967) found the species distributed in waters with temperatures between 7° and 15°C in the Southern Hemisphere in a narrow band in the subantarctic region.

C. patagoniensis was amongst the three most abundant species of copepods in two samples of Subantarctic Water (with temperatures equal or below 11°C), and in six samples taken through Subantarctic Water and layers of Low Salinity Water near to the coast. The species did not occur in waters in which all layers had salinity below 34‰, though near the coast.

TABLE III

Distribution of young and adult *C. patagoniensis* during the day and during the night at the surface and in the 0-140 m layer. Average number of animals per minute hauling

Layer sampled		Surface		0-140 m	
Time		Day	Night	Day	Night
Average n.° of specimens per min of hauling	Females	4	105	19	13
	Copepodites	68	16	38	49
	Males	1	11	1	15

From the above data it seems that females rise to the surface at night and that young *C. patagoniensis* swim to the surface during the day. Males remain evenly distributed.

Though not very frequent, this species can be very abundant near to the coast and its life cycle should be better investigated because, owing to its size, it probably occupies an important position in the local food chain.

Nannocalanus minor (Claus 1863)

Material and occurrence: Number of specimens per minute (in brackets) taken from the 140 m upper layer, present in the following EMCI samples (sample number out of brackets): 2(2.3), 4(223), 5(150), 6(146.1), 7(2656), 8(132.8), 9(683), 10(803.8), 12(301.6), 13(336), 14(1210), 15(450), 16(488), 17(2238), 19(869), 22(53), 24 (692), 25(25), 26(195.4), 27(36.9), 28(623), 29(1000), 30(754), 31 (56.9), 32(112.8), 33(369.2), 34(10.7), 35(713), 36(158), 37(679), 39(37.5), 41(27), 42(800), 43(192.8), 44(1361.5), 45(490.7), 46(113), 47(53), 48(67.6), 49(0.7), 53(0.9), 55(5.7), 56(16.9), 57(4.6), 58 (32), 59(1038.3), 60(81.3), 61(160), 62(50), 63(61.5), 64(36.3), 70 (12.5), 72(23.8), 73(2), 74(346), 79(0.1), 80(7.6), 82(1.5), 83 (18.7), 84(187.2), 85(1453), 86(492.8), 89(0.7), 97(192.3), 98(10.0), 99(100), 100(692), 101(593.3), 102(2150), 103(22), 104(1.8), 105(1.5), 107(130). At the surface *N. minor* occurred in the EMCI samples: 6(50), 7(10460), 8(150), 9(110), 10(65), 11(315), 12(110), 13(91.3),

14(53.3), 16(60), 17(460), 19(540), 25(265), 26(1940), 27(90), 28 (2200), 29(530), 30(100), 31(599), 32(5040), 33(2700), 34(610), 35 (990), 36(1), 37(33), 39(1), 41(27), 42(3), 43(1380), 44(2200), 45 (188), 46(250), 47(480), 48(171), 49(26), 57(6), 58(3), 59(30), 60 (5), 61(3), 72(2), 73(40), 74(120), 77(1), 78(1), 79(5), 81(1.0), 83(40), 84(1770), 85(11), 86(2300), 99(970), 100(119), 101(270), 102 (2), 103(530), 107(1), 111(1). "Eltanin" samples 28, 29, 33, 34, 36, 38, 43, 45, 49, 53, 57, 58, 61, 63, 64, 69, 81, 85, 94, 95, 180, 183, 184, 186, 188, 191, 194, 200, 201, 207, 209 also contained the species.

Frequency: *N. minor* was present in 77% of the samples of the Marchile I expedition taken through the upper 140 m layer during the day, and, during the night, it occurred in 80.5% of the samples. It was found during the day in about 41% of the samples, and, at night, in 77% of the surface hauls. There is therefore an indication that *N. minor* migrates to the surface at night. Heinrich (1961) found *N. minor* at the surface in the Pacific from 18 p.m. to 6 a.m. the next day. During the day it was found between 25 and 100 m depth. In the Mediterranean *N. minor* concentrated in the 100 to 50 m layer during the day (Apostolopoulou, 1971).

TABLE IV

Average distribution of *N. minor* at the surface and in the 0-140 m layer during the day and during the night (number of specimens per minute of hauling)

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute of hauling	115	953	466	311

The above data confirm that *N. minor* concentrates at the surface at night.

It seems to prefer the warmer water off Chile, as it was absent in 42% of the samples taken from waters with temperatures under 16°C where it occurred in numbers less than 50/min in 29.8% of

the same samples. Only 21% of these samples contained more (50 specimens/min up to 600/min). In 80% of the warmer water samples, with temperature above 17°C, *N. minor* occurred in numbers higher than 50/min and in 34.2% of these, the numbers were higher than 600/min. In 35 samples of Subantarctic Water covered by Warm Surface Water *N. minor* was one of the three most numerous species of copepods. In Subantarctic Water it was abundant only in 9 samples. In Warm Surface Water it was numerous in 7 samples. The salinity of the 35 samples of Subantarctic Water covered by Warm Surface Water, was always above 34‰. With one exception *N. minor* was never abundant in samples containing Low Salinity Water.

TABLE V

Distribution of adults and copepodites of *N. minor* (average number/min) in different layers and by day and night

Layer sampled		Surface		0-140 m	
Time		Day	Night	Day	Night
Average n.° of specimens per min of hauling	Females	41	67	76	70
	Copepodites	44	20	46	26
	Males	18	47	45	46

Males and females seem to prefer the deeper layers during the day. At night they partially migrate to the surface.

In samples taken by day in the 140 m layer there was a 50% occurrence of female, male and juveniles, and 30% occurrence of females, either alone or accompanied by juveniles or males. 66% of the day samples taken at the surface contained juveniles acompanied or not by adults. Females, males and juveniles were usually present in the surface samples taken at twilight. The samples taken at night and at twilight in the upper 140 m layer usually contained the two adult and the juvenile forms. At the surface the samples taken at night contained 19 times adults and juveniles. Adults alone were present rarely in the 0-140 m and at the surface layers. The two sexes seem to migrate to the surface at night. The juveniles are more nume-

rous at the surface during the day. Females are more abundant than the males and juveniles in the 0-140 m layer.

The frequency of the length of 123 females was: 1.9 mm (84); 1.8 mm (24); 2.0 mm (15). The frequency of the male lengths was 1.5 mm (53); 1.7 mm (23) and 1.8 mm (1). The juveniles ranged from 1.0 to 1.6 mm (male juveniles). Males were frequently larger (1.8 mm) in the samples taken in colder water and smaller (1.6 mm), in samples from warmer water. Females also were frequently larger (2.0 mm) in the colder; and smaller (1.8 mm) in the warmer waters. Brodsky (1967) also found the larger animals in the colder waters and the smaller in warmer waters.

Abundance: More than a 1000 specimens per minute hauling were present in 21 samples of the total collected. The greatest catch was at the surface by night: 10460/min. At night at the surface *N. minor* was 21 times more numerous than 100/min in a total of 39 catches. By day it was present in higher numbers than 100/min at the surface only 7 times in 20 catches. In the 140 m layer it occurred in 22 out of 39 catches with higher abundance than 100/min. During the day in the same layer it was present in 17 out 26 catches in numbers larger than 100/min. In the 140 m layer it was less abundant than 10/min only in 10 samples. At the surface it was also less than 10/min in 11 catches. It is therefore an important constituent of the zooplankton biomass. The numbers around 500/min or more occurred in 12 out of 15 samples of the waters warmer than 17°C. *N. minor* according to the Map n.° 13 is more frequent in warmer waters away from the coast, and therefore occurs more frequently in high numbers towards the North and West of the area surveyed by the Marchile I expedition. This is confirmed by Vidal's (1966) data. High numbers of *N. minor* were taken during the Marchile II expedition off the North of Chile.

The females and juveniles were more numerous than the males, and there was a higher number of 0-140 m samples containing *N. minor* than surface samples. In the "Eltanin" samples 34, 43, 45, 57, 69, 81, 85, 89, 186 *N. minor* was amongst the three most numerous copepod species.

The southernmost "Eltanin" sample containing *N. minor* was n.° 183 taken at 39°20'S and the surface sample 111 of Marchile I Expedition at 42°16,5'S, but in it there was only 1 specimen/min catch.

In smaller latitudes at 30°S the number of specimens per minute hauling reached over 10.000 per minute.

The northernmost observation of *N. minor* was at 02°34'N ("Eltanin" sample). A "stray into the Antarctic environment" it was found as far South as 78°26'S in the Ross Sea (Bradford, 1971).

Other Remarks: In most samples of the EMCI *N. minor* females were mature and sometimes nauplii of the species were also present. It seems that the species reproduces in February and March off Chile. It may also reproduce at other times of the year. The annual cycle of this important species and its vertical migration should be studied off Chile.

Discussion: The distribution of *N. minor* according to Brodsky's data (1967) occurs in waters of the Southern Hemisphere, between temperatures 10 and 29°C; with a length variation range from 1.66 to 2.00 mm. Vidal (1968) found it in the samples of the Marchile II expedition with 66 6% frequency. The waters in which it occurred had from 15.64 to 17.82°C temperature, at the surface and in the Marchile I from 12.1° to 19.9°C. Heinrich (1961) studied its vertical migration in the West Pacific.

FAMILY EUCALANIDAE

The most important in frequency and abundance in the area studied was *R. nasutus,* present in 63.1% of the EMCI samples and in 25 "Eltanin" samples. *E. elongatus hyalinus,* found in 32.6% of the EMCI samples also occurred in 11 "Eltanin" samples. These two species will be treated in more detail further on.

E. attenuatus, sometimes numerous, but not frequent, was identified in 9 EMCI surface samples (7 of which taken at night or twilight) and in 10 EMCI samples from the 0-140 m layer. The surface samples and the number of specimens per minute hauling (in brackets) were the following: 10(2.5), 44(10), 78(1), 85(1), 86 (40), 100(1), 101 (10), 102(4), 106(3). The 0-140 m samples and the number of specimens per min (in brackets) were the following: 10(11.5), 24(7.6), 30(7.6), 74(46), 82(0 7), 84(2.7), 85(392), 86(7.1), 102(50), 103 (1.1). It did not occur in the coastal waters, and was mostly found

in the oceanic EMCI samples, therefore in waters with higher temperatures. This is confirmed by the "Eltanin" data. Present in the "Eltanin" samples 29, 33, 60, 34, 38, 50 and 52, from latitudes 2°34'N to 16°30'S in the Peru Surface Water, it thrived in higher temperatures 14-23°C, than are usual in Subantarctic Water. Nauplii of the species were found at the EMCI stations 95 (1/min) and 103 (20/min) at the surface and in samples 101 (6/min) and 103 (1.1/min) from the 0-140 m layer. There are indications that the species migrates down during the day and to the surface at night, confirming Heinrich (1961).

Eucalanus longiceps was less frequent than *E. attenuatus*. It occurred in 12 "Eltanin" samples (84, 97, 99, 165, 169, 175, 183, 184, 213, 215, 216, 313, 325 and 326), of which 7 were taken in Deep or Intermediate Waters, 2 in surface Low Salinity Water and 2 in Subantarctic Water from 31°54'S to 52°53'S. It also was found during the day in the 0-140 m layer (0.8 and 15.3/min) at EMCI stations 95 and 97. Vervoort (1957, 1965) registered the species as a surface bathypelagic type with subantarctic distribution. The species, though rare, characterizes the transition zone of the South Pacific Ocean (Bui Thi Lang 1965, *in* Beklemishev 1969). In the "Eltanin" samples 97 and 99 it was amongst the three most numerous copepods, off the South of Chile (46°35' to 51°30'S lat.).

Eucalanus bungii occurred in 7 "Eltanin" samples (34, 38, 50, 52, 53, 58, 87, 216). It was amongst the most abundant copepods in the "Eltanin" samples 34 and 38, at 7°47'S and 8°19'S, in a haul from deep water to the surface. Numerous and frequent in the East North Pacific (Fleminger, 1964; Johnson, 1938; Morris, 1970) it is quite rare in the Eastern Southern part of the same Ocean, judging from EMCI and "Eltanin" data.

Eucalanus inermis occurred twice during the EMCI in the upper 140 m layer in small numbers at stations 5(2/min), 6(17.9/min), 7 (14.2/min), 8(0.2/min), 9(6/min), 42(15.3/min), 49(1.5/min). It was present at the surface off Peru (Eltanin station 33); in Subtropical and Equatorial Surface Water (Eltanin station 45); off Chile (Eltanin station 53). During the Marchile II expedition it was quite numerous in 2 samples and frequent in 11 out of 42 samples (Vidal 1966).

Eucalanus subtenuis was frequent in the Marchile II expedition (Vidal 1966). It was then present in 21 stations out of 42, but was

not registered in the EMCI samples. It occurred in the "Eltanin" samples 29, 33, 45 (in Equatorial Subtropical Surface Water and in Subtropical Surface Water), off Peru, and at stations 58, 72 and 84 between 31° and 32°S off Chile in hauls taken through Subantarctic Surface Water and deeper layers. In samples 29, 33 and 58 it was amongst the most numerous copepods.

Rhincalanus gigas, found in Antarctic Waters (Hardy and Gunther, 1935; Mackintosh, 1934; Ottestad, 1936; Vervoort, 1965), was frequent in the "Eltanin" samples 43, 61, 67, 97, 99, 160, 163, 165, 169, 175, 213, 215, 272, 302, 313, 326) taken off southernmost Chile and in the Southern Ocean. Its greatest concentrations occurred in the Drake passage at 2000 m depth more or less, during August (Yamanaka, 1970). The highest sex-ratio of the species (95%) was found in surface Deep Water and in the Antarctic Convergence (82%) (Björnberg and Yamanaka, 1969). It was collected as far north as 13°15'S and 78°06'W off Peru in a haul from 5234 to 0 m. It probably was taken to this latitude by the deep Antarctic Intermediate water.

Eucalanus crassus was present in the EMCI samples from the 0-140 m layer: 5(0.7/min), 6(2.5/min), 8(0.8/min), 35(6.6/min), 48 (0 7/min), 55(1.4/min), 72(0.7/min); and in the surface sample 17 (10/min). It occurred only during the night and at sunset or dawn in very low numbers. The distribution range was from 30° to 38°S. Vidal (1966) found *E. crassus* during the Marchile II expedition up to the Arica latitude (18°29'S).

Eucalanus monachus occurred once, during the day (1.9/min) and once at night (0.7/min) in the 0-140 m layer at the EMCI stations 10 and 26. It is also rather rare off the North American coast (Fleminger, 1964)

Rhincalanus rostrifrons (Dana, 1852) (see Bowman, 1971) is a warm water species. It occurred in the 0-140 m layer only four times during the day, ranging in number from 0.9/min to 15.38/min at the EMCI stations 4, 31, 53, and 104. It was found in the "Eltanin" samples 28, 29, 33, 34 taken off Tamaco (Colombia) and Ecuador, in Tropical, Coastal and Equatorial Subtropical Surface Water. It is in the East South Pacific the rarest *Rhincalanus* contrasting in low numbers with its substitute in warm atlantic waters — the abundant *R. cornutus.*

Of the species which occur off the West South American shores, *Eucalanus attenuatus* seems to be an oceanic warm water form (Heinrich, 1968); *E. subtenuis,* of the upper 200 m layer (Heinrich, 1961; Vervoort, 1946) is probably warm subtropical with perhaps a definite yearly cycle which would explain its occasional abundance, followed by total absence; *E. crassus* is also an oceanic warm subtropical species found in waters all around the world. *E. monachus* is subtropical, *E. subcrassus* and *E. pileatus* are neritic-shelf, tropical-subtropical forms, very abundant, the first in the Pacific, and the second, in the Atlantic. *E. elongatus* lives in subsurface layers in the subtropical and subantarctic regions. *E. longiceps* is mainly subantarctic, of gradually deeper water as it is collected further away from the South. *Rhincalanus nasutus,* also a subsurface species, is more commonly found at the surface, than *E. elongatus.* It is a typically subantarctic form, as much as *R. gigas* is mostly antarctic in the 100 m surface layer. Both can spread far in deeper layers.

Eucalanus pileatus (1.95 mm), 2 females, occurred in Eltanin sample 216. *Eucalanus mucronatus* was found in the Eltanin sample 33. *E. subcrassus* was present in Eltanin sample 49.

Eucalanus elongatus hyalinus (Dana 1852)

Material and occurrence: EMCI samples containing the species (in brackets number of specimens per minute hauling): 2(1.2), 4(61.5), 7(14.2), 8(2), 9(6), 10(1.9), 12(1.9), 24(7.6), 31(10.7), 32(20.7), 33(84.6), 34(2.3), 37(5), 41(1.8), 43(35.7), 44(138.4), 46(2.3), 47 (6.9), 48(9.2), 53(0.9), 55(6.4), 56(10), 57(3.0), 61(9.3), 62(6.4), 66(25), 73(0.36), 79(0.1), 80(53.8), 95(10), 96(38.4), 97(46.1), 98 (10), 100(7.6), 104(0.9). At the surface it occurred in EMCI samples 37(3), 42(2) and 78(1). "Eltanin" samples containing the species 38, 43, 48, 52, 53, 57 (nauplii), 61, 87, 94, 175, 184, 186, 209, 213, 215.

Remarks: The most frequent of the *Eucalanus,* it usually appeared in small numbers (0.2 to 9.4% of the total number of copepods) and rarely at the surface (once during the day 3/min and once at night, 1/min). The number of females, juveniles and males was approximately the same at night and during the day in the 0-140 m layer. During the EMCI it was present in the 0-140 m layer at 13 stations

(from 0.9/min to 100/min) during the day and in 14 stations during the night (ranging from 0.36/min to 138.4/min). *E. elongatus* copepodites occurred (3/min and 1/min) in cold surface waters (15.15°-14.7°C) at stations 37 and 38. One sample contained more than 100/min; 13 samples 99 to 10/min and 21 samples contained less than 10/min.

It was amongst the most frequent species of *Eucalanus* caught in the deep water. Present in 7 samples out of 14 collected from 1000 m more or less depth and also further to the surface, from the latitude of Trujillo (Peru) to Antarctic waters. In these it occurred in samples taken from smaller depths (375 m) to the surface. It is probably a subsurface or a deep living species. In "Eltanin" and EMCI samples the adult females were ripe. Thus, it seems that the species has at least two reproductive periods during the year.

Rhincalanus nasutus Giesbrecht 1888

Material and occurrence: EMCI samples (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer: 5(0.7), 6(23), 7(1.7), 8(1), 9(1), 10(3.8), 14(8), 19(15.3), 22(1.5), 24(7.6), 31(6.9), 32(5.7), 33(238.4), 34(9.2), 37(29), 41(16.2), 42(100), 43(400), 44(392.3), 46(15.3), 47(16.1), 48(33), 49 (26.1), 50(7.8), 53(2.7), 54(15), 55(28.5), 56(56), 57(23), 58(2.8), 60(0.6), 61(114), 62(70), 63(438), 64(27.3), 66(325), 68:69 (27.2), 70(18.7), 73(5.2), 74(523), 77(400), 78(55.3), 79(2.5), 80(630 7), 81(30.7), 82(1.5), 83(18.7), 88(223), 89(7.6), 90(19.2), 91(112.5), 95(24.16), 96(507.6), 97(489.2), 98(470), 103(1.1), 104(0.9), 106(1), 107(150), 109(10). Surface samples of the EMCI containing specimens of *Rhincalanus nasutus* (number per minute in brackets): 34(10), 35(10), 37(3), 41(1), 42(5), 46(20), 47(16.1), 48(2), 49(2), 58(0.1), 63(1), 64(7), 73(6), 74(290), 77(34), 78(117), 79(1), 83(1), 92(140), 106(1), X_2(20), X_3(390).

EMCI samples containing nauplii (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer: 44(7.6), 47(2.3), 57(1.5), 61(0.6), 70(6.3), 72(4.6), 77(20), 82(0.7). "Eltanin" samples: 61, 67, 75, 84, 94, 95, 97, 99, 165, 175, 176, 180, 182, 183, 184, 188, 191, 192, 194, 195, 197, 198, 201, 209, 213, 215, 326.

Remarks: It was amongst the most frequent species (present at 41 stations) of the EMCI and not amongst the most numerous (0.6 to

548/min). Its distribution ranges from 42°20'S to 30°S. Nauplii of *Rhincalanus* occurred in the "Eltanin" surface samples taken between 31°S and 33°S. It was also very frequent in the night samples of this expedition, both in the adult and in the other copepodite stages, down to the latitude 46°30'S (station 97).

Nauplii of *Rhincalanus* occurred in night EMCI hauls at the surface (stations 73 and 77 with 8 specimens/min) and in the EMCI day samples 72(0.5/min) and 81(2/min) in Surface Subantarctic Water and in Low Salinity Water. *R. nasutus* nauplii occurred in 0-140 m layer at night or in the early dawn or at sunset (EMCI stations 7, 0.7/min; 8, 0.2/min; 43, 14.2/min; 44, 7.6/min; 47, 23/min; 57, 15/min; 77, 20/min; 109, 20/min). During the day they were present in the following EMCI samples 61(0.6/min), 72(4.6/min), 82(0.7/min), 89(3.1/min). Thus, it seems that the larvae of *R. nasutus* live just off the shore and migrate up during the night. Copepodites were found rarely at the surface during the day in sample 81(1/min), and more frequently at night in sample 72(0.2/min), 83(1/min) and 92(10/min). In the 0-140 m layer copepodites occurred in samples 12(0.2/min), 92(50/min) and 109 (10/min).

R. nasutus was amongst the three most abundant copepods in samples from Subantarctic Water or from Low Salinity Water mixed or not with other waters.

TABLE VI

Distribution of *R. nasutus* at the surface and in the 0-140 m layer during the day and the night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Percent of samples containing the species	16.2	32.6	63.1	59.5
Average number of specimens per minute of hauling	120.0	23.0	90.9	118.7

On comparing the percentage of night and of day surface samples which contain the species there is indication of a slight migrational

movement towards the surface at night, but, when the average number of specimens found at the surface during the day is compared with the average number occurring at the surface at night, the opposite conclusion is arrived at. The species usually remains in the subsurface or in deeper layers.

TABLE VII

Distribution of females, males and juveniles of *R. nasutus* in the layers sampled by day and by night during de EMCI

Layer sampled		Surface		0-140 m	
Time		Day	Night	Day	Night
Average n.° of specimens per min of hauling	Females	2	14.5	3.6	11.8
	Males	—	1	6.2	7
	Juveniles	16	17	17.2	11.6

It seems from the above data that only the females move up during the night. The males remain mostly at the bottom and the juveniles are evenly distributed at the surface and in the deep layer.

The highest frequency and abundance of *R. nasutus* during the Marchile I expedition was between the latitudes of Valparaiso (33°S) and Valdivia (40°S). There seem to be four generations per year of *R. nasutus*. It was found in "Eltanin" samples in latitudes as high as 66°S (Björnberg and Yamanaka, 1969). The highest sex-ratio (64.8%) for *R. nasutus* occurred in Subantarctic Subsurface Waters off Chile. In other waters of the region the sex-ratio was low.

Though not very numerous the species has a large size and therefore will contribute substantially towards the plankton biomass in the region where it is frequent.

FAMILY MEGACALANIDAE

The Megacalanidae (female = f; male = m; copepodite = j), were found in the following "Eltanin" samples:

Megacalanus princeps Wolfenden 1904: 34 (1 f); 48 (1 m.j. = 7 mm); 52, 53 (2 f = 11 mm; 1 m = 10 mm); 65 (2 f.j. = 7.5, 8 mm and 1 m.j.); 72 (1 f = 10 mm); 75, 175; 87 (1 f); 313 (1 f = 10.5 mm); 326 (1 m = 10 mm; 1 f = 13 mm),

Bathycalanus bradyi Wolfenden 1905: 97 (4 f = 10.5 mm); 99; 175 (3 f = 10.5 mm; 2 f = 11.0 mm; 1 m = 9.5 mm); 313 (1 f = 10 mm); 326 (2 f = 13 mm; 1 f = 11 mm),

Bathycalanus princeps (Brady 1883): 97 (1 f = 12 mm; 99; 175 (1 f = 12 mm; 1 f = 11.5 mm; 1 f = 10.5 mm); 215 (1 f = 11 mm); 313 (1 f = 13 mm; 4 f = 12 mm; 3 f.j. = 10, 9.5, 8 mm); 326 (2 f = 12 mm; 1 f = 13 mm, 1 f = 12.5 mm),

Bathycalanus eltaninae Björnberg 1969: 326 (1 m = 12.70 mm; 1 f = 16.00 mm),

Bathycalanus unicornis Björnberg 1969: 175 (2 f = 9.12, 10.5 mm),

Bathycalanus inflatus Björnberg 1969: 325 (1 f = 13.6 mm),

Bradycalanus pseudotypicus Björnberg 1969: 326, 175.

Though classified by Raymont (1963) as a true bathypelagic form *Megacalanus princeps* is the most eurybath representative of the Megacalanidae. It occurred in samples taken from less than a 1000 m depth. Owre and Foyo (1967) also found *M. princeps* in samples from the 137 to 907 m layer.

This species was the one collected in the lowest latitudes (07°45'S). *B. princeps* was collected from 40°46'S southwards in hauls through Deep Water, Antarctic Water, in transition Water to Antarctic Circumpolar Water and from these layers to the surface. *Bathycalanus bradyi* seems to occur also in the Deep Water and Antarctic Water. The others were all captured in hauls from depth of more than 1.600 m to the surface, excepting *B. inflatus* probably collected in Antarctic Intermediate Water in a haul from 983 m depth to the surface.

FAMILY PARACALANIDAE

Acrocalanus gracilis from the EMCI station 22(0.7/min) in the upper 140 m layer and from the "Eltanin" samples 28 and 29, was

numerous in surface water with 26°C temperature. *Acrocalanus longicornis* was collected at the EMCI station 9(1/min) in the upper 140 m. *Acrocalanus* is usually a warm water genus, therefore only common near to the Equatorial region in the East South Pacific, in warm water. *Paracalanus quasimodo* was also found only once at the EMCI station 53(32.7/min) in the 0-140 m layer. The specimens were badly preserved and the identification is not quite trustworthy. It was longer (1.100 mm) than *P. indicus*. The most numerous species found during the EMCI was *P. indicus*. It will be specially treated below.

The *Acrocalanus* registered here with *Acrocalanus gibber* added, were found in the North East and North West Pacific (Fleminger 1964, 1967; Tanaka, 1956). Heinrich (1961) identified *Acrocalanus monachus* in the East Central Pacific. *A. gracilis* is mostly a surface copepod by day and by night. *A. longicornis* and *A. monachus* are also found in the subsurface layers (50-100 m or 200 m) mostly during the day. *Paracalanus parvus* s.l. was also registered off Japan (Tanaka, 1956), off North America (Fleminger, 1964) and in the South East Pacific (Farran, 1929).

Paracalanus indicus (Wolfenden 1905) (= *P. parvus* Claus 1863 partim)
(for identification of this species see Bowman 1971)

Material and occurrence: It was found at the following stations of Marchile I in the 140 m upper layer (n.° of specimens/min in blackets): 2(470), 4(1469), 5(1146.1), 6(1180.3), 7(107.1), 8(15 7), 9(155), 10(3590), 12(0.9), 15(37.5), 16(960), 17(153), 19(92.3), 20(26400), 22(66.1), 24(1233.3), 25(27.1), 26(13.8), 27(6.9), 28 (38.4), 29(38.4), 30(261.5), 31(6.1), 32(7.1), 34(1.5), 35(26.6), 36(45 7), 37(29), 39(3525), 41(81.8), 42(384.6), 43(171.4), 44 (4338.4), 45(16.7), 46(15.3), 47(16.9), 48(16.9), 49(21.5), 50 (109.2), 52(11.8), 53(31.8), 55(13.5), 56(5.3), 57(5.3), 58(7.1), 59 (6392.3), 60(1.3), 61(8.0), 62(9.2), 63(4761.5), 64(6836.3), 66 (1108.3), 68:69(4581.8), 70(2687 4), 72(270), 73(60.5), 74(3930.8), 77(20), 79(0.8), 80(15 6), 81(276.8), 82(2.3), 83(212), 84(16.3), 85 (30.7), 86(7.1), 95(0.8), 99(100), 101(20), 102(60), 103(2.2), 104 (0.9), 105(3.8), 107(150), 109(350), 111(3), 112(3). At the surface it occurred at stations: 2(25.2), 4(2170), 5(13620), 6(9020), 7(810), 8(2650), 9(245), 10(8627.5), 11(17.5), 12(20), 13(2.3), 16(1100), 17 (620), 19(350), 20(2820), 22(1840), 24(2450), 25(3), 26(760), 27(10), 28(200), 30(220), 31(5), 32(5760), 33(830), 34(330), 35(140), 36(43),

37(1521), 39(4), 41(33), 42(9), 43(5370), 44(20070), 45(57), 46(760), 47(4040), 48(103), 49(42), 50(10), 52(280), 54(60), 57(163), 58(58), 59(1450), 60(25), 61(123), 63(113), 64(62), 68:69(8), 70(25380), 72 (28.2), 73(2257), 74(10800), 77(1), 78(4), 79(19), 80(220), 81(332), 82(1), 83(73), 84(380), 85(7), 86(110), 87(2300), 88(6), 89(1), 90 (20), 95(11), 98(400), 99(380), 100(5), 101(37), 102(21), 103(240), 104(19), 105(3), 106(4), 109(2.6), 111(4), 112(5), X_2(140), X_3(30). It occurred also in the "Eltanin" samples: 29, 33, 36, 43, 57, 64, 69, 81, 85, 89, 94, 180, 183, 191, 194, 197, 200.

Remarks: It was the most numerous and amongst the most frequent copepods present in 83 surface EMCI samples and in 77 EMCI samples of the upper 140 m layer. It was among the 3 most numerous species: 1) in 13 samples at the surface, in Warm Surface Water (temperatures above 17°C and salinity above 34.056‰); 2) in 16 samples of Subantarctic Surface Water plus Warm Surface Water; 3) in 26 samples of Subantarctic Water; 4) and in 8 samples from Warm Low Salinity Water. The highest numbers of specimens per minute of sampling occurred in the Subantarctic Surface water, and in Warm Surface Water. It occurred 9 times in numbers of more than a thousand per minute in Warm Surface Water. In the Subantarctic Water the number of specimens per minute exceeded a thousand in seven samples, and also in six hauled through Subantarctic plus Warm Surface Water. In water with lower salinity there were never larger numbers than 400 per minute of sampling. It therefore seems better adapted to life in the Subantarctic Surface Water or in Warm Surface Water.

TABLE VIII

Distribution of *Paracalanus indicus* at the surface and in the 0-140 m layer during the day and the night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Percent of samples containing the species	97.3	89.7	76.9	80
Average number of specimens per minute of hauling	1702	16509.6	929.4	1053.3

From Table VIII it seems that during the night *P. indicus* moves chiefly to the surface, and during the day a considerable number remains at the surface.

TABLE IX

Average distribution of adults and copepodites of *P. indicus* at night and during the day at the surface and in the 0-140 m layer

Layer sampled		Surface		0-140 m	
Time		Day	Night	Day	Night
Avcrage n.° of specimens per min of hauling	Females	152	149	124	56
	Copepodites	50	301	77	25
	Males	20	63	27	21

From the data of Table IX the males and the copepodites move to the surface at night, and the females, which seem to stay mostly at the surface, move down during the day.

The map of distribution of the specimens caught during the Marchile I expedition shows a larger concentration of the species from about 37° lat. S towards the north (Map. 13).

During the "Eltanin" cruises *P. parvus* s.l. was collected in Tropical water (with more than 20°C temperature), Subtropical Surface water and Equatorial Subtropical surface water at stations 33 and 36 off Colombia, 45, 49 off Peru and in the same waters off Chile (station 57). Off Chile it also occurred in Subantarctic Surface water (stations 64, 89, 85, 94, 191, 194, 197, 200, 207) and in Low Salinity Water (stations 180, 183).

Paracalanus nauplii (20/min) were found in a sample of the Marchile I expedition during the day at the surface. Young Paracalani occurred during the night (48) at the surface (2/min), and in the 0-140 m layer (station 10, 3.8/min).

"P. parvus" was the most numerous copepod in many samples. In 25 surface water samples it totalled more than 40% of all the copepods present. In 13 samples taken through the upper 140 m layer

"P. parvus" was present in a higher percentage than 40% of the copepods present. Its small size (about 1 mm long) diminishes its value in the biomass, but the very large numbers of this species perhaps compensates for the want of body volume. It is also one of the primary consumers in the food chain of the ocean.

FAMILY CALOCALANIDAE

Calocalanus pavo Dana 1849 was collected at EMCI stations 42, surface (1/min); 12 and 44, in 0-140 m hauls respectively 1.6/min and 7.6/min. The "Eltanin" samples contained *C. pavo* in Subtropical Surface Water and in Equatorial Subtropical Surface Water (stations 28, 29, 33), off Peru and off the North of Chile (stations 43, 45, 49, 57, 60). It is a warm water species. Vidal (1966) found it in 11 samples of water with 17°C temperature or more. Only three samples which contained *C. pavo* had temperature well under 17°C (Vidal 1966).

Calocalanus contractus Farran 1926 was found at station 8(0.2/min) in the 0-140 m layer. *Calocalanus pavoninus* Farran 1936 was present at the EMCI samples hauled from the 0-140 m layer 8(0 4/min), 12(1.4/min), 14(18.6/min), 48(0.7/min), 58(0 7/min), 64 (9.1/min), 106(1/min) at night, and by day at the EMCI stations 82 and 53(1.5 and 0.9/min). It was also present in the "Eltanin" station 183. *Dolichocerea tenuis* (Farran 1926) was present in samples: 4 (15.3), 7(10.7), 8(0.4), 9(3), 10(3.8), 12(1.4), 14(8), 16(16), 28 (7.6), 31(0.7), 46(0.7), 47(0.7), 50(0 7), 58(0 7), 60(1.3), 61(2), 77(20), 79(0.2), 82(2.3), 88(23), 89(0 7), 90(0 7), 107(30), 112(1) in the 0-140 m layer, and in the EMCI surface samples: 37(1), 42(1), 73(1), 83(1), 101(10), 103(10). It was found in the "Eltanin" samples 81, 85, 94, 182, 183, 188, 189, 191, 197, 206, 213 in Subantarctic Surface Water and in Low Salinity Water. *D. tenuis* occurred at 11 stations during the day in numbers that varied from 0 7 to 23 per minute of hauling; and at 13 stations at night (0 7 to 30/min). At the surface it was present only twice during the day and four times at night. It was also frequently present in the "Eltanin" samples collected between 40° and 25°S off Chile.

From the data below it seems that *D. tenuis* lives mostly in the subsurface layer, but, also rises to the surface at night.

TABLE X

Distribution of *D. tenuis* in the surface and in the 0-140 m layer by day and by night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Percent of samples containing the species	5.4	4	19.5	12.5
Average number of specimens per minute of hauling	1	11	6	8

Ischnocalanus plumulosus (Claus 1863), 1.1 mm long, occurred at the EMCI stations 42(4/min) at the surface, and 4(7 6/min), 12 (0 4), 19(7.6), 73(0.09), 83(18.7), 102(0.9), 104(0.9) in the 0-140 m; also in Subtropical Surface Water, in cooled Subtropical Surface Water off the South of Peru and in Low Salinity Water ("Eltanin" samples 45, 49, 69, 170). A very large specimen, 1.44 mm, resembling *I. plumulosus,* was found in the "Eltanin" sample 94, but the fifth legs were broken, having two small segments besides a probable third one, which was missing. *I. plumulosus* has only two segments on the fifth leg.

When comparing the data about *I. plumulosus* and *D. tenuis,* it seems that the second has a wider distribution in cooler waters than the first. Both are found in subsurface layers, rarely or not at all at the surface.

Calocalanus styliremis Giesbrecht 1888

Material and occurrence: It was found at the following stations of Marchile I expedition in the 140 m upper layer (the number of specimens per min is in brackets after the station number): 5(2.0), 6 (2.5), 7(8.9), 8(1.0), 9(6), 10(3.8), 12(1.9), 14(8.0), 15(8.3), 16 (32), 17(7 6), 32(0 7), 39(12.5), 42(7.6), 45(0.7), 48(0.7), 49(0.7), 55(1.4), 60(0.6), 61(2.0), 62(0.7), 63(23), 64(27.2), 73(1.9), 74 (30.7), 79(0.1), 80(61.5), 81(15.3), 83(25), 84(0.9), 85(7.6), 92 (16.6), 95(1.6), 97(7.6), 98(30), 99(6.6), 107(30), 109(10). At the surface it occurred at stations: 9(2.5), 16(100), 61(2), 79(1), 81(2).

It is sparingly distributed (0.6/min to 76/min mostly less than 10/min) all along the trek of the EMCI cruise. If the indication is

confirmed that it prefers living in zones of water mass mixture (Björnberg, 1967) its frequent occurrence near the coast of Chile can be explained because of the upwelling and consequent mixture of the waters. Along latitude 38°20'S it was perhaps found at the more oceanic stations because this is the latitude generally reached by Antarctic Waters from the South and by Subtropical Waters from the North. The Calocalanid species registered here, plus *C. gracilis,* were also the species found in the North West Pacific (Fleminger, 1967), in numbers never higher than 499/1000 m^3 of water, and in the North East Pacific (Tanaka, 1956). *C. contractus* did not occur off Japan (Tanaka, 1956). *C. styliremis,* numerous off New Zealand (Farran, 1929) is a species which prefers cooler waters as is evident from its vertical distribution (Heinrich, 1961). *Mecynocera* also seems to prefer cooler regions outside the Equatorial Area, from 20° to 30°S (Heinrich, 1968). *C. styliremis* is usually concentrated in 25-50 or in the 50-200 m layers during the afternoon and night, never reaching the surface (Heinrich, 1961). *C. pavo* and *I .plumulosus* are surface species at night and in the afternoon, with downward sinking at dawn or in the morning (Heinrich, 1961). They are mostly warm water species. *C. pavo* lives in the area between 10°N and 10°S (Heinrich, 1968), thus, an Equatorial species. Young *Calocalanus* were present (25/min and 1/min) at the surface in temperatures above 17°C at two stations (11 and 83) at night. In the 140 m upper layer the copepodites were found once during the day (0.8/min) and in 6 samples taken at night (ranging from 0.2 to 6.2/min).

C. styliremis was also caught by the "Eltanin" (at stations 81, 85, 170, 188) mostly in Subantarctic Surface Water off the coast of Chile and ranged among the frequent species from 30°S to about 40°S.

Mecynocera clausi J. C. Thompson 1888

Mecynocera clausi was found in 27 samples of the Marchile I expedition in the 0-140 m layer: 2(1.2), 7(16), 9(10), 12(0 7), 14 (8.6), 15(16.6), 16(16), 28(7.6), 36(0.7), 44(38.4), 46(0.7), 48 (0.7), 56(0.7), 60(1.3), 73(1.5), 80(7.6), 82(15), 83(6.2), 84(3.6), 89(0.7), 95(2.5), 98(10), 101(6.6), 102(10), 105(3.8), 107(20) It never occurred in percentages higher than 3.3 of the total number of copepods. It was caught at the surface 4 times by day, at stations 9 (7.5/min), 84(10/min), 101(10/min), X_3(30/min), and 4 times by night at stations 12(0.3), 13(0.33), 42(3), 100(1.0). In the upper

140 m layer it was collected during the day at 13 stations in quantities averaging 6.1 per min of hauling. At night it occurred at 16 stations averaging 9.9/min. The following "Eltanin" samples contained *Mecynocera*: 29, 49, 81, 180, 184, 188. They were taken in Equatorial Surface Water, Subantarctic Surface Water and Low Salinity Water.

Young *Mecynocera* occurred at station 84 at the surface (10/min) and in the 140 m upper layer in Low Salinity Water (33.688‰ salinity and 18.6°C temperature).

In the USARP surface samples *Mecynocera* was present, but not very frequently, off the coast of Chile between 30°S and 42°S.

FAMILY PSEUDOCALANIDAE

Clausocalanus mastigophorus (Claus 1863) was found in the "Eltanin" samples from Equatorial Surface Water (28, 29) and from the Peru Surface Water (sample 33), in the EMCI samples from surface waters, 85(1 specimen/min) and 100(1 specimen/min) and from the 0-140 m layer, 14(2.4/min), 41(1.2/min), and 85(7.6/min). It is the *C. arcuicornis* f. *major* registered by Vidal (1968) during the Marchile II expedition off the northern part of Chile.

Clausocalanus lividus Frost and Fleminger 1968 was recorded in two EMCI samples from the 0-140 m layer: 30 (with 7.6 specimens/min) and 58 (5.7 specimens/min).

Clausocalanus ingens Frost and Fleminger 1968, *Clausocalanus arcuicornis* (Dana 1849) and *Clausocalanus parapergens* Frost and Fleminger 1968 will be treated with more detail below.

Clausocalanus farrani Sewell 1929 occurred at the surface, in EMCI samples 84 (2 specimens/min), 85 (15.3/min), and 100 (6 specimens/min), thus extending the distribution range of the species (Frost and Fleminger, 1968) to the East.

Clausocalanus jobei Frost and Fleminger 1968 was caught at the surface at the EMCI stations 6(30/min), 7(950/min), 25(1/min), 45(2/min), 100(1/min), and in the 0-140 m layer at stations 4(22.9/min), 5(9.2/min), 7(3.5/min), 8(0.2/min), 10(1.9/min), 12(1.4/min), 14(2.4/min), 16(8/min), 17(23/min), 22(7/min), 26(1.5/min), 42(7.6/min), thus only once in high numbers, and mostly in the north of the area surveyed by the EMCI. It was also present in the "Eltanin"

samples 33, 45, 49, 57, 60, 64, 69, 85 in the Peru Surface Water and in samples taken through the Subantarctic Surface Water and through deeper layers. In samples 60 and 69 it was among the most numerous copepods. Vidal (1968) also found this species (*C. arcuicornis* f. *minor*) off the North of Chile (see Vidal 1968 — Pl. 7 — figs. 13-17).

Clausocalanus pergens Farran 1926, 0.7 mm, 0.99, 0.95, 0.94 mm long occurred in the EMCI samples collected at the surface: 83(1/min), 100(1/min), 102 (2/min), 103(50/min); and in the 0-140 m layer in samples 14(18.3/min), 19(7.6/min), 44(7.6/min), 78(6.1/min), 86(7.1/min), 90(0.7/min), 99(6.6/min), 101(13.3/min), 106(1/min), 107(20/min), thus mostly in the Southern part of the area surveyed.

Clausocalanus brevipes Frost and Fleminger 1968 (female, 0.900-1.400 mm long; male 1.000, 0.700-0.800 mm, and 0.84 mm long) was found in the EMCI surface samples 28(10/min), 60(3/min), 83(6/min) and in the 0-140 m layer samples 25(2.1/min), 29(123/min), 41 (1.2/min), 45(2.1/min), 60(1.3/min), 61(12.6/min), 74(7.6/min), 83(12.5/min), 95(0.8/min), 101(6.6/min), thus extending its known distribution range further North.

Clausocalanus laticeps Farran 1929 was present at the surface in the EMCI sample 82(0.4/min), and in the "Eltanin" samples 98, 160, 163, 164, 206, 216, taken in Subantarctic Waters and from Deep Waters. In the "Eltanin" sample 98 off the Archipelago region in the South of Chile it was among the most numerous copepods in the sample.

Farrania frigida (Wolfenden 1911) occurred in "Eltanin" sample 87.

Clausocalanus ingens Frost and Fleminger 1968

Material and occurrence: EMCI surface samples (number of specimens per min in brackets): 25(1), 28(200), 33(20), 42(4), 44(100), 45(1), 58(0 7), 59(180), 81(8), 82(0 4), 83(4), 84(20), 85(1), 86(20), 87(400), 88(3), 89(1), 99(200), 100(6), 101(230), 102(39), 103(100), 104(3), 112(2). EMCI 0-140 m layer samples (number of specimens per min in brackets): 15(425), 30(7.6), 58(5.7), 59(84.5), 61(1.3), 74(7.6), 82(0.7), 83(24.9), 84(1.8), 85(7 6), 86(7.1), 88(15.3), 97 (15.3), 98(20), 99(13.3), 100(15.3), 102(60), 106(20), 107(10). "Eltanin" samples 50, 89, 94, 97, 170, 175, 176, 180, 182, 183, 184, 188, 191, 209, 212, 213, 216, 325.

Remarks: It is distributed from 53°S lat. to 31°S lat. and concentrated between 38° and 42°S lat. The females were 1.202 mm to 1.600 mm long, 1.700 mm in low temperature (11.5°C). The male was 1.250 mm long.

TABLE XI

Distribution of *C. ingens* by day and by night at the surface and in the 0-140 m layer

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute of hauling	47.1	81.5	23.0	51.7
Percent of samples containing the species	34	24	23	17

From the data of table XI it is not certain whether *C. ingens* migrates to the surface or not. The frequency of *C. ingens* at the surface is higher during the day, but the average number of specimens is higher at night.

The number of specimens above 10 per min hauling were found mostly in waters of low salinity in the 0-140 m layer. At the surface the higher numbers of *C. ingens* occurred in low salinity or in Subantarctic Surface Water. During the "Eltanin" cruise it was also found mostly in the same environments.

The distribution range of *C. ingens* based on our data agrees entirely with those of Frost and Fleminger (1968).

Clausocalanus arcuicornis (Dana, 1849)

Material and occurrence: EMCI surface samples (specimens/min in brackets): 6(20), 9(2.5), 12(70), 17(30), 29(70), 45(6), 54(1), 59 (240), 60(7), 64(2), 78(4), 83(4), 84(170), 85(11), 86(330), 87(100), 100(14), 101(50), 102(2), 103(130), 106(1), X_3(10). EMCI samples taken in 0-140 m: 2(1.2), 6(2.5), 9(1), 10(19.2), 12(36 6), 13(311), 14(13.3), 15(87.5), 19(15.3), 22(1.5), 25(2.9), 26(0.7), 28(15.3), 29(76.9), 45(4.2), 59(69.2), 61(109.3), 68:69(9), 81(1.5), 83(6.2), 84(47.2), 85(146.1), 86(42.8), 88(15.3), 92(50.0), 100(100 0), 101 (80), 102(30), 103(14.4), 104(4.5). "Eltanin" samples: 60, 69, 89, 206.

Remarks: *C. arcuicornis* was identified here according to Frost and Fleminger (1968). The females were mostly 1.100 mm and 1.400 mm; the males, 0.82 mm long.

TABLE XII

Distribution of *C. arcuicornis* at the surface and in the 0-140 m layer by day and by night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute of hauling	55.4	60.9	33.7	33.8
Percent of samples containing the species	32.4	20.4	39.4	26.7

The highest concentrations of specimens during the EMCI occurred in Low Salinity waters or in mixed low salinity and Subantarctic Surface Water from 35° to 41°S lat. in the offshore stations. It was 5 times among the most numerous species in warm Low Salinity Water.

Table XII shows that it is a surface species with no vertical migration.

Clausocalanus parapergens Frost and Fleminger 1968

Material and occurrence: EMCI surface samples (number of specimens/min, in brackets) : 5(60), 6(30), 7(4770), 8(520), 9(5), 11(37.5), 13(9.3), 14(16), 17(30), 19(10), 26(40), 27(20), 29(40), 32(5600), 33(320), 34(480), 35(10), 37(30), 42(3.0), 43(260), 44(210), 45(2), 46(60), 47(3440), 48(91), 49(16), 54(77), 57(9), 58(1), 60(5), 72(3), 73(71), 77(420), 78(1), 82(1.1), 83(10), 84(20), 85(1), 86(20), 87 (100), 98(100), 101(10). EMCI samples taken from 0 to 140 m: 2 (30.1), 4(146.1), 5(26.1), 6(17.8), 7(117.8), 8(0.2), 9(196), 10(20), 12(58.7), 14(152), 16(568), 17(169), 19(7.6), 22(7.0), 24(7.6), 25 (0 7), 26(6.9), 27(3.0), 28(53.7), 29(46), 30(23), 31(3), 32(0.7), 33 (35.4), 34(6), 35(20), 36(5), 37(6), 42(115.2), 43(21.4), 44(7.8), 46(13.8), 47(55.3), 48(19.2), 49(2.3), 50(0 7), 53(12.7), 56(3.0), 57(1.5), 58(2.8), 60(2.6), 61(95.3), 62(5.7), 63(153.8), 64(545),

72(23.8), 73(3.9), 74(492.3), 78(0 7), 79(0.1), 82(13.0), 83(18.7), 84(3.6), 95(0.8). "Eltanin" samples 60, 94, 98, 170, 171, 172, 176, 186, 189, 191, 192, 194, 195, 200, 201, 215.

Remarks: The species was more frequent and numerous in the northern part of the area surveyed during the EMCI from 30°S lat. to about 36°S lat. The lengths observed were in the females: 0.95 mm (4), 1.1 mm (3), 1.245 mm, 1.250 mm, 1.284 mm, 1.292 mm, 1.300 mm (3), 1.400 mm, 1.65 mm (9), 1.61 mm; in the males: 1.034 mm in temperature 15°C or less, 1.092 mm, 1.000 mm.

TABLE XIII

Distribution of *C. parapergens* at the surface and in the 0-140 m layer by day and by night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute of hauling	32.6	392.5	660.5	47.2
Percent of samples containing the species	29.7	61.2	51.2	58.9

The above table shows that *C. parapergens* migrates to the surface at night and concentrates in the 0-140 m layer by day.

It was the most numerous and frequent *Clausocalanus* species off Chile. In Warm Surface Water it was amongst the three most abundant copepods in 2 samples; in Subantarctic Water with Surface Warm Water it was among the most numerous in 4 samples; and in Subantarctic Water it was one of the most abundant copepods also in 4 samples. It was present in 59% of the samples of the 0-140 m layer and in 46% of the surface samples.

Clausocalanus furcatus (Brady 1883)

Material and occurrence: During the Marchile I expedition in the 140 m layer it was found at the stations: 4(161.5), 5(40), 6(5.0), 7(255.3), 8(23.2), 9(198), 10(829.9), 12(243.6), 13(680.3), 14(2818.6), 15

(841.6), 16(280), 17(492), 19(338), 24(30 7), 25(17.1), 26(2.3), 27 (6.0), 28(153.8), 29(328.0), 30(192.3), 31(39.2), 32(35.7), 33(15.3), 34(3.8), 35(66.6), 36(0.7), 37(1), 39(12.5), 42(46.1), 43(7.1), 44 (269.2), 45(18.8), 47(1.5), 53(0.9), 55(2.1), 56(0.7), 57(0 7), 58 (4.3), 59(30 7), 60(46.6), 61(72.6), 79(0.2), 82(0.7), 84(7.2), 85 (15.3), 86(7.1), 100(38.4), 101(53.3), 102(20). At the surface it was caught at stations: 7(1280), 8(1880), 9(1247.5), 10(2747.5), 11 (1885), 12(1570), 13(126.3), 14(149.6), 16(460), 17(380), 19(320), 25(2), 26(240), 27(170), 28(13200), 29(2630), 30(700), 31(6.0), 32 (2960), 33(1350), 34(1020), 35(620), 36(42), 43(30), 44(300), 45 (252), 46(250), 47(40), 49(2), 57(27), 58(9 0), 60(10), 84(140), 85 (11), 86(20), 88(3), 100(4), 101(510), X_3(10). "Eltanin" samples 28, 29, 33, 43, 45, 49, 53, 57, 60, 69, 81, 85, 89, 94, 186, 188, 191, 194.

Remarks: This species was recognized from the description of *C. furcatus* by Rose (1932) and Giesbrecht (1892). Frost and Fleminger (1968) have published a revision of the genus. The species *C. furcatus* did not suffer splitting.

C. furcatus was very numerous relatively to other copepods during the Marchile I expedition in the Northern part of the region surveyed (Map 13). At the surface the percentage of *C. furcatus* relatively to other copepod species was larger than 40% in 7 samples. It was less than 10% in 13 samples. Its frequency was: 46% in the EMCI surface samples and 52.6% in the 0-140 m layer samples. In this layer the percentage of *C. furcatus,* relatively to other species, rarely reached high numbers (in 24 samples it was less than 10%, in 13 samples it was between 10% and 20% and only twice it was above 20%).

TABLE XIV

Distribution of *C. furcatus* during the day and the night at the surface and in the 0-140 m layer (Marchile I Expedition)

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute of hauling	502	1198.9	128.9	226.8

From Table XIV it is clear that *C. furcatus* is a surface species, with a greater concentration in this layer at night.

Numbers exceeding 1000/min (in 9 samples) and 100/min (in 8 samples) occurred in water with more than 17°C at the surface, thus, in Warm Surface Water. Three times only the catch in warmer water yielded less than 50 specimens/min. The species was amongst the 3 most abundant copepods in 18 samples of Subantarctic Water covered by Warm Surface Water. It was 11 times amongst the most numerous copepods in samples.

C. furcatus is therefore better adapted to a warmer environment. Its concentration in the northern part of the area surveyed is explained by the higher temperatures of the water in that region (Map 13).

Samples near to the coast rarely contain the species in high numbers. It seems to prefer the oceanic environment. In the "Eltanin" surface samples it also occurred at stations 28, 29, and 33 and other stations off Colombia and Peru in Coastal, Tropical, Equatorial Subsurface, and in Subtropical Surface waters up to latitudes off the North of Chile. In samples of Subantarctic Surface Water the species was found, at night, between 30° and 33°S. The samples taken further South still contained *C. furcatus,* but rarely, and in small numbers or in bad conditions.

TABLE XV

Distribution of adult and juvenile *C. furcatus* at the surface and in the 0-140 m layer by day and by night

Layer sampled		Surface		0-140 m	
Time		Day	Night	Day	Night
Average n.° of specimens per min of hauling	Females	54	155	12	114
	Copepodites	49	54	12	17
	Males	63	23	3	3

The data above lead to the following conclusions: 1) the females migrate to the surface at night; 2) the males concentrate at the surface during the day and remain there also during the night; 3) the females specially and the copepodites are also found in subsurface layers.

Clausocalanus Copepodites

Young Clausocalani were very frequently present and not always identified to species. Stations 10(890), 12(642), 19(63), 24(21.4), 25 (21.4), 26(2.3), 27(76), 28(115), 29(307), 36(5.7), 45(8.5), 61(84.6), 81(38.4), 84(11.8), 88(23), 101 (53.3), and 102(50) had *Clausocalanus* copepodites in the 0-140 m layer; stations 8(3870), 9(277.5), 17 (380), 22(30), 27(140), 32(1520), 44(490), 45(300), 47(1680), 60 (122), 63(3), 82(1.1), 84(70), 87(200), 98(40), 100(21), 102(90), 105(1), 109(1), 111(1) and 112(2) had copepodites at the surface.

The largest number of copepodites was also found in waters warmer than 17°C (18/min to 3,870/min). In the 0-140 m layer they ranged from 0.2/min to 11575/min. From the data it seems that the young *Clausocalanus* are in the deeper layers during the day and at night they move to the surface, as about only half of the number found at the surface was collected in the 0-140 m upper layer.

Ctenocalanus vanus Giesbrecht 1888

It was found at the following EMCI stations in 0-140 m layer (n.° of specimens per minute in brackets): 2(12.9), 7(19.6), 12(6.9), 13 (8.3), 50(0.7), 104(1.8) It occurred at the surface EMCI stations: 2(0.5), 78(1).

Remarks: A very common and numerous species on the Atlantic side of South America (Björnberg, 1963) and in the Antarctic (Farran, 1929; Bradford, 1971). It was rather rare during the Marchile I expedition. It was collected in larger number at night than during the day. The numbers per minute varied from 0.5 to 16.0/min. It was not found during the Marchile II expedition (see Vidal, 1966) nor was it present in the "Eltanin" samples taken off Chile, Peru and Colombia. Off North America it was numerous in the Pacific surface waters (Fleminger, 1964).

Drepanopus forcipatus Giesbrecht 1888

Material and occurrence: It was found at the following EMCI stations in the 140 m upper layer (number of specimens per min in brackets): 4(7.6), 6(2.5), 14(2.4) 15(20.8), 20(100), 39(12.5), 48(0.7), 50 (0.7), 52(2.7), 53(10), 58(4.3), 61(4.6), 62(0 7), 63(1638.4), 64

(1000), 66(358.3), 68:69(1836.8), 70(143.7), 72(31.5), 73(1.4), 74 (3438.4), 75:76(756.2), 77(15240), 78(93.8), 79(33), 80(3815.3), 81 (2684.6), 82(41.5), 83(6.2), 88(7 6), 89(1.5), 90(137.6), 91(8337.5), 92(450), 93:94(1760), 95(17.5), 97(7.6), 99(6.6), 104(10.9), 105 (26.9), 106(33), 109(1710), 111(180), 112(2). At the surface it occurred at EMCI stations: 34(10), 42(1), 49(1), 61(2), 64(9), 68:69 (7), 70(750), 73(2), 74(1240), 77(45), 78(11), 79(3), 80(13020), 81 (1158), 82(0.3), 83(1), 86(10), 87(6100), 92(770), 93:94(11), 95(4), 98(1600), 102(1), 109(2.7), X_2(140), X_3(40). "Eltanin" samples: 170 and 201.

Remarks: It was found in 26 surface samples and in 44 samples of the 0-140 m layer, of the Marchile I expedition. This is an indication that *Drepanopus* lives preferentially in the subsurface layer. It occurred at the surface in 7 samples containing low salinity water near or just off the coast and in this environment it showed the higher number per minute (13020/min). It was caught 3 times in each of the other environments. *D. forcipatus* was amongst the three most numerous copepods in 13 samples from Low Salinity and Subantarctic Waters. It was twice one of the most abundant copepods in Low Salinity Waters; and 5 times amongst the most numerous copepods in Subantarctic Surface Water.

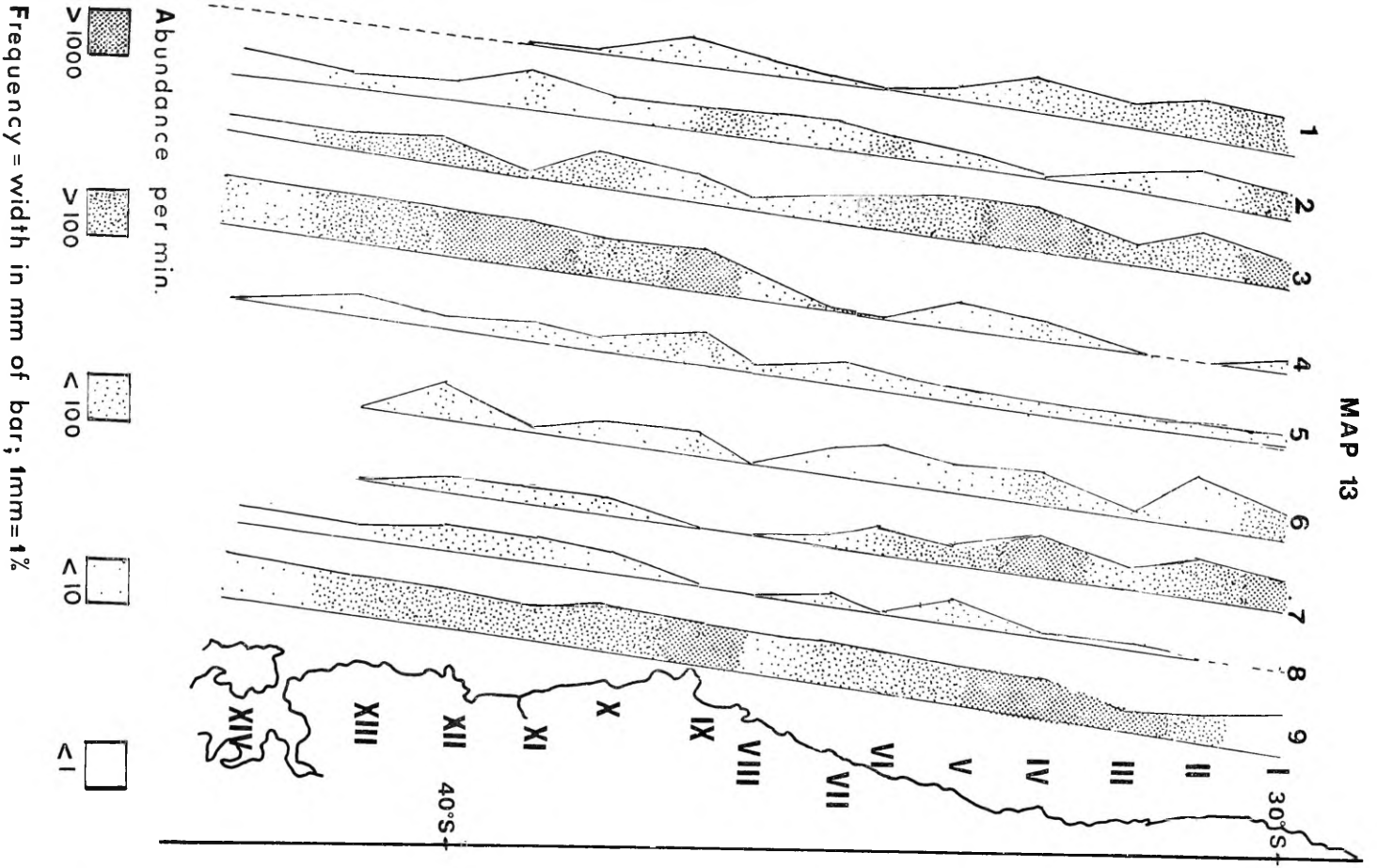
TABLE XVI

Distribution of *D. forcipatus* in the surface and in the 0-140 m layers by day and by night

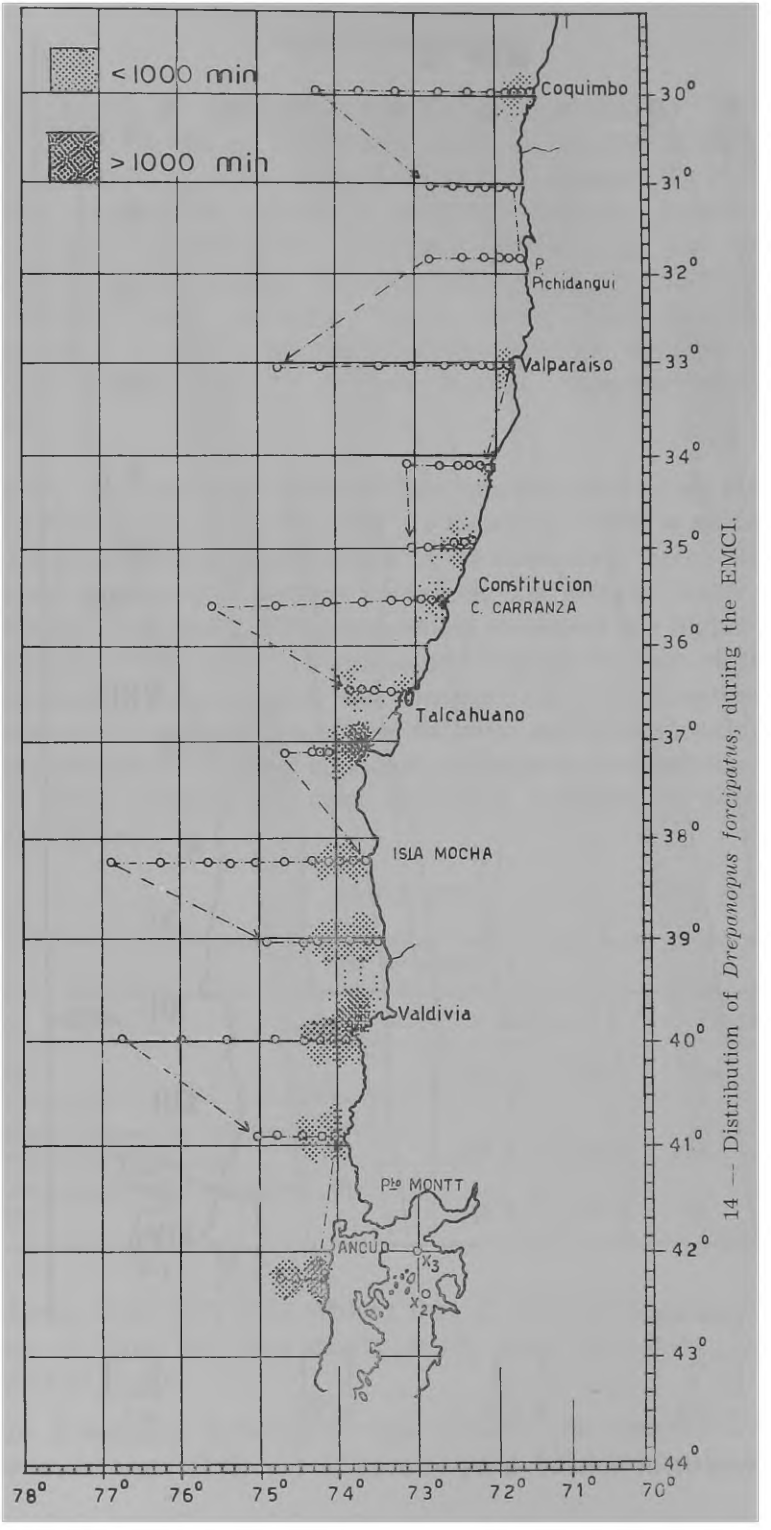
Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute of hauling	304.8	1439.0	834.1	1026.3
Percent of samples containing the species	29.4	30 6	51	41

From Table XVI it is evident that *D. forcipatus* migrates to the surface at night, but lives mostly in the subsurface layer during the day and at night.

In 6 samples, in which it was present, the temperature of the water was above 17°C. In 10 samples the temperature varied from



13 — Abunlance (represented by different shadowing) and frequency (= width of the bars) of some of the most important species of copepods found off Chile during the EMCI. The width of the bars was drawn based on the frequency (measured in mm) of the species in the samples taken along each leg (I-XIV) of the treck of the EMCI. The numbers used indicate species — n.º 1 = *Coryceaus dubius*, n.º 2 = *Acartia tonsa*, n.º 3 = *Nannocalanus minor*, n.º 4 = *Centropages brachiatus*, n.º 5 = *Oithona similis*, n.º 6 = *Clausocalanus pdrapergens*, n.º 7 = *Clausocalanus furcatus*, n.º 8 = *Clausocalanus ingens*, n.º 9 = *Paracalanus indicus*.



14 — Distribution of *Drepanopus forcipatus*, during the EMCI.

12.1°C to 15.95°C. The species seems to prefer colder and coastal waters. From station 78 to 112 the number of *Drepanopus* per sample was, 9 times out of 15, higher than 20% of the total number of copepods. The percentage of *Drepanopus* relatively to other copepods at the EMCI stations 91 and 93-94 was more than 60 in the upper 140 m layer.

From the map it is evident that *D. forcipatus* is concentrated in the southern half of the region surveyed and in the area near to the coast or just off it, thus confirming former observations (Vervoort, 1957).

In the "Eltanin" surface samples it was present by day from 33°S to 46°S where it was also caught at night (station 170).

D. forcipatus seems to be characteristic of southern waters. It was not collected during the Marchile II expedition off the North of Chile (see Vidal, 1966), but occurs off Argentine in the Atlantic off South America (Ramirez, 1969).

Discussion: Besides *Ctenocalanus vanus* Giesbrecht, 1888, *Drepanopus forcipatus* Giesbrecht, 1888 and *Drepanopsis frigidus* Wolfenden 1911, the following species of *Clausocalanus* were registered (Frost and Fleminger, 1968) off S. America: *C. mastigophorus* (Claus 1863), from about 30°N to 40°S off America in the Pacific; *C. lividus* Frost and Fleminger (1968), with a biantitropical distribution in the Pacific, and occuring between 30° and 40°S off Chile; *C. ingens* Frost and Fleminger 1968, found only in the Southern Hemisphere, from about 32° to 40°S; *C. arcuicornis* (Dana 1849), from 33°N to 40°S off America; *C. jobei* (Frost and Fleminger 1968), from 33°N to 33°S, neritic; *C. pergens* Farran 1926 (found off America along the Equator, and from 32°S to 40°S); *C. parapergens* Frost and Fleminger 1968 (from 33°N to 40°S); *C. furcatus,* from 33°N to 34°S; and *C. brevipes* Frost and Fleminger 1968, from 45°S into Antarctic Waters. Frost and Fleminger state further that *mastigophorus, arcuicornis, parapergens,* and *furcatus* are circumglobal and the most wide-ranging throughout tropical regions. *C. brevipes* is considered subantarctic; and *C. laticeps,* antarctic subantarctic. *C. ingens* is warm-temperate (Frost & Fleminger, 1968).

The Marchile I expedition data added knowledge on the abundance of these species in the South-East Pacific, off South America.

The most numerous *Clausocalanus* in warm and warmed waters was *C. furcatus* and the most numerous species off Chile was *C. paraper-gens* in Subantarctic Surface waters. *C. ingens* was frequent but not numerous.

FAMILY SPINOCALANIDAE

It is characterized by bathypelagic habits, the absence of rostrum and of female fifth legs and by often incomplete fusion of the head to the thorax, and of thoracic segments 4 and 5. This family is represented in the samples studied by the genus *Spinocalanus* and the genus *Mimocalanus*. The species found were:

Spinocalanus abyssalis Giesbrecht 1888 in "Eltanin" sample 53; 215;

Spinocalanus magnus Wolfenden 1904 in "Eltanin" sample 215;

Spinocalanus parabyssalis Park 1970 in EMCI 0-140 m samples 10(5 7/min), 47(0.7/min), 73(0.2/min);

Spinocalanus spinosus Farran 1908 in "Eltanin" sample 97;

Mimocalanus cultrifer Farran 1909 in EMCI 0-140 m samples 46 (0.7/min), 68:69(0.9/min), 79(0.3/min), 90(0 7/min), 99(70/min).

This species is probably quite numerous in the plankton, but rarely caught because of its small size.

Spinocalanus sp. was found in the "Eltanin" samples 52, 87, 175, 325.

FAMILY AETIDEIDAE

The EMCI and "Eltanin" samples contained the following species, accompanied by the number of the samples in which they were found and, when possible, the number of specimens per minute of hauling (*Aetideus armatus, Euaetideus bradyi, Gaidius pungens, Euchirella pulchra* will be treated with more detail further on):

Aetideopsis multiserrata Sars 1903 — Eltanin 50, 53, 75, 215, 325;

Aetideopsis sp. — Eltanin 169, 172;

Young Aetideidae — Eltanin 52, 71, 169, 175;

Snelliaetideus arcuatus Vervoort 1949 — Eltanin 97;

Chiridius armatus (Boeck 1872) — Eltanin 75;

Chiridius gracilis Farran 1906 — Eltanin 50, 52;

Chiridius obtusifrons (Sars 1900) — Eltanin 216;

Chiridius poppei Giesbrecht 1892 — Eltanin 175, 215;

Chiridius sp. — EMCI 14, 0-140 m (5/min);

Chiridiella copepodite — Eltanin 175, 326;

Chiridiella macrodactyla Sars 1907 — Eltanin 53;

Gaidius sp.[1] — EMCI 99, 0-140 m (6.6/min);

Gaidius sp.[2] — Eltanin 50, 53;

Gaidius sp.[3] — Eltanin 326;

Gaidius affinis Sars 1905 — Eltanin 52, 97, 165, 215, 313, 325, 326;

Gaidius brevicaudatus (Sars 1907) — Eltanin 215;

Gaidius brevispinus (Sars 1900) — Eltanin 34, 52, 75, 213, 215, 325;

Gaidius intermedius Wolfenden 1905 — Eltanin 72, 75;

Gaidius robustus (Sars 1905) — Eltanin 75, 175, 326;

Gaidius tenuispinus Sars 1900 — Eltanin 53;

Gaetanus sp.[1] — Eltanin 53, 216;

Gaetanus sp.[2] — Eltanin 97, 175;

Gaetanus antarcticus Wolfenden 1905 — Eltanin 53, 61, 97, 175, 215, 326;

Gaetanus curvicornis Sars 1905 — Eltanin 326;

Gaetanus divergens Wolfenden 1911 — Eltanin 75, 99;

Gaetanus hamatus Scott 1909 — Eltanin 53;

Gaetanus kruppii Giesbrecht 1903 — Eltanin 52, 53, 61, 99, 169;

Gaetanus latifrons Sars 1905 — Eltanin 53, 61, 75, 165;

Gaetanus microcanthus Wilson 1950 — Eltanin 53;

Gaetanus miles Giesbrecht 1888 — EMCI 16, 0-140 m, (24/min); Eltanin 53, 61, 72, 215;

Gaetanus minor Farran 1905 — EMCI 7, 0-140 m (1.7/min);

Gaetanus pileatus Farran 1903 — Eltanin 34, 165;

Gaetanus recticornis Wolfenden 1911 — Eltanin 61;

Gaetanus simplex Brodsky 1950 — Eltanin 52;

Bryaxis brevicornis Boeck 1872 — Eltanin 216;

Euchirella bella Giesbrecht 1888 — Eltanin 34, 52;

Euchirella brevis Sars 1925 — Eltanin 34;

Euchirella curticauda Giesbrecht 1888 — Eltanin 97, 165;

Euchirella formosa Vervoort 1949 — Eltanin 165;

Euchirella galeata Giesbrecht 1888 — Eltanin 61;

Euchirella rostrata (Claus, 1866) — Eltanin 169;

Euchirella rostromagna Wolfenden 1911 — Eltanin 61, 172, 176, 184, 325;

Euchirella similis Wolfenden 1911 — Eltanin 33, 61, 75, 97, 165, 169, 175, 212, 213, 215, 326; EMCI (0-140 m) — 13(19 4), 41(3.7), 83(31), 84(0.9), 99(26.6), 100(69.2) and EMCI surface 41(60);

Euchirella copepodites — EMCI 2(1.2), 6(15.3), 7(8.2), 14(5.2), 28(22.9), 29(23), 37(3), 42(15.3), 46(2.3), 66(8.1), 88(7.6);

Pseudeuchirella cryptospina Sars 1905 — Eltanin 75, 53;

Pseudeuchirella divaricata Sars 1903 — Eltanin 97;

Pseudeuchirella dubia (Sars 1905) — Eltanin 175;

Pseudeuchirella hirsuta (Wolfenden 1911) — Eltanin 97, 99, 165, 175, 213, 215, 313, 326;

Pseudeuchirella mawsoni Vervoort 1957 — Eltanin 97, 99, 169, 175, 212, 213, 215, 326;

Pseudeuchirella notacantha Sars 1905 — Eltanin 216;

Pseudeuchirella obtusa Sars 1905 — Eltanin 97, 215;

Pseudeuchirella polyspina Brodsky 1950 — Eltanin 175;

Pseudeuchirella pustulifera Sars 1905 — Eltanin 165, 213, 325;

Pseudeuchirella semispina Vervoort 1949 — Eltanin 52;

Pseudeuchirella squalida Grice and Hülsemann 1967 — Eltanin 52, 61, 99;

Undeuchaeta intermedia A. Scott 1909 — EMCI 83 (0-140 m); Eltanin 65, 215, 325;

Undeuchaeta major Giesbrecht 1892 — Eltanin 61, 97, 175, 215;

Undeuchaeta plumosa (Lubbock 1856) — Eltanin 60, 75, 165, 212, 213, 215; EMCI 27(0.7), 82(6.2), 84(0.9);

Undeuchaeta copepodites — EMCI 12(0 7), 13(19.4), 43(7.1), 99(6.6);

Chirundina sp. — EMCI 34(1.5), 86(7.1);

Pseudeuchaeta brevicauda Sars 1905 — Eltanin 53, 175, 215;

Valdiviella oligarthra Steuer 1904 — Eltanin 53, 175;

Valdiviella insignis Farran 1909 — Eltanin 34, 52, 53, 97, 99, 175, 215, 325;

Valdiviella brevicornis Sars 1905 — Eltanin 175;

Valdiviella minor Wolfenden 1911 — Eltanin 52, 175;

Valdiviella sp. — Eltanin 326.

The Aetideidae are usually deep-water species. Those found with more frequency in the EMCI samples are sub-surface inhabitants which migrate to the 0-140 m layer at night and are then caught with surface living copepods. Among these are some species found at night in warmer surface layers such as the *Aetideus armatus, Euaetideus bradyi, Undeuchaeta* spp., *Gaidius brevispinus, Euchirella pulchra, Gaetanus miles, Gaetanus pileatus, Gaidius pungens,* and *Euchirella similis,* which are probably brought to the Peru-Chile region by the subtropical sub-surface counter-current, and during the night migrate vertically into the Subantarctic Surface Water.

The remaining species found off the West South America are bathypelagic and caught in samples collected from layers deeper than 200 m, mostly deeper than 1000 m, in Deep Water or Antarctic Intermediate Waters.

The most numerous and frequent aetideids were: *Aetideus armatus, Euaetideus bradyi, Gaidius pungens* and *Euchirella pulchra.*

E. similis which occurred always far out to sea at stations in the 0-140 m layer, varied in number from 0.9 to 69.2/min hauling at night. At the Marchile II expedition *E. bella* Giesbrecht 1888 was collected twice (Vidal 1966).

In the deep waters off Chile, from latitude 46°S to latitude 57°S, in samples, collected from 2000 to 0 m and 800 to 0 m, *P. hirsuta* was sometimes the dominant copepod in numbers and in biomass, in the macroplankton samples collected with the IKMWT, during the "Eltanin" cruises.

Aetideus armatus (Boeck 1872)

Material and occurrence: EMCI samples containing the species (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer: 4(69.2), 5(0.7), 6(15.3), 7(7.1), 8(0.2), 14 (2.4), 17(7.6), 19(7 6), 22(1.5), 27(0.7), 28(7.6), 29(7.6), 35(6.6), 36(3), 37(3), 39(25), 41(3.1), 42(30.7), 43(7.1), 44(53.8), 45(1.4), 46(4.6), 47(10.7), 48(17.6), 49(1.5), 50(1.4), 55(0 7), 56 (0.7), 60(0.6), 61(1.3), 62(8.5), 63(176.9), 64(118.2), 66(50), 68: 69(18.1), 70(18.7), 72(3.0), 73(2.7), 74(69.2), 77(40), 78(25.3), 79 (4.7), 80(7.6), 82(0.7), 83(18.7), 84(3.6), 90(2.3), 91(12.5), 97 (30.7), 99(26.6), 100(7 6), 107(10), 112(1). EMCI surface samples containing specimens of *A. armatus* (number per minute in brackets) 42(24), 48(4), 64(4.0), 77(2), 78(1), 84(10). Young *Aetideus* in EMCI sample: 25(1). "Eltanin" samples 36, 75, 160, 216, 215.

Remarks: It was present in 54 EMCI samples, collected by oblique hauls through the 0-140 m layer.

TABLE XVII

Distribution of *A. armatus* in the surface and 0-140 m layer by day and by night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute of hauling	—	10.2	29.2	44.6

It was caught at the surface by night at 6 stations. *A. armatus* is not a surface water species. It probably migrates down to deeper layers by day and during the night reaches the 0-140 m layer. Brodsky (1957) cites the species as belonging to the group present in the 0-50 m layer of the North Pacific eastern tropical waters. Fleminger (1967) reported its presence in the upper 140 m layer off the W. coast of N. America from 41°N to almost 20°S in quantities usually below 50/1000 m^3 of water, and near to the coast, where the numbers were higher. Vidal (1966) did not register its presence at the Marchile II expedition.

A. armatus was found with greater frequency and abundance between latitudes 34°S and 39°S, but it was also present up to latitudes 30°S and 42°20'S, off Chile during the Marchile I expedition. The greatest numbers of specimens (118.2/min and 176.9/min) were found at latitude 36°30'S. The highest numbers occurred near to the coast, confirming Fleminger's data.

There were females in 67% of the samples containing the species: in 46% there were juveniles, and males occurred only in 16%.

Euaetideus bradyi (A. Scott, 1909)

Material and occurrence: EMCI samples containing the species (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer: 2(2.3), 4(7.6), 6(35.3), 7(7.1), 8(1.2), 12 (1.9), 16(16), 17(7.6), 19(30 7), 26(0.7), 37(3), 45(1.4), 49(3.0), 56(3.8), 60(0.6), 70(6.25), 73(0.1), 81(15.3); and the EMCI surface samples: 13(0.8), 49(1), 102(1). Also in "Eltanin" samples 33, 34, 38, 50, 52, 53, 94, 160, 183, 209, 325.

Remarks: It occurred rarely both in the Marchile I and in the Marchile II expeditions (Vidal 1966). A deep water species, it was present in 18 samples collected through the 0-140 m layer and in 3 samples taken at the surface. Eight"Eltanin" samples contained the species mostly taken from deeper layers. The greatest numbers per minute (35.3 and 30.7) occurred at latitudes 30° and 31°S.

E. bradyi seems to migrate up into the 0-140 m layer during the day, where it was caught in an average of 10.02/min. At night it was found in this layer in an average number of 6.20/min.

In the "Eltanin" samples *E. bradyi* was found from latitude 32°27'S southwards off Chile.

Gaidius pungens (Giesbrecht 1895)

Material and occurrence: EMCI samples containing the species (numbers out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer: 7(3.5), 12(17 7), 13(2.7), 14(16), 26(0.7), 27(3.0), 28(15.3), 29(76.9), 33(7.6), 34(13.8), 43(28.5), 44(15.3), 55(0 7), 56(1.5), 57(1.5), 60(14.6), 73(0.18), 78(15.3), 84(0.9), 86 (57.1), 99(6.6). "Eltanin" samples: 53, 97, 98, 99, 165, 169, 195, 212, 215, 216, 272, 302, 313, 325.

Remarks: *G. pungens* is a deep living species. At night it migrates to the 0-140 m layer. It was usually collected in the oceanic stations. It was not collected south of 39°10'S during the Marchile I expedition.

In the "Eltanin" samples caught during the night it was present also to about 63°S.

Euchirella pulchra (Lubbock 1856)

Material and occurrence: EMCI samples taken in the 0-140 m layer (number per min in brackets): 2(1), 7(14.2), 12(8.7), 13(125), 14 (13.3), 22(0.7), 27(4.6), 33(146.1), 34(8.4), 35(33.3), 42(246.1), 43(14.2), 44(61.5), 47(10.7), 48(13.8), 55(3.5), 56(6.9), 57(2.3), 60(4.6), 73(0.8), 78(0.7), 80(38.4), 84(1.8), 86(21.4), 100(30.7), 112(2). EMCI surface samples: 14(0.3), 46(10), 48(5). "Eltanin" samples: 61, 65, 75, 197, 198, 208, 212.

Young *Euchirella* occurred in the following 0-140 m EMCI samples: 2(1.2), 6(15.3), 8(0.2), 10(17.3), 14(5.2), 17(7.0), 28(22.9), 29 (23.0), 32(2.1), 37(3.0), 42(15.3), 43(7.1), 61(0.6), 64(18.2), 66 (8.5), 68(9.0), 83(0.9), 84(0.9), 88(7.6), 99(26.6), 100(69.2), 101 (6.6), 102(20). At the surface it was present in samples: 14(0.1), 17(10), 25(3.0). "Eltanin" samples: 61, 65, 75, 170, 191, 195, 197, 198, 208.

E. pulchra occurred at the surface during the day at station 46 (10/min) and at night at station 14(3.3/min) and 48(5/min). It also occurred in the 140-0 m layer at night at 21 stations, varying in number between 0.3/min and 246.1/min.

E. pulchra was present in the "Eltanin" samples at the surface at night from 53°S to about 43°S. It seems to prefer warmer and oceanic waters.

Young *Euchirella* occurred in the 0-140 m layer in 23 samples varying from 0 6 to 66/min. At the surface they were found in 3 samples.

FAMILY EUCHAETIDAE

Three species were found in the EMCI samples: *Euchaeta marina* (Prestrandrea 1833), *Euchaeta acuta* Giesbrecht 1892, *Paraeuchaeta weberi* A. Scott 1909.

Euchaeta marina occurred in the EMCI samples 5(27/min) and 6(28/min) taken from the 0-140 m layer. It was more frequent in the Marchile II expedition appearing in 40.5% of the samples (Vidal 1966) taken off the North of Chile between 18°29'S and 20°48'S. "Eltanin" samples, 29, 33, 34, 36, 38, 43, and 45 also contained the species. They were collected in Coastal, Tropical, Equatorial Subsurface and Subtropical Surface Water. It was one of the most numerous species off Colombia, during the day in two surface hauls at Station 29, and off Peru southwards to latitude 15°S. It is characteristic of warm oceanic waters. The "Eltanin" samples 33, 38, also contained *Euchaeta longicornis*.

Euchaeta acuta was present in EMCI samples (number of specimens per minute in brackets) from the 0-140 m layer 7(7.1), 32(1.4), 37(3), 42(76.9), 46(1.5), 54(0.8); "Eltanin" sample 69 also contained the species. It was more frequent than *E. marina* during the Marchile I expedition, and seems better adapted to cooler environments than the first. Vidal (1966) registered it off the North of Chile with a frequency of 2.4% in the samples collected by the Marchile II expedition.

Paraeuchaeta weberi occurred in EMCI samples from the 0-140 m layer 12(4.2), 13(52.6), 14(42.7), 27(6.1), 33(7.6), 60(0.6), 73 (0.4) and in the surface sample 48(1), all taken at night off the northern part of the area sampled. A deep-water copepod, it was not mentioned in Vidal's (1966) report of the Marchile II expedition.

Many young Euchaetidae were collected during the day in the 140-0 m layer (0 6 to 50 per min) at stations 2, 4, 10, 17, 24, 37, 50,

47, 53, 61, 102, and at night in the same layer (0.07 to 10 per min) at stations 7, 19, 26, 107. Juveniles occurred at the surface at night (10/min). The frequency and number of young Euchaetidae diminishes inversely to the latitude.

Yamanaka (1969, 1970), based on "Eltanin" samples, summarized the distribution of the Euchaetidae off South America on the Pacific side in the following conclusions: 1) the species which seem to predominate in the North are *Paraeuchaeta sarsi, P. pseudotonsa* and *P. weberi;* 2) in the South *P. antarctica, P. rasa, P. norvegica, P. barbata, P. scotti* and *P. biloba;* 3) *P. barbata, P. norvegica, P. antarctica* and *P. rasa* did not occur in surface waters, and as they predominate in the South region, they are probably cryophil and stenothermic; 4) the Deep Inferior Water contains the greatest number and variety of species during Winter. Yamanaka (1969, 1970), found the following species, besides those already mentioned above, in the region surveyed (13°15'S to 67°23'S lat.), off South America in the Pacific: *Euchaeta marina, E. longicornis, Paraeuchaeta farrani, P. hanseni, P. similis, P. tonsa, P. malayensis, P. aequatorialis, P. bisinuata, P. birostrata, P. californica, P. confusa, P. gracilis, P. comosa, P. polita, P. glacialis,* and *P. birostrata.*

FAMILIES PHAENNIDAE and SCOLECITHRICIDAE

The following representatives of Phaennidae and Scolecithricidae were found in EMCI and "Eltanin" samples (numbers out of brackets) taken off West South America. The number of specimens caught per minute corresponds to the number in brackets; op. 2 and op. 1 refer, the first to samples taken in the 0-140 m layer, and the second, to collections at the surface.

Phaenna spinifera Claus 1863 — EMCI, op. 2, 79(0.1), 82(0.7), 85(7.6), 112(1);

Phaenna sp. — EMCI, op. 1, 84(10);

Xanthocalanus calaminus Wolfenden 1911 — "Eltanin" 97;

Xanthocalanus muticus Sars 1905 — "Eltanin" 175;

Xanthocalanus sp. — EMCI, op. 2, 112(1);

Onchocalanus magnus Wolfenden 1906 — "Eltanin" 326;

Onchocalanus trigoniceps Sars 1905 — "Eltanin" 97, 99, 175, 326;

Cornucalanus chelifer (I. C. Thompson 1903) — "Eltanin" 65, 75, 97, 99, 165, 175, 213, 215, 325;

Cornucalanus robustus Vervoort 1956 — "Eltanin" 97, 313, 99;

Cornucalanus simplex Wolfenden 1905 — "Eltanin" 53;

Cephalophanes frigidus Wolfenden 1911 — "Eltanin" 52;

Scaphocalanus affinis (Sars 1907) — EMCI, op. 2, 14(5.2), "Eltanin" 61, 182, and 313;

Scaphocalanus brevicornis (Sars 1903) — "Eltanin" 50, 52, 215, 302; EMCI, op. 2, 34(1.5);

Scaphocalanus curtus (Farran 1926) — EMCI, op. 2, 6(7.6), 7 (7.1), 10(3.8), 22(0.7), 26(3), 27(0.7), 28(7.6), 33(7.6), 34(0 7), 37(1.0), 42(23), 43(15.3), 45(2.3), 47(5.3), 48(0.7), 55(5.7), 56 (1.5), 60(1.3), 63(15.3), 64(27.3), 72(3.0), 73(0.2), 78(0 7), 80 (7.6), 83(6.2), 99(6.6), 101(6 6), 112(1); "Eltanin" 61;

Scaphocalanus echinatus (Farran 1909) — "Eltanin" 169, 171, 172, 175, 195, 198, 209, 213, 215; EMCI, op. 2, 6(33.3), 7(1.7), 12 (17.6), 13(58.3), 14(18.6), 27(1.5), 29(61.5), 34(3.8), 42(100), 43 (28.5), 55(3.5), 57(1.5), 66(16.6), 78(5.3), 79(0.2), 84(1.8), 86 (14.2), 99(33.3); EMCI, op. 1, 48(3), 58(0.1);

Scaphocalanus longifurca (Giesbrecht 1888) — EMCI, op. 2, 12 (0.2), 14(2.4), 26(3.1), 36(0.7), 42(138.4), 47(0.7); EMCI, op. 1, 25(1); "Eltanin" 52, 53, 212;

Scaphocalanus magnus (T. Scott 1894) — "Eltanin" 34, 52, 53, 61, 65, 97, 99, 165, 175, 213, 215, 313, 325; EMCI, op. 2, 6(5), 33 (30.7);

Young *Scaphocalanus* — EMCI, op. 1, 7(50), 85(25); EMCI, op. 2, 7(75.7), 14(2.4), 16(24.0), 22(0.7), 28(30.7), 47(0.7), 60(1.3), 73(0 4), 80(7.6), 83(6.2); "Eltanin" 172, 182, 184, 186, 191, 214;

Scolecithrix bradyi Giesbrecht 1888 — "Eltanin" 33, 34, 52, 53, 69; EMCI, op. 2, 4(7.6), 6(15.3), 7(3.5), 8(1.6), 13(5.5), 16(8.0), 17(7.6), 19(15.3), 22(1.5), 32(2.1), 36(0.7), 37(2.0), 39(37.5), 41 (1.2), 42(30.7), 43(14.2), 46(23), 48(2.3), 56(1.5), 60(0.6), 64

(18.2), 78(0 7), 79(0.1), 85(461.0); EMCI, op. 1, 25(1), 46(10), 48(1);

Scolecithrix danae (Lubbock 1856) — "Eltanin" 29, 33, 34, 209; EMCI, op. 2, 12(5.0), 15(4.2), 44(7.6), 45(0 7), 55(0.7), 82(0.7);

Scolecithricella abyssalis (Giesbrecht 1892) — "Eltanin" 33, 94, 209; EMCI, op. 2, 12(0.4), 14(8.0), 19(15.3), 22(0.7), 36(0.7), 41 (1.2), 47(0.7), 64(18.2), 73(0.1); EMCI, op. 1, 49(1), 103(10.0);

Scolecithricella (*Amalothrix*) *arcuata* Sars 1920 — "Eltanin" 52;

Scolecithricella (*Amalothrix*) *curticauda* A. Scott 1909 — "Eltanin" 53;

Scolecithricella dentata (Giesbrecht 1892) — "Eltanin" 61, 84, 169, 213; EMCI, op. 2, 7(5.3), 13(63.1), 14(10.4), 27(0.7), 29(23), 47(0.7), 57(0.7), 66(25.0), 72(1.5), 73(0.1), 80(0 07), 86(7.1);

Scolecithricella (*Amalothrix*) *dentipes* Vervoort 1951 — "Eltanin" 52, 61, 83, 97, 165, 213 and 215;

Scolecithricella (*Amalothrix*) *emarginata* (Farran 1905) — "Eltanin" 208(?);

Scolecithricella glacialis (Giesbrecht 1902) — "Eltanin" 98;

Scolecithricella marginata (Giesbrecht 1888) — EMCI, op. 2, 42 (69.2);

Scolecithricella minor (Brady 1883) — EMCI, op. 2, 2(15.3), 28 (7.6); "Eltanin" 85, 98;

Scolecithricella ovata (Farran 1905) — "Eltanin" 209, 302; EMCI, op. 2, 39(12.5), 48(3.8), 60(2.0);

Scolecithricella (*Amalothrix*) *obtusifrons* Sars 1905 — "Eltanin" 326;

Scolecithricella (*Amalothrix*) *polaris* (Wolfenden 1911) — "Eltanin" 52, 175;

Scolecithricella (*Amalothrix*) *propinqua* Sars 1920 — "Eltanin" 43, 175, 215, 313;

Scolecithricella (*Amalothrix*) *robusta* (T. Scott 1863) — "Eltanin" 38, 53, 94, 175, 169, 215;

Scolecithricella tenuiserrata (Giesbrecht 1892) — EMCI, op. 2, 83(6.2);

Scolecithricella (*Amalothrix*) *valida* (Farran 1909) — "Eltanin" 53, 52;

Scolecithricella (*Amalothrix*) *valens* (Farran 1926) — "Eltanin" 50, 53;

Scolecithricella vittata (Giesbrecht 1892) — EMCI, op. 2, 55(1.4), 6(5);

Racovitzanus antarcticus Giesbrecht 1902 — EMCI, op. 2, 83(37.4); "Eltanin" 97, 182, 302, 313;

Scottocalanus copepodites — EMCI, op. 2, 34(1.5), 57(0.7);

Scottocalanus australis Farran 1936 — EMCI, op. 2, 13(2.7);

Scottocalanus persecans (Giesbrecht 1892) — "Eltanin" 75, 213; EMCI, op. 2, samples 12(0.4); 14(8);

Scottocalanus terranovae Farran 1929 — "Eltanin" 67;

Scottocalanus sp. male — "Eltanin" 67;

Lophothrix frontalis Giesbrecht 1895 — "Eltanin" 61, 63, 65, 75, 165, 213, 175; EMCI, op. 2, 7(1.7), 12(0.2), 14(8), 27(0.7), 73(0.1);

Lophothrix humilifrons Sars 1905 — "Eltanin" 53, 48;

Lophothrix quadrispinosa Wolfenden 1911 — "Eltanin" 175;

Lophothrix sarsi Wilson 1950 — "Eltanin" 175, 326;

Lophothrix similis Wolfenden 1911 — "Eltanin" 53, 97, 215.

Both Phaennidae and Scolecithricidae are deep-dwelling copepods. *Scaphocalanus curtus* was the most frequent species, present in 28 EMCI samples taken in the 0-140 m layer. The greatest frequency was registered from 31°40'S to 38°10'S. The highest numbers per minute of hauling were 27.3 and 15.3. The next most frequent species was *Scolecithrix bradyi* usually a warm water inhabitant, present in 24 EMCI samples taken in the 0-140 m layer and in 3 samples from the surface. It occurred mostly from 30° to 35°S off Chile in numbers up to 461/min (in warmer water). *Scaphocalanus echinatus* was found in 18 EMCI samples from the 0-140 m layer and in 2 EMCI samples from the surface. The 9 "Eltanin" samples in which it occurred were

collected between 34°S and 46°S. No special concentration of the species was observed. *Scolecithricella dentata* occurred in 12 EMCI samples and in 4 "Eltanin" samples from 30°S to 46°S. *Scolecithrix danae* was frequent in the samples from warmer waters off South America and appeared sometimes in more southern regions. *Scolecithricella abyssalis* was present in 3 "Eltanin" and in 11 EMCI samples taken off Peru and off Chile to about 41°S. The difference between this species and *S. glacialis* seems to be mostly the greater width of the fifth legs of the female and the different geographical distribution.

These deep-dwelling copepods are frequently surface dwellers in the Antarctic region. Many of the supposedly antarctic copepods really have a wide distribution. *Racovitzanus antarcticus* is found up to 38°S. Because of the bulk of its species and the abundance of its occurrence, the genus *Cornucalanus* may be of significance in the biomass of deep waters off Chile.

The presence of the Phaennidae and Scolecithricidae in a sample is usually an indication that it was collected in sub-surface or deep waters or in surface waters at night to which the species migrate from deeper layers.

The study of the limits of the variation of certain taxonomic characters in most of the *Scolecithricella* species treated in this work, is strongly indicated so as to solve the difficult problem of identifying the species correctly.

FAMILY CENTROPAGIDAE

The following *Centropages* occurred in the area sampled: *Centropages bradyi* Wheeler 1901, *Centropages brachiatus* Dana 1842, *Centropages furcatus* (Dana 1849), and *Centropages gracilis* (Dana 1849). Besides these Vidal (1966) registered *Centropages elegans* Giesbrecht 1895 during the Marchile II expedition.

The following samples contained the species found:

Centropages bradyi — in EMCI samples (number of specimens per minute in brackets) from the 0-140 m layer: 12(1.6), 15(8.3), 44(8.6), 45(2.1), 60(0.6), 61(2), 82(0 7), 84(3.6), 95(16.6), 97(7.6), 98(10), 99(13.3), 102(40), 103(6.6), 104(1.8), 105(0 7); in surface EMCI samples (number of specimens per minute in brackets): 9(6),

26(10.0), 60(3), 82(0.6), 84(20), 90(50), 101(20 0), 102(8), 103(100), 106(2), 111(1), and in "Eltanin" sample 176 taken from Warm Surface Water and from Coastal Water at the surface.

Centropages furcatus and *C. gracilis* occurred in the "Eltanin" sample 29 taken through warm Equatorial Surface and Subsurface Waters. The first, also in "Eltanin" sample 216.

Centropages brachiatus Dana 1842

Material and occurrence: EMCI samples (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer: 2(2.3), 4(7 6), 5(1), 6(15.3), 8(0.2), 10(1.9), 24(7.6), 25 (14.1), 30(7.6), 34(1.5), 39(37.5), 41(253.8), 42(7.6), 43(7.1), 49 (0.7), 50(0.7), 53(1.8), 57(3.8), 58(43.6), 60(8), 61(114), 62(15.7), 63(261.5), 64(254.5), 68:69(2918.1), 70(831.2), 72(8.4), 73(10.3), 74(8576.9), 75:76(35), 77(270), 78(9.2), 79(17.3), 80(715.3), 81 (253.8), 82(609.2), 83(600), 84(16.3), 86(7.1), 88(1515.3), 89(21.5), 90(245.3), 91(875), 92(333.3), 93:94(50), 95(50), 96(7.6), 97(123), 98(1010), 99(266.6), 101(160), 102(60), 103(94.4), 104(316.3), 105 (70.7), 106(39), 107(800), 109(200), 111(27), 112(113). EMCI surface samples (number of specimens per minute in brackets): 10(2.5), 11(2.5), 12(10), 16(10), 29(10), 33(80), 34(320), 35(10), 37(81), 41(11.0), 42(363), 43(30), 44(20), 46(50), 54(5), 57(6), 59(9570), 60(35), 63(6), 64(4), 68:69(4), 70(1220), 72(11.1), 73(87), 74(19540), 77(37), 78(281), 79(467), 80(4590), 81(224), 82(0.8), 83(221), 84(20), 86(100), 87(42500), 88(267), 89(5), 90(10050), 92(620), 93:94(2), 95 (106), 98(6660), 99(90), 100(2), 101(320), 102(1), 103(900), 104(12), 105(21), 106(22), 107(39), 109(0.2), 111(95), 112(61), X_2(230), X_3 (200). "Eltanin" samples: 33, 43, 45, 48, 49, 50, 52, 53, 57, 64, 85, 95, 164, 165, 169, 171, 172, 175, 176, 180, 182, 183, 184, 188, 189, 191, 192, 194, 195, 213, 215, 326.

Remarks: *C. brachiatus* was amongst the 5 most frequent species in the EMCI surface samples (frequency of 64.3%). In Low Salinity Water it was always present (100% frequency). It was also the most numerous copepod in most samples taken from this environment. The largest abundance of specimens, more than 100/min, occurred 12 times in Low Salinity Water. In samples taken in other waters it was also frequent and numerous. It was present and abundant in half of the samples taken from Low Salinity Water and Subantarctic Water,

and in 68.4% of the samples from Warm Low Salinity Water mixed with other Waters. *C. brachiatus* had a frequency of 63.1% in the 0-140 m layer EMCI samples, and it was present in greater number and frequency off the South of the area sampled during the EMCI. In twelve stations from latitude 35°30'S to 42°20'S it represented more than 40% of the copepod total. The number of females in 18 samples out of 36 was smaller than the number of males; in 5 samples it was larger; and, in the remaining, the females were absent. The number of copepodites was larger than the number of adults in 29 samples.

TABLE XVIII

Distribution of young, adult, and total average number of *Centropages brachiatus* during the day and the night at the surface and in the 0-140 m layer (EMCI samples) (Note: Only in some of the samples each of the sexes and the copepodites were counted separately)

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number per min of females	40	24	36	9
Average number per min of juveniles	159	70	62	41
Average number per min of males	42	40	43	9
Total average number of specimens/min in total n.° of samples	1747	1748	593	165.1

From the data of the Marchile I expedition it is possible to conclude that the young are concentrated at the surface during the day. Males and females are more numerous at the surface at night. From the total average number per min *C. brachiatus* is a surface copepod. More experiments on the vertical distribution of this abundant species should be made. Some of the largest numbers were found at the surface during the day (19540, 10050, 1220 per min) or at dawn and at sunset (6660, 4590 per min). In the "Eltanin" samples it was the dominant species among copepods when collections were made during the day at the surface. Comparing the distribution of *C. brachiatus* with the salinity profiles of the Marchile I expedition it is evident that the species occurred mostly in Low Salinity Water in the southern portion of the area sampled by the Marchile I expedition specially between 36°20'S and 41°S. *C. brachiatus* was found also up to 07°45'S

off the limits between Peru and Ecuador at the surface. It was present in samples taken as far South as 51°09'S. It was the second most frequent species (90.4% of the samples) in the Marchile II expedition (Vidal, 1966).

The greatest frequency and number of *C. brachiatus* during the "Eltanin" cruise was between 33 and 35°S off Chile. Ramírez (1969) also found *C. brachiatus* in lower salinity Atlantic waters, under influence of the fresh water from the La Plata river, off Argentine and in temperatures from 18°C to 8°C.

FAMILY TEMORIDAE

Temora discaudata Giesbrecht 1888 (2.0 to 2.5 mm long) was found in Coastal, Tropical, Equatorial and Subtropical Surface Waters, collected off Colombia by the "Eltanin" at stations 28 and 29 (cruise 3). *Temorites brevis* Sars 1900 occurred in "Eltanin" samples 53 and 67 taken off the North of Chile in deep water.

FAMILY METRIDIIDAE

The following Metridiidae occurred in the samples studied:

Metridea brevicauda Giesbrecht 1889 — "Eltanin" samples 50, 52, 53, 75, 97, 175, 215;

Metridea curticauda Giesbrecht 1889 — "Eltanin" samples 34, 52, 61, 175, 302, 313, 325;

Metridea gerlachei Giesbrecht 1905 — EMCI sample 41 taken in the 0-140 m layer, and in "Eltanin" samples 97, 98, 160, 169, 184, 215, 216, 272, 313, 325, from the surface and from deep waters in the area south of 39°S and in Antarctic Waters off Chile;

Metridea longa (Lubbock 1854) — a male 3,3 mm long, in "Eltanin" sample 38;

Metridea gurjanovae Epstein 1949 — "Eltanin" samples 61, 215;

Metridea princeps Giesbrecht 1892 — "Eltanin" samples 52, 53, 61, 75, 97, 99, 175, 215, 325;

Metridea venusta Giesbrecht 1892 — 2.8 mm long males, in "Eltanin" samples 65, 160 and 302, from deep waters off Chile and surface and subsurface Antarctic waters, off the South of Chile;

Metridea sp. — "Eltanin" samples 67 and 87;

Gaussia princeps (T. Scott 1893) — "Eltanin" samples 34, 53, 65, 75, 99, 326 all from waters deeper than 600 m;

Pleuromamma borealis F. Dahl 1893 — EMCI 0-140 m layer samples 12(0.7), 13(8.5), 22(4.6), 34(3.8), 35(20), 43(7.1), 57(1.5), 63 (7 6), 78(3.8), 100(7.6); and in "Eltanin" samples 60, 94, 171, 172, 184, 213, 215;

Pleuromamma gracilis (Claus 1863) — EMCI samples from the 0-140 m layer 70(12.5), 72(2.2); and in "Eltanin" samples 33, 53, 65, 99, 176;

Pleuromamma quadrungulata (F. Dahl 1893) — EMCI samples from the 0-140 m layer 6(20 4), 12(2.8), 13(80.5), 14(8), 29(7 6), 33(69.2), 34(6.8), 48(0.7), 57(0.7), 73(0.09), 84(0.9), and in "Eltanin" samples 52, 61, 75, 175, 212, 213, 215;

Pleuromamma robusta Dahl 1893 — EMCI samples from the 0-140 m layer 2(0.6), 26(0.7), 28(7 6), 41(0.6), 73(0.5), 99(6.6), and in "Eltanin" samples 33(?) and 302;

Pleuromamma xiphias (Giesbrecht 1889) — EMCI 0-140 m layer sample 84(0.9); and in "Eltanin" samples 61, 75, 215, and 216;

Metridea lucens Boeck 1864, *Pleuromamma piseki* Farran 1929, and *Pleuromamma abdominalis* (Lubbock 1856) will be treated especially, because they were the most frequent and abundant Metridiidae.

Metridea lucens Boeck 1864

Material and occurrence: EMCI samples containing the species (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer 14(2.4), 28(15.3), 42(15.3), 44(38.4), 47 (2.3), 56(3.0), 57(0.7), 60(10.6), 63(30.7), 64(27.3), 70(6.3), 72 (0.7), 73(0.3), 77(360), 78(17 6), 79(5.4), 83(193.7), 84(15.4), 86 (85.7), 90(11.5), 91(275), 92(66.6), 98(60), 99(206.0), 100(130), 101 (100), 102(150), 103(10), 106(1), 107(340), 109(900), 111(174), 112

(71), and from surface 64(1), 72(10), 77(95), 78(3), 84(20), 92(110), 107(1), 111(49), 112(33). "Eltanin" samples: 38, 94, 95, 97, 98, 99, 114, 165, 169, 170, 171, 172, 175, 176, 180, 182, 184, 186, 188, 191, 192, 194, 195, 197, 198, 200, 206, 207, 209, 212, 213, 215, 216, 272, 325.

Remarks: The species was found with greatest frequency and abundance from 34° to 52°S. At the surface it occurred only at night in numbers varying from 1 to 110/min. In the 140-0 m layer it was present during the day and at night in number varying from 0.3 to 340 specimens/min.

TABLE XIX

Distribution of *M. lucens* at the surface and in the 0-140 m layer by day and by night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens/min	0	35	95	71.9

According to the data *M. lucens* migrates a little from deeper layers to the surface at night. It lives off Chile in cold coastal water or in water influenced by the coastal water and in the cold Subantarctic Water from the Peru current. The following table compares the occurrence of the species in cold and in warmer water. It is clear that it favors the colder water in the 0-140 m layer where it usually lives.

TABLE XX

Percentage of cold and warmer water samples containing *M. lucens* off Chile (cold water = less than 16°C; warm water = over 16°C)

Layer sampled	Surface				0-140 m			
Time	Day		Night		Day		Night	
Water	Cold	Warm	Cold	Warm	Cold	Warm	Cold	Warm
% of samples containing *M. lucens*	—	—	34.7	3.5	13.3	12.5	54.1	35.4

Young *Metridea* occurred at station 89 (1 per minute) and 100 (1.0) in surface cold coastal waters and at stations 106, 88, 97 in the 0-140 m layer during the day varying from 6.2 to 138.4, and at night, at stations 12, 49, 72, 80, 86 and 193 ranging in number from 0.5 to 107.1 per minute. From the 0-140 m layer 14 samples contained females and young; 5 contained young only; 4 had males, females and young; and, 1 had females only, other samples males and young only. At the surface both the adults and young occurred.

Metridea lucens was the most numerous copepod or the next most numerous in "Eltanin" samples (95, 98, 170, 171, 172, 176, 184, 209, 213), collected in or through Low Salinity waters (below 34.00‰) at the surface, during winter at night between 39°S and 51°S. In samples (180, 182, 183) taken in the same region and time and in Low Salinity waters during the day, either none of the species were found or only 1 or 2 specimens. The same was observed in most samples collected in Subantarctic Surface Waters (189, 188, 194, 192, 197, 198). *M. lucens* was also the most numerous copepod or the second or third most numerous copepod in samples 94, 97, 98, 169, 186, taken in Subantarctic Water at night at the surface or during the day (sample 169) from 200 m depth to the surface.

Pleuromamma piseki Farran 1929

Material and occurrence: EMCI samples containing the species (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer 4(7.6), 6(7.6), 7(69 6), 9(1), 10(3.8), 12 (13.5), 13(266.6), 14(184.0), 16(4), 24(23), 27(13.8), 28(7.6), 29 (7.6), 30(15.2), 32(0.7), 34(1.5), 35(26.6), 37(15), 39(15.5), 41 (7.5), 42(76.9), 43(64.2), 44(84.6), 46(0 7), 47(5.3), 48(4.6), 55 (2.8), 56(6.9), 57(1.5), 60(24.6), 63(53.7), 64(36.3), 74(30.7), 77 (10), 78(3.9), 80(23.0), 83(12.5), 84(9 0), 86(7.1), 101(6.6), 103 (1.1), 107(20), 112(1); and EMCI surface samples (number of specimens per minute in brackets) 7(80), 10(2.5), 11(25), 13(5), 14(9.0), 25(6.0), 26(10), 27(870), 33(30), 43(20), 46(10), 48(16), 49(1), 59 (10), 63(2), 64(2), 78(23), 79(1), 83(2), 84(180), 112(1). "Eltanin" samples 33, 50, 60, 61, 64, 69, 75, 84, 94, 99, 165, 175, 180, 184, 185, 189, 191, 192, 194, 195, 197, 198, 200, 201, 206, 207, 209, 212.

Remarks: In the 0-140 m EMCI samples this species had a 46% frequency. It was amongst the 4 most abundant species in 4 EMCI

samples taken through Subantarctic Water and Warm Surface Water. *P. piseki* was caught on the surface at night at 17 stations, in 9 samples of Warm Surface Water where the numbers per minute were from 5 to 870, in 4 samples of Subantarctic Surface Water (1 to 20 per minute), in 4 samples of Low Salinity Water (2 to 170 per minute) and 1 sample taken through Warm Surface and Subantarctic Water. *P. piseki* was also collected during the day at the surface at 5 stations varying from 1 to 50 per minute. It was caught mostly in the 0-140 m layer at 28 stations, varying in number from 0.5 to 266 6 per minute. The EMCI samples were taken during end of Summer and Autumn. During Winter the "Eltanin" samples contained *P. piseki* from 23°S to 39°S. It was the most numerous or second most numerous species in the samples taken at night in the Subantarctic Surface Water in the area from 35°S to 39°S ("Eltanin" samples 94, 184, 186, 191, 192, 194, 195, 197, 198, 200). Samples collected in the same conditions but during the day had none or very few specimens (189, 201, 206, 207). Further north to 23°S (60, 61, 64, 69, 75, 84) the species was found frequently at night and in samples taken through deep layers but in smaller numbers (fourth most numerous species). In Low Salinity Water "Eltanin" samples (209, 212) it was not numerous.

According to Heinrich (1961) *P. gracilis* migrates to the surface layer at night and concentrates in the 25-50 m horizon. At dawn it is concentrated in the 100-200 m layer, but there are still specimens at the surface. It then remains concentrated in deeper waters, and migrates to the 50-100 m layer at dusk. Our results indicate a similar behavior of *P. piseki*.

TABLE XXI

Distribution of *P. piseki* at the surface and in the 0-140 m layer, during day and night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per minute hauling	6	67	18.9	38

During the day very few specimens were found at the surface and few in the 0-140 m layer. At night there were specimens at the surface but the greatest frequency was found in the 0-140 m layer.

This species occurred in the "Eltanin" samples from 5°S to 45°S in the surface layers. The largest frequency of the species off Chile was found from latitude 35° to 41°S. The Metridiidae are thus represented by two mass copepods in the SE Pacific: further North, in more saline but cool waters, by *P. piseki,* and further South, in low salinity waters, by *Metridea lucens.*

Pleuromamma abdominalis (Lubbock 1856)

Material and occurrence: EMCI samples containing the species (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer 6(2.5), 7(18.7), 10(9 6), 12(19.9), 13(606.6), 14(96), 26(1.5), 27(7.6), 28(38.4), 29(30.7), 33(123), 34(8.4), 35 (20), 42(630.3), 43(21.4), 47(4.6), 55(2.8), 56(6.1), 57(2.3), 60 (4.6), 63(15.3), 73(0.2), 74(15.3), 78(6.9), 79(0.3), 80(0.2), 83 (18.7), 84(4.5), 86(71.4), 100(15.3), 101(13.3), 102(10), 103(1.1), and in EMCI surface samples (number per minute in brackets) 7(30), 14(1.3), 22(10). "Eltanin" samples with species 33, 34, 38, 61, 63, 65, 69, 71, 72, 75, 81, 97, 99, 165, 169, 170, 172, 175, 176, 186, 192, 195, 198, 200, 201, 206, 208, 209, 212, 213, 215, 216, 313, 325, 326.

Remarks: *P. abdominalis* occurred at the surface with a 2.7% frequency during the day in Subantarctic Surface Water and with a 4% frequency at night in Surface Warm Water. During the day it was collected with a 17% frequency in the 0-140 m (10 to 125 specimens per minute) and at night with a frequency of 48% in the same layer.

TABLE XXII

Distribution of *P. abdominalis* at the surface and in the 0-140 m layer during the day and at night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per min of hauling	10	15	63.5	63
Number of samples	1	2	7	27

P. abdominalis lives in deeper layers than those sampled here (Heinrich, 1961). It spends most of the day, since dawn, below the

100 m depth. At dusk it rises to the 100-50 m layer and during the night, it migrates to the 50-25 m horizon (Heinrich, 1961). The frequency data obtained from the Marchile I expedition confirm Heinrich's observations. *P. abdominalis* occurred only in one sample of the Marchile II expedition (Vidal 1966).

Thirteen "Eltanin" samples (44%) from deep waters or subsurface waters contained *P abdominalis* in the forms *edentata, typica* and, in one sample (38), *abyssalis*. Specimens of *P. abdominalis* occurred in 33% of the surface samples taken at night, with exception of two which were collected in daylight.

FAMILY LUCICUTIIDAE

List of species which were collected during the EMCI and the "Eltanin" cruises off West South America:

Lucicutia aurita Cleve 1904 — "Eltanin" samples 52, 61, 97;

Lucicutia bicornuta Wolfenden 1905 — "Eltanin" samples 52, 53, 75, 97;

Lucicutia clausi (Giesbrecht 1889) — "Eltanin" sample 33; EMCI stations 57(2.3) and 14(2), 0-140 m layer;

Lucicutia curta Farran 1905 — EMCI sample 32(0 7), 0-140 m layer; "Eltanin" sample 52;

Lucicutia formosa Hülsemann 1966 — "Eltanin" sample 175;

Lucicutia gemina Farran 1926 — EMCI sample 10(7 7), 0-140 m layer;

Lucicutia grandis (Giesbrecht 1895) — "Eltanin" samples 34, 38, 43, 52, 53, 65, 84, 97, 99, 313;

Lucicutia longicornis (Giesbrecht 1889) — EMCI sample 28(7.6), 0-140 m layer; "Eltanin" sample 75;

Lucicutia lucida Farran 1908 — "Eltanin" sample 61;

Lucicutia magna Wolfenden 1903 — "Eltanin" samples 38, 61, 72, 75;

Lucicutia macrocera Sars 1920 — "Eltanin" sample 67;

Lucicutia maxima Steuer 1904 — "Eltanin" sample 53, 99, 175, 215, 325;

Lucicutia ovalis (Giesbrecht 1889) — "Eltanin" sample 33; EMCI samples, 0-140 m layer (n.° of specimens per min in brackets): 6(2.5), 45(0 7), 61(0.6), 72(0 7), 79(0.1), 82(1.5), 84(0.9), 89(0.7), 101 (6.6);

Lucicutia pacifica Brodsky 1950 — "Eltanin" sample 175;

Lucicutia pellucida Hülsemann 1966 — "Eltanin" sample 175;

Lucicutia tenuicauda Sars 1907 — "Eltanin" sample 72;

Lucicutia wolfendeni Sewell 1932 — "Eltanin" sample 75, 99, 175;

Lucicutia rara Hülsemann 1966 — "Eltanin" sample 325;

Lucicutia flavicornis will be treated below.

Of the deep-dwelling species (*L. bicornuta L. grandis, L. macrocera, L. magna, L. tenuicauda* and *L. maxima*) *L. grandis* was the most frequent always in samplings through Bottom, Deep and/or Intermediate Waters. *L. ovalis* and *L. clausi* were collected in Subtropical Surface and in Equatorial Subsurface Waters. *L. ovalis* and *L. flavicornis* were also found by Vidal (1966) during the Marchile II expedition.

Lucicutia flavicornis (Clauss 1863)

Material and occurrence: EMCI samples containing the species and number of specimens per minute (in brackets) from the 0-140 m layer: 4(7.6), 6(30.7), 7(12.5), 8(6), 9(5), 12(6.9), 14(5.2), 16(8), 17(7.6), 19(7.6), 37(3), 39(12.5), 41(1.8), 43(7.1), 47(3.0), 48(4.6), 49(0 7), 53(0.9), 55(2.1), 58(0.7), 64(18.2), 79(0.1), 101(6.6), 111 (1), and EMCI surface samples (number of specimens per minute in brackets): 43(10), 48(1.0). "Eltanin" samples 28, 29, 33, 60.

Remarks: *L. flavicornis* was the most numerous and the most frequent species of the Lucicutiidae. It was present mostly from lat. 36°S to 29°50'S, thus, in the northern part of the area visited by the EMCI. Vidal (1966) found *L. flavicornis* with a frequency of 19.6% and *L. ovalis* with a 7.1% frequency in the Marchile II expedition. The distribution of *L. ovalis* contrasted with that of *L. flavicornis* in

the EMCI, because *L. ovalis* was usually found in stations far from the continent and mostly from 34°S to 39°S. *L. flavicornis* in the West South Pacific seems to be concentrated chiefly between 10°S and 30°S (Heinrich, 1968). It occurred during the day with an average of 6 specimens/min and during the night with an average of 7/min in the 0-140 m layer sampled by the EMCI. At the surface it was found only twice in small numbers at night. The frequency of its occurrence in the 0-140 m layer was in 25.5% of the samples. According to Heinrich (1961) *L. flavicornis* concentrates at the surface at night and at dawn. At 09.45 it is concentrated in the 50-100 m layer; from 10.30 to 12.00, it migrates to the 25-50 m horizon; and, at 14.00, it descends to the 100-200 m deep layer. It rises again to the 50-100 m at 16.00 and then moves still further up at 18.00. Thus, most of *L. flavicornis'* vertical migration is executed within the 200-0 m layer. This is probably the reason why the total number of specimens per minute found by day was practically equal to the total found by night in the 0-140 m layer during the EMCI.

FAMILY HETERORHABDIDAE

Species which were collected during the EMCI (specimens per min in brackets) and "Eltanin" cruises:

Disseta palumboi Giesbrecht 1889 — "Eltanin" sample 34, 52, 175;

Heterorhabdus abyssalis Giesbrecht 1889 — "Eltanin" sample 175;

Heterorhabdus austrinus Giesbrecht 1902 — "Eltanin" samples 53, 61(?), 97, 160, 175, 213, 215, 302, 313, 325;

Heterorhabdus compactus Sars 1900 — "Eltanin" samples 52, 63;

Heterorhabdus farrani Brady 1918 — "Eltanin" samples 175, 215, 313;

Heterorhabdus pustulifer Farran 1929 — "Eltanin" 215, 99;

Heterorhabdus robustus Farran 1908 — "Eltanin" samples 61, 71, 169, 216, 325;

Heterorhabdus spinifrons Claus 1802 — "Eltanin" samples 34, 165, 169, in EMCI 0-140 m samples 80(7.6), 55(0.7), and in EMCI surface sample 9(10);

Heterorhabdus copepodites — EMCI samples, 0-140 m layer, 8 (2.5), 14(2.4), 29(7.6), 41(3.7), 46(0.7), 66(83.3), 73(0.3), 77(10), 78(0 7), 79(0 4), 84(10.9), 101(13.3); EMCI surface samples 9(2.5), 82(0.1), 92(10); "Eltanin" sample 52;

Hemirhabdus grimaldii (J. Richard 1893) — "Eltanin" sample 34;

Mesorhabdus sp. — "Eltanin" sample 175;

Heterostylites longicornis (Giesbrecht 1892) — EMCI 0-140 m sample 14(2.4); "Eltanin" samples 75, 175;

Heterostylites major (Dahl 1894) — EMCI 0-140 m sample 10(23); "Eltanin" sample 325;

TABLE XXIII

Distribution of *Heterorhabdus* copepodites at the surface and in the 0-140 m layer by day and by night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per min of hauling	1	10	7	12

From the data of table XXIII the copepodites of *Heterorhabdus* migrate to the surface and to the 0-140 m layer at night and down to deeper layers during the day.

Heterorhabdus papilliger Claus 1863

Material and occurrence: EMCI samples containing the species (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer: 4(38.4), 5(6.0), 6(71.7), 7(26.7), 8(2.0), 9(1), 12(8.5), 13(11.1), 14(13.3), 15(16.0), 16(16), 17(23), 20(100), 22(8.4), 24(30.7), 31(6.1), 32(10), 36(2.1), 37(16), 39(25), 41(4.3), 42(107.6), 43(14.2), 46(2.3), 47(4.6), 48(5.3), 49(1.5), 50(4.2), 55(1.4), 56(3.0), 60(1.3), 64(127.3), 68:69(36.3), 70(12.5), 80 (30 7), 85(7.6), 90(2.3), 97(7.6), 98(20). EMCI surface samples containing specimens of *Heterorhabdus papilliger* (number per minute in brackets): 19(10), 25(8), 43(10), 46(20), 48(1), 93:94(1). "Eltanin" samples 33, 69, 75, 209, 212, 215.

Remarks: It was amongst the most frequent of the subsurface-dwelling copepods (present in 39% of the samples taken during the night and in 48% of those collected during the day) in the 0-140 m layer. Sometimes it was also present in high numbers up to 127/min. Only 5 4% of the surface samples taken by day and 10.8% of the surface samples collected by night contained the species.

TABLE XXIV

Distribution of *Heterorhabdus papilliger* at the surface and in the 0-140 m layer

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per min hauling	10	7	19	22

It is clear from the data above that the species is rare at the surface and remains mostly in the subsurface layers. Heinrich (1961) found that *H. papilliger* reached the surface from 10:40 P.M. to 6:00 A.M. and is usually concentrated in the 50-100 m layer.

The species is mostly concentrated in the northern part of the area sampled during the EMCI from 35°S to 30°S, but from "Eltanin" data it occurs from 7°S in the North to 47°S in the South. It was usually found in Subantarctic Water.

FAMILY AUGAPTILIDAE

The following species were collected during the EMCI and the "Eltanin" cruises (specimens per minute in brackets):

Haloptilus acutifrons (Giesbrecht 1892) — EMCI 0-140 m samples 4(7 6), 7(1.7), 9(5 0), 78(0.7);

Haloptilus longicornis (Claus 1863) — EMCI 0-140 m samples 6(2.5), 12(0.7), 46(1.5); "Eltanin" sample 175;

Haloptilus oxycephalus (Giesbrecht 1892) — "Eltanin" sample 302 from Antarctic waters;

Haloptilus spiniceps (Giesbrecht 1892) — EMCI 0-140 m sample 46(0.7);

Haloptilus copepodites — EMCI 0-140 m samples 7(5.3), 43 (14.2), 46(3.8), 79(0.1);

Augaptilus anceps Farran 1908 — "Eltanin" samples 53, 326;

Augaptilus glacialis Sars 1900 — "Eltanin" samples 61, 175;

Augaptilus longicaudatus (Claus 1863) — EMCI 0-140 m sample 84(0.9);

Augaptilus sp. — EMCI 0-140 m sample 10(1.9);

Euaugaptilus filiger (Claus 1863) — "Eltanin" samples 61, 326;

Euaugaptilus fungiferus Wolfenden 1911 — "Eltanin" samples 52, 53, 67, 175;

Euaugaptilus grandicornis Sars 1920 — "Eltanin" sample 53;

Euaugaptilus laticeps (Sars 1905) — "Eltanin" samples 50, 52, 175;

Euaugaptilus longimanus Sars 1905 — "Eltanin" samples 53, 67?, 75;

Euaugaptilus nodifrons Sars 1905 — "Eltanin" sample 99;

Euaugaptilus magnus (Wolfenden 1904) — "Eltanin" samples 52, 53, 61, 99, 215, 325, 326;

Euaugaptilus sp. — "Eltanin" sample 67;

Centraugaptilus cuculatus Sars 1905 — "Eltanin" sample 97;

Centraugaptilus horridus (Farran 1908) — "Eltanin" samples 61, 169;

Centraugaptilus rattrayi Scott 1893 — "Eltanin" samples 75, 99, 175, 325;

Augaptilina scopifera Sars 1920 — "Eltanin" sample 175;

Pachyptilus sp. — "Eltanin" sample 313;

Pachyptilus eurygnathus Sars 1920 — "Eltanin" samples 175, 326;

Pachyptilus lobatus Sars 1920 — "Eltanin" sample 175;

Pachyptilus pacificus Johnson 1936 — "Eltanin" sample 313.

Most of these species are deep-dwelling, with exception of *Haloptilus oxycephalus* an Antarctic copepod. *Haloptilus acutifrons* and *H. longicornis* are usually found in tropical and subtropical regions, where they live in sub-surface cool waters.

FAMILY ARIETELLIDAE

The species *Arietellus setosus* Giesbrecht 1892, in "Eltanin" samples 53, 61; *Arietellus simplex* Sars 1905, in "Eltanin" samples 34, 53, 65, 97; *Phyllopus bidentatus* Brady 1883, in "Eltanin" sample 75; *Phyllopus impar* Farran 1908, in "Eltanin" samples 34, 53; *Phyllopus integer* Esterly 1911, in "Eltanin" sample 65; and *Phyllopus* sp., in "Eltanin" sample 53, were the representatives of the family off West South America. Young *Arietellus* were found in the "Eltanin" samples 75, 175, and 216.

FAMILY CANDACIIDAE

The following Candaciidae were found in the "Eltanin" and EMCI samples:

Candacia pachydactyla (Dana 1849) — "Eltanin" samples 33, 53, 71;

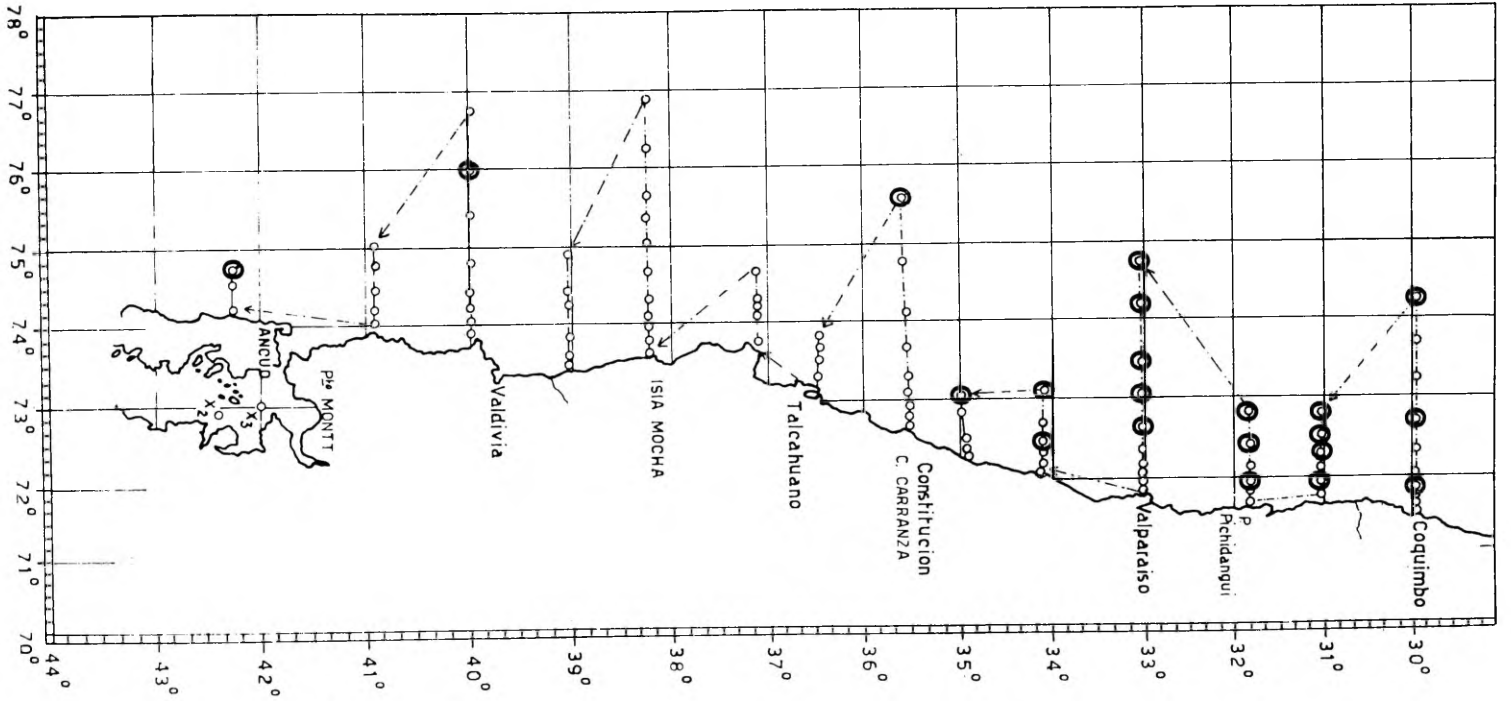
Candacia longimana (Claus 1863) — EMCI 0-140 m layer station 84(0.9/min); "Eltanin" sample 313;

Candacia tenuimana (Giesbrecht 1889) — EMCI 0-140 m layer stations 13 (44.4/min), 27(0.7/min), 28(7.6/min), 29(7.6/min);

Candacia bipinnata (Giesbrecht 1889) — EMCI 0-140 m layer sample 45(0.7/min); "Eltanin" sample 45;

Candacia cheirura Cleve 1905 — EMCI 0-140 m sample 99(13.3/min); "Eltanin" samples 165, 170, 172, 213, 215, 325;

Candacia curta (Dana 1849) — "Eltanin" samples 29, 38, 50, 52, 58, and EMCI samples from the 0-140 m layer: 6(2.5), 9(8), 12(8), 13(8.2), 14(45.2), 15(58.3), 17(7.6), 27(0.7), 28(7.6), 29(30.7), 30(19.6), 31(0 7), 32(0.7), 33(7.6), 45(1.4), 46(0.7), 60(0 6), 101 (6.6), 112(1), and from the surface 9(2.5), 13(0.3), 26(2.0), 32 (80), 43(10);



15 — Distribution of C*andacia* during the EMCI, black circles indicate the occurrence of the species (*C. curta*).

Paracandacia simplex (Giesbrecht 1889) — "Eltanin" stations 33, 213, 313;

The only species of the Candaciidae significantly represented was *Candacia curta,* also the most frequent and most numerous *Candacia* during the Marchile II expedition (Vidal 1966). During this last survey (Vidal 1966) *Paracandacia truncata* (Dana 1849) was also registered off the North of Chile. This species was not found in our samples.

The distribution of *Candacia curta* in the 0-140 m and in the surface layers is summarized as follows:

TABLE XXV

Average number of *Candacia curta* per min of hauling at the surface and in the 0-140 m layer, during the day and during the night

Layer sampled	Surface	0-140 m
Average n.° by day	6.2	12.8
Average n.° at night	27.4	9.4

Though the number of samples is very small, from the results in seems that *Candacia curta* migrates to the surface during the night and to deeper layers by day. It is found from 7°S lat. to about 42°S lat. Map n.° 15 shows the horizontal distribution of the species, mostly concentrated off the Northern part of the area surveyed during the EMCI and always in stations off the coast.

Candacia pachydactyla is a known inhabitant of warmer waters and therefore was present in the "Eltanin" samples taken mostly off the norherm coast of South West America. *Paracandacia simplex* also seems to prefer warmer waters but it can live further South than *C. pachydactyla.*

Candacia tenuimana occurred in the north of the area surveyed during the EMCI. *Candacia cheirura* seems to substitute *C. curta* in the waters off the Archipelago region of Chile, from 40°S lat. to 44°S lat. *Candacia longimana* was found still further South off Chile.

Candacia copepodites were found in the "Eltanin" samples 49, 57, 85, 95, 98, 184, 192 all from the surface, in the EMCI samples from

the 0-140 m layer 10(38.4), 12(2.8), 14(40), 25(1.4), 44(7.6), 61 (0.6), 83(6.2), 86(7.1), 88(7 7), 107(20), and from the surface 6 (10), 10(2.5), 11(10), 33(40), 107(1).

FAMILY PARAPONTELLIDAE

The genus *Bathypontia* was present in two "Eltanin" samples 75 and 99. The external characteristics did not coincide with those of any known species.

FAMILY PONTELLIDAE

The following species occurred in the material examined:

Pontellina plumata Dana 1849 — "Eltanin" stations 28, 29, in Tropical Coastal and Equatorial Subsurface water off Colombia and Ecuador;

Labidocera acutifrons Dana 1849 — "Eltanin" stations 28, 33, 45, 49, in Equatorial and Peru surface water, in Peru and South Subtropical Subsurface water off the North East South America; also in "Eltanin" samples 53 and 216 taken through deep and surface waters;

Labidocera acuta Dana 1849 — "Eltanin" station 33 in Peru Surface water, off Northern Peru;

Labidocera aestiva Wheeler 1950 (= *Labidocera insolita* Wilson 1950 see Fleminger 1955) in "Eltanin" sample 216, taken through Deep Warm, Antarctic Intermediate and Subantarctic Surface Water off Chile, and in "Eltanin" sample 53 taken through Equatorial Subtropical Surface and Subtropical Surface, Upper Deep and Equatorial Intermediate waters.

Labidocera copepodites in "Eltanin" sample 29.

Fleminger (1965) doubted Wilson's (1950) findings of *Labidocera aestiva* in Pacific samples. It seems though that the species does occur in this Ocean, as it was found in two "Eltanin" samples. It also seems to be morphologically a rather variable species like *P. regalis,* another very widespread pontellid. On comparing the figures of the "Eltanin" specimens, those of Wilson's (described as *L. insolita*)

and those of Owre and Foyo's (1967) the male fifth leg seems slightly different in all three.

Vidal (1966) found *Pontellopsis regalis* during the Marchile II expedition and Heinrich (1971) found *Pontellopsis lubbocki* in the neritic equatorial waters; *Labidocera detruncata* in the oceanic equatorial region; *Pontella tenuiremis* rarely; *Pontella danae* and *Labidocera acuta* down to 10°S; *Pontella whiteleggei* and *Pontella valida,* central southern species, were found west to the divergence region far off the coast of Chile and Peru. *Labidocera acutifrons* and *Pontellopsis regalis* were numerous south of latitude 6°S away from the coast, and east of the line of divergence (Heinrich, 1971).

The Pontellidae are known components of the neuston and therefore not usually caught with the common plankton net procedures. This explains the small number and variety of species collected during the "Eltanin" and "Marchile" expeditions.

FAMILY ACARTIIDAE

The following species (specimens per min in brackets) were present in the EMCI and "Eltanin" cruises:

Acartia longiremis (Lilljeborg 1853) — "Eltanin" samples 57, 61;

Acartia danae Giesbrecht 1889 — "Eltanin" samples: 28, 29, 33, 85, 188, 189, EMCI 0-140 m samples 7(7.1), 10(5.7), 12(6.1), 13 (11.1), 14(18.6), 15(54.1), 39(12.5), 58(0.7), 81(1.5), 84(1.8), 97 (7.6), 98(10), 102(10); EMCI surface 7(60), 12(10), 13(2.3), 14(1), 42(1), 84(10), 106(2).

Acartia negligens Dana 1849 — EMCI 0-140 m samples 29(7.6), 41(0.6), 60(3.3), 61(0.6), 85(7.6); "Eltanin" sample 49;

Acartia clausi Giesbrecht 1889 — EMCI 0-140 m sample 41(0.6);

Acartia copepodites in EMCI 0-140 m samples 16(8.0), 58(0 7), 81(7 6), 107(30).

Because of its abundance and frequency *Acartia tonsa* Dana 1849 will be specially treated below.

Acartia tonsa Dana 1848

Material and occurrence: EMCI 0-140 m samples containing the species and number of specimens per minute (in brackets): 2(5.8), 4 (423), 5(39), 6(61.5), 14(2.4), 17(7 6), 20(300), 34(0.7), 37(5), 39 (250), 41(1.8), 46(1.5), 48(3.8), 49(3.8), 50(66.4), 52(6.3), 53 (28.2), 55(0.7), 63(369.2), 64(336.3), 66(141.6), 68:69(436.3), 70 (118.7), 74(38.4), 75:76(140), 77(730), 79(0.5), 90(0.7), 92(366.6), 93:94(50), 104(3.6), 105(3.0), 109(30), 112(1). EMCI surface samples (number of specimens per minute in brackets): 2(3.75), 4(2150), 5(640), 6(740), 8(30), 9(2.5), 17(10.0), 20(470), 22(10), 24(10), 36 (5), 39(93), 41(1), 46(30), 50(2120), 52(270), 54(4), 57(5), 63(34), 64(97), 68:69(313), 70(210), 74(40.0), 77(5), 78(8), 79(3.0), 80 (20), 82(0 7), 88(1.0), 92(280), 93:94(3), 104 (2.0), 105(5), 109 (2.8). "Eltanin" samples: 36, 60, 64.

TABLE XXVI

Distribution of *A. tonsa* at the surface and in 0-140 m deep water during the day and during the night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens/min	183	282	115	118

The number of specimens at the surface is higher than in the deeper layer, but at night this number increases. It is an indication of a slight vertical migration to the surface. It also indicates that part of the *A. tonsa* specimens remain mostly at the surface. In laboratory experiments with *Acartia lilljeborgi* (Björnberg and Wilbur, 1966) it was noticed than the adults migrate vertically whilst the juveniles remain at the surface. It is possible that such a behavior also occurs in *Acartia tonsa*. Conover (1956) found a higher percentage of copepodites above the thermocline during the months of July and April at Long Island Sound, but at other times of year when *A. tonsa* occurred, the number of copepodites above and below the thermocline was about the same.

In EMCI samples *A. tonsa* was 39% frequent at the surface and mostly in coastal water samples. Its frequency in the 0-140 m layer was 36%. The water in which it occurred in mass numbers (among the three most numerous copepods of the sample) was the Subantarctic or Warm Surface Water, also when the net was towed through several water masses of which at least one was from Subantarctic origin. It was very numerous only in one sample of Low Salinity water. Its frequency and numbers decreased towards the south of the area surveyed during the EMCI. It occurred in Equatorial Subsurface Waters and in Subtropical Surface Waters as far north as 8°23'S off Peru in "Eltanin" samples.

TABLE XXVII

Distribution of adults and copepodites (average number/min hauling) of *Acartia tonsa* during the day and during the night at the surface and in the 0-140 m layer

Layer sampled		Surface		0-140 m	
Time		Day	Night	Day	Night
Average number of specimens per minute hauling	Females	61.4	8.3	5.5	11.0
	Males	111.0	16.8	4.7	3.5
	Copepodites	38.6	5.6	1.5	14.1

From the data above it seems that *Acartia tonsa* in the Chilean Sea lives mostly at the surface during the day. Females and copepodites are also found in small numbers in deeper layers at night. During the day very small numbers of adults and copepodites are also found in deeper layers and at the surface at night. More should be investigated about the vertical distribution of this important mass copepod.

Other Acartiidae

A. danae occurred in the "Eltanin" samples taken off Colombia in Coastal, Tropical and Equatorial Sub-surface waters, off Peru in Subtropical Surface and in Equatorial Subsurface water and southwards to 33°S mostly in stations well away from the coast.

A. negligens was present (station 52) off the North of Chile in Subtropical Surface and Warm Surface Water.

Vidal (1966) found *A. danae* and *A. negligens* in the Marchile II expedition of the North of Chile. The first was present only once; the second was frequent. *A. tonsa* was also present in many samples with temperature below 17°C and usually excluding by its presence the occurrence of *A. negligens* (See "Anexo 2" *in* Vidal, 1966). In the EMCI samples *A. negligens* was always found at stations very far out.

A. danae occurred in surface samples, all but one, taken from water with higher temperature than 17°C at night.

TABLE XXVIII

Distribution of *A. danae* at the surface and in the 0-140 m layer at night and during the day

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per min hauling	—	12	7	13

From the data *A. danae* seems to migrate partially to the surface at night. It is a known warm water indicator and thus present mostly in the Northern part of the area sampled and in the oceanic warmer water.

CYCLOPOIDA

FAMILY OITHONIDAE

The following species were found in the EMCI and "Eltanin" samples:

Ratania flava Giesbrecht 1892 — EMCI station 61 (0.6 specimens/min), 0-140 m layer;

Oithona hamata Rosendorn 1917 — "Eltanin" samples 64, 98;

Oithona plumifera, O. similis and *O. atlantica* will be discussed with more detail, as follows:

Oithona plumifera Baird 1843

Material and occurrence: EMCI surface samples (in brackets the number of specimens per minute hauling): 12(10.0), 13(0.6), 14(1.6), 17(10.0), 19(20 0), 22(30.0), 80(30.0), 102(2.0), EMCI 0-140 m layer samples: 10(17.3), 12(6.0), 13(5.5), 14(56.0), 15(62.5), 80 (69.2), 81(81.0), "Eltanin" samples 28, 33, 45, 49, 57, 58, 69, 89.

Remarks: It is a warm oceanic water species, and it was found mostly in higher temperatures above 18°C and in higher salinites, more than 34.0‰, thus usually in Warm Surface Water. It did not occur in latitudes higher than 38°10'S and was present in stations away from the coast.

TABLE XXIX

Distribution of *Oithona plumifera* at the surface and in the 0-140 m layer during the day and at night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per min hauling	14.0	16.4	49.1	39.8

From the data *O. plumifera* is a non migrating species, thus confirming Zalkina's (1970) data for the behavior of the species in the tropical Pacific Ocean.

Females and juveniles were more frequent than males.

In "Eltanin" samples the species was found in Equatorial Surface, Peru Surface, Equatorial Subsurface, Subtropical Surface and in Subantarctic Surface Waters.

Oithona similis Claus, 1863

Material and occurrence: EMCI samples from 0-140 m (number of specimens per minute of hauling in brackets): 2(8.2), 4(107.6), 5(1.0),

6(15.3), 7(62.5), 8(0.8), 9(30.0), 10(13.4), 14(66.6), 15(20.8), 17 (7 6), 20(800), 24(7.6), 28(30.7), 29(38.4), 32(2.8), 33(7 6), 34 (0.7), 36(3.5), 39(300.0), 41(1.8), 43(14.2), 44(107.6), 46(1.5), 47 (1.5), 48(6.0), 50(32.1), 52(2.7), 53(3.6), 55(1.4), 59(7.6), 60(7.3), 64(372.7), 66(125.0), 68:69(109), 70(43.7), 72(5.3), 73(1.3), 75:76 (16.2), 77(490.0), 78(16.0), 80(46.1), 81(46.1), 82(5.3), 86(71), 88 (200.0), 91(50.0), 92(66.6), 93:94(20.0), 95(3.3), 96(7.6), 97(23.0), 98(10.0), 99(13.3), 104(7.2), 105(2.3), 107(110.0), 109(160), 111 (1.0). EMCI surface samples: 6(10.0), 9(7.5), 11(2.5), 17(10.0), 22(40.0), 29(10.0), 33(10 0), 34(20.0), 43(30.0), 44(20.0), 46(40.0), 50(10.0), 54(1.0), 58(0.5), 59(10 0), 60(10.0), 63(12.0), 68:69(7.0), 70(340 0), 72(1.8), 73(12.0), 77(12 0), 78(1.0), 81(55.0), 88(1.0), 92(10.0), 95(1.0), 98(10 0), 105(2.0), 107(2.0), 109(0.5), 112(1.0), X_3(20 0). "Eltanin" samples 28, 67, 81, 85, 98 and 160.

Remarks: This species is not usually caught in abundance by the wide meshed normally used plankton-nets. The frequency of the species during EMCI in the 0-140 m layer samples was 40%; at the surface it occurred in 38% of the samples. It was amongst the most numerous copepod species in one sample of Low Salinity Water and in another taken through Low Salinity and Subantarctic Water off Chile.

TABLE XXX

Distribution of *Oithona similis* females, males and juveniles in the 0-140 m layer and at the surface

Layer sampled	Average number of		
	Females	Males	Juveniles
Surface	2.3	3.6	4.0
0-140 m	6.5	1.3	6.0

Males seem to concentrate at the surface; females in the 0-140 m layer.

The species seems to migrate to the surface during the day but remains chiefly in the 0-140 m layer during the day and the night.

It was present mostly near the coast but occurred also in stations far out to sea in the area surveyed by the area surveyed by the EMCI.

TABLE XXXI

Distribution of *Oithona similis* by day and at night at the surface and in the 0-140 m layer during EMCI

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute	39	8	72	56
Number of samples	(25)	(34)	(14)	(19)

It showed the greatest abundance between 34°S and 41°S latitude. A cold water indicator, it must be much more numerous than revealed by the catches made with the coarse net used during the EMCI in the Chilean Sea.

In Wellershaus' (1970) review of the main characteristics of the *Oithona* species *O. similis* is considered as having the following spinulation on the first to the fourth feet exopods: 1.1.2; 1.0.1; 1.0.1; 0.0.1. From the figures drawn after the Chilean specimens this is true, but there are also fake spines, not articulated with the exopod and unflanged which vary in number from specimen to specimen on feet 2 and 3. These are really marginal processes of the exopod, but can easily be mistaken for real spines. On the mandible endopod 3 large setae and a minute, almost invisible one, were present. The Chilean specimens thus resemble the *O. spinirostris* description (Giesbrecht 1882 *in* Wellershaus, 1970).

Young *Oithona*

Young *Oithona* not identified to species level, were collected in surface waters at the stations 5(10/min) and 17(10/min). In the 0-140 m layer the following young *Oithona* were collected: 27(1.5), 29(38.4), 35(6.6), 42(23), 43(14.2), 61(8.0), 89(0 7), 98(10), 104 (0.9)

Oithona atlantica Farran 1908

Material and Occurrence: EMCI samples of the 0-140 m layer (the numbers in brackets the specimens per min of hauling): 2(1.5), 6

(12.6), 8(0 4), 9(3), 10(5.7), 12(2.3), 13(2.7), 14(13.3), 15 (25.0), 16(48), 20(100), 22(2.3), 24(7.6), 27(0.7), 28(15.3), 29 (15.3), 30(23), 31(7 6), 32(2.1), 34(0.7), 37(3.0), 39(87.5), 44 (184.6), 45(0.7), 46(6.1), 47(1.5), 49(1.5), 50(5.7), 52(0.9), 56 (1.5), 58(1.4), 60(0.6), 61(4.6), 62(2.8), 63(233.1), 64(36.3), 66 (8.3), 68:69(90.0), 73(0.54), 74(184.4), 75:76(12.5), 77(10.0), 78 (6.1), 79(5.1), 80(15.3), 81(46.1), 82(10.0), 83(81.2), 84(9.1), 85 (7.6), 86(7.1), 88(84.6), 89(0.7), 90(12.3), 91(75), 95(2.5), 97(23), 98(20), 99(20.0), 101(33.3), 102(60), 103(2.2), 105(0.7), 107(110 0), 109(30.0), 111(2). Surface EMCI samples (the numbers in brackets refer to the specimens per min of hauling): 9(17:5), 19(100), 27(10.0), 37(1.0), 42(87.0), 63(1), 68:69(117.0), 73(2), 79(3.0), 81(1.0), 82 (0.2), 83(4.0), 86(20), 92(10), 98(10.0), 99(10.0), 101(30.0), 102 (3.0), 103(30 0), 106(2.0), 107(2.0), and in the "Eltanin" samples 28, 60, 85, 163, 176, 188.

Remarks on the data obtained: The frequency of *O. atlantica* in the samples taken through the 0-140 m layer was of 70%. At the surface the frequency was 24%. The hauls containing *O. atlantica* were made in Coastal Water, Warm Surface Water, Low Salinity and Subantarctic Surface Waters. In one sample of Subantarctic Water *Oithona atlantica* was the most numerous copepod.

It occurred more frequently in the 0-140 m layer and in higher numbers (6 times above 50 per min). Females and juveniles occurred at the surface. In the 0-140 m layer the number of juveniles was about the same, but larger, than that of females; and the number of males was 53 times smaller. It was impossible to discover which were the limiting factors in the distribution of this species at it was found over most of the area surveyed during the EMCI.

TABLE XXXII

Distribution of *Oithona atlantica* during the day and the night in the surface and in the 0-140 m layers

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per min	21	200	37	662.9

The species seems to remain mostly in the 0-140 m layer.

FAMILY ONCAEIDAE

Oncaea venusta Philippi 1843

Material and occurrence: EMCI samples from the 0-140 m layer (in brackets = numbers of specimens per minute): 5(3.0), 8(14), 9(5), 10(1.9), 12(6.9), 14(5.2), 17(15.3), 19(7 6), 22(3.0), 36(1.4), 41 (1.8), 79(4.0), 84(3.6), 85(228.0), 99(6.6), 100(1.5), 101(13.3), 102(60), 103(1.1). Surface EMCI samples (number of specimens per minute in brackets): 8(20), 12(40), 60(3), 84(10), 85(23), 86(60), 100(2), 105(1), and in the "Eltanin" samples: 28, 29, 33, 36, 49, 60 and 85.

Remarks: *O. venusta* was only present in 20% of the EMCI catches in the 0-140 m layer and in 9% of the surface EMCI samples. It occurred in the stations at the North of the area sampled by the Mar chile I expedition and at the outermost stations of the southern part of the area. In the "Eltanin" samples it was present at the surface in the region between 16°2'S and 32°05'S and in Equatorial Surface, Peru Surface, Equatorial Subsurface, and in Temperate Surface Water. The temperature of the water containing the species (EMCI surface samples) was, with one exception, above 18.4°C. The number of animals per min was from 2 to 60, with the larger numbers in the warmer water. This shows the preference of the species for higher temperatures.

TABLE XXXIII

Distribution of *O. venusta* in the 0-140 m layer and at the surface during the day and during the night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute hauling	12	22	40	42.7

There is a strong indication that *O. venusta* migrates vertically.

The greatest concentration of *Oncaea venusta* (Zalkina 1970) is limited in depth by the 29° to 28°C isotherm, which is at 150 to 125 m depth during most of the day and at 100 m depth at night in the Tropical region of the Pacific Ocean. The upper level of the highest concentration of the species during most of the day is between 50 and 75 m deep and at night it migrates to the 25 m level.

Oncaea media Giesbrecht 1891

Material and occurrence: EMCI 0-140 m layer samples (number of specimens per min in brackets): 10(86.5), 12(14.5), 13(8.3), 14(2.4), 15(41.6), 16(16.0), 28(7 6), 37(2), 42(15.3), 45(2.1), 60(10), 70 (50), 85(38.4), 102(90). EMCI surface samples: 5(10), 7(60), 9 (7.5), 11(107.5), 12(420), 13(1), 14(0.3), 26(20), 29(30), 30(10), 42(2.0), 43(20), 60(4), 85(3), 86(10), 101(3). "Eltanin" samples: 36, 53, 57, 170 and 212.

Remarks: 14% of the 0-140 m layer EMCI samples contained the species in number between 2 and 90 per min. At the surface the frequency was higher in 19% of the samples and the abundance was higher also, from 0.3 per min to 420/min.

TABLE XXXIV

Distribution of *O. media* at the surface and in the 0-140 m layer during the day and at night

Layer sampled	Surface		0-140	
Time	Day	Night	Day	Night
Average number of specimens per minute hauling	5	57	40	14

The results indicate that *O. media* migrates vertically confirming other data (Zalkina 1970). Nearly all the samples containing the species at the surface were taken from waters with higher temperatures than 17,4°C, with one exception, thus, from Warm Surface waters or dilute Subtropical waters (in which the salinity was always below 34.5‰, though the temperature high). Thus, the distribution of the

species was usually in the northern and outermost stations of the area explored. The "Eltanin" collected the species in the Peru Surface, Equatorial Subsurface, Low Salinity and Subantarctic Surface Waters.

Oncaea conifera Giesbrecht 1891

Material and occurrence: EMCI of the 0-140 m layer samples (numbers in brackets = n.° of specimens per min): 2(1.2), 4(38.4), 6 (30 7), 7(10 7), 8(2.0), 10(13.4), 12(9.5), 13(5.5), 14(18.6), 17 (7 6), 19(15.3), 24(15.3), 28(23), 31(0.7), 32(0.7), 37(3), 39(12.5), 41(5.0), 43(14.2), 44(500), 46(7.6), 47(4.6), 48(3.8), 49(5.3), 50 (4.2), 54(0.8), 56(2.3), 57(3.0), 58(0 7), 60(0.6), 61(2.6), 62(0.7), 63(7.6), 64(109), 66(8.3), 68:69(181.8), 72(17.6), 73(5.7), 74 (15.3), 75:76(1.2), 77(170), 78(6.9), 79(4.0), 80(20.7), 82(1.5), 83(737.5), 84(19.9), 85(84.6), 86(7.1), 95(0.8), 97(7.6), 100(7.6), 101(60), 103(2.2), 105(3.0), 107(10), 112(1). The surface samples containing the species were: 14(6.6), 17(6.6), 25(1), 48(36.0), 72(0.1), 77(2), 83(2), 84(40), 85(1), 93:94(1), 112(1), and the "Eltanin" samples: 33, 94, 95, 170, 172, 176, 184, 191, 192, 194, 195, 197, 209, 212, 213.

Remarks: It was the most frequent *Oncaea* during the Marchile I expedition. It was present in 54% of the samples of the 0-140 m layer. The number per minute of hauling varied from 0 7 to 737.5, usually less than 10/min. The small size and the fusiform body of the animal may be the cause of the small number usually caught.

It was rarely present at the surface and then mostly at night. It did not appear preferentially in one certain water mass. The largest numbers (181, 500 and 737/min) in the 0-140 m layer samples occurred between 39°S and 34°S in April-March (EMCI) and from this latitude to 40°S lat. during August ("Eltanin").

In the 0-140 m layer females (173), males (105) and young (149) were caught in about the same quantity. At the surface females were more numerous, and juveniles and males appeared in very small numbers.

During the "Eltanin" cruises 3 and 4 it was caught mostly from 34°54'S to 46°15'S at the surface. Females were caught with more frequency, but in some samples there were also males and juveniles.

TABLE XXXV

Distribution of *O. conifera* in the 0-140 m layer and at the surface during the day and during the night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per minute hauling	2	11	13	48

It seems to be a migrating species from the data above, probably coming to the subsurface and surface at night and sinking to deeper layers during the day. Zalkina (1970) classifies *O. conifera* and *O. mediterranea* among the species with "extensive diurnal migration" that is, with migration from 0 to 300 m depth.

Other Oncaeidae

The following species occurred in the following samples (in brackets number of specimens per minute of sampling):

Oncaea mediterranea (Claus 1863): in EMCI samples from the 0-140 m 2(1.2), 12(2.3), 48(1.5), and 98(10.0);

Oncaea dentipes Giesbrecht 1891 — in EMCI sample from the 0-140 m 68-69(54.5);

Lubbockia aculeata Giesbrecht 1892 — in EMCI sample from 0-140 m 84(0.9);

Lubbockia brevis Farran 1908 — in the EMCI surface sample 93-94(1).

Juvenile *Oncaea* — in EMCI samples from 0-140 m 7(5.3), 34(0 7), 39(2.5), 70(50), 75:76(1.2), 81(7 6), 88(23), 90(12.5), 95(0.8), 106 (1), 107(20), 111(1) and EMCI surface samples 27(10), 33(10), 63(1), 81(1), 85(5), 111(1).

FAMILY CORYCAEIDAE

Corycaeus (*Ditrichocorycaeus*) *dubius* Farran 1911

Material and occurrence: It was found in the following samples of the

EMCI (number of specimens collected per minute in brackets): 2(2.3), 4(153.8), 5(28), 6(23), 7(491.2), 8(144), 9(185), 10(582.7), 12(3.3), 13(2.7), 14(50.6), 16(160), 17(76.9), 19(84.9), 22(1.5), 24(15.3), 25(0.7), 26(3.07), 27(0.7), 28(15.3), 29(15.3), 30(53.8), 31(1.5), 35(6.6), 37(2), 42(7 6), 44(369.2), 45(12.1), 46(4.6), 47(0 7), 56 (0.7), 58(0.7), 59(76.9), 60(1.3), 61(3.3), 62(0.7), 74(7.6), 55 (0 7), 15(58.8). At the surface it occurred in the following samples of the same expedition (number of specimens per minute in brackets): 4(10), 5(40), 6(30), 7(1140), 8(70), 9(377.5), 10(467.5), 11(107.5), 12(40), 13(5.6), 14(4.3), 16(10), 17(90), 19(90), 22(10), 26(20), 27 (30), 28(400), 29(20), 30(400), 31(5), 34(20), 35(10), 37(1), 44(20), 45(6), 63(1), 72(1), 73(2), 74(20), 90(10). "Eltanin" samples containing the species 36, 45, 49, 57, 69 taken at the surface between latitudes 8°23'S and 25°43'S.

Remarks: It was the most numerous and frequent corycaeid of the EMCI in 41% of the 0-140 m layer samples and in 36% of the surface samples. In surface waters it was frequent from 33°S to 30°S. At this latitude the largest numbers were found at the surface (377 to 1140/min). In the 150 m layer it was frequent from 30°S to 36°30'S, and from this to higher latitudes it was completely absent from the samples. The largest numbers were also registered at about 30°S in the 0-140 m layer (491 and 582.7/min). In the "Eltanin" samples it was found further North till latitude 8°23'S.

TABLE XXXVI

Distribution of *Corycaeus dubius* by day and by night in the surface and in the 0-140 m layer

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per minute of sampling	108	113	79	58

From the data above *Corycaeus dubius* is mostly a surface copepod which can also be found in the 0-140 m layer.

TABLE XXXVII

Distribution of *C. dubius* females, copepodites and males in the 0-140 m layer and at the surface by day and by night

Layer sampled		Surface		0-140 m	
Time		Day	Night	Day	Night
Average number per minute of sampling	Females	4	16	12	15
	Copepodites	30	4	15	13
	Males	22	7	20	25

The young rise to the surface and the females sink to the deeper layer during the day, while the males sink away from the surface at night.

The total number of females found in the 140 m layer was about half the number of males. In the Corycaeids the number of males is very frequently higher than the number of females, a rather unusual phenomenon when calanoids and some other cyclopoids are considered.

C. dubius at the surface usually occurred in waters with temperatures above 17°C thus in Warm Surface Water and in Subtropical Surface Water. The largest numbers of specimens were also found in these waters. The salinity of the waters in which they thrived, with one exception, was above 34.2‰. As the species was also caught in deeper layers where the temperature was usually below 17°C, it is probable that the salinity more than the temperature, limits the distribution of the species. Off southern Chile the salinities are frequently below 34‰.

The substitute species of *C. dubius* off the Atlantic coast of South America in waters with temperatures below 18°C is *C. amazonicus* (Björnberg, 1963; Ramirez, 1969) very similar to *C. dubius* in its external morphology.

Other Corycaeidae

Corycaeus (*Onychocorycaeus*) *pacificus* F. Dahl 1894 occurred during the EMCI at the following station in the 0-140 m layer during

the day, 16(8/min), 39(12.5/min), 85(7.6/min), 102(20/min), and at night at stations 12(1.6/min), 84(0 4/min), 86(7.6/min) and 100 (7 6/min). At the surface it was present during the day at stations 85(19/min), and 102(2/min), and at night at stations 11(25/min), and 84(10/min). The "Eltanin" samples of the third USARP cruise numbers 28, 29, 33, 45, 49, 57 and 60 taken in Equatorial Surface and Peru Surface Waters also contained the species. Off Peru it was caught in Surface Subtropical Waters and off Chile in Warm Surface Waters, in which the temperature of the water was above 18°C.

TABLE XXXVIII

Distribution of *Corycaeus pacificus* at the surface and in the 0-140 m layer by day and by night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average n.° of specimens per min of hauling	10	6	12	4

Corycaeus (*Agetus*) *flaccus* Giesbrecht 1891 was collected at EMCI station 12 in the 0-140 m layer (0.4/min) at night at the surface in the sample 101(10/min).

Corycaeus (*Corycaeus*) *speciosus* Dana 1849 is an indicator of warm oceanic waters off Brasil (Björnberg 1962). It occurred in only one EMCI station (13 with 8.3/min) in the North of the area sampled at night in the 0-140 m layer, and in the "Eltanin" samples 28, 29, 49 and 60 taken in Equatorial Surface and in Peru or Subtropical Surface Waters.

Corycaeus (*Corycaeus*) *crassiusculus* Dana 1849 occurred at the EMCI station 85 during the day at the surface (13/min), and in the 0-140 m layer (38.4/min), and 12 during the night (10/min) at the surface and in the 0-140 m layer (0.2/min). The water at the surface in both stations had more than 19°C temperature and salinities above 34.2‰. It was also present in Equatorial Surface Waters sampled by the "Eltanin" (Stations 28, 29).

Corycaeus (*Corycaeus*) *clausi* F. Dahl 1894 was found at the EMCI stations 84(38.4/min) from the 0-140 m layer and 86(10/min) from the surface in waters with temperature 18.4°C and salinity 33.603‰; also in the "Eltanin" station 33 in Subtropical Surface Water.

Corycaeus (*Onychocorycaeus*) *agilis* Dana 1849 was caught at the "Eltanin" stations 29, 60 and 89, at the surface in Equatorial and Subtropical Waters.

Juvenile *Corycaeus* were caught at stations 10 and 32 in numbers respectively equal to 1.9/min and 7.1/min, both in the 0-140 m layer, and in the EMCI surface samples 60(1.0/min).

Farranulla rostrata (Claus 1863) occurred during the day at stations 9 (at the surface, 62.5/min and in the 0-140 m layer, 1/min) and 93-94 (1.0/min); during the night at stations 7 (in the 0-140 m layer, 1.7/min), 8(30/min at the surface), 12(at the surface 20/min, and in the 0-140 m layer 6 4/min), 15(8.3/min in the 0-140 m layer), and 28(7.6/min in the 140 m layer). It was caught at the surface in waters with a temperature of 19°C or more and a salinity of 34.3‰ or more. The data indicate that this copepod is a surface species.

TABLE XXXIX

Distribution of *Farranulla rostrata* at the surface and in the 0-140 m layer by day and by night

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per min of sampling	63.5	50.0	1	6

Farranulla sp. was collected at the EMCI stations 80(0.07/min), at night, 85 (7.6/min) by day in the 0-140 m layer, and in the station 13(0.6/min) at the surface. The "Eltanin" samples 28 and 29 from Equatorial Waters also contained the species. Though similar to *F. gibbula* it differs in the width and shape of the abdomen, which rather resembles *F carinatus*.

Farranulla gracilis (Dana 1853) occurred once in "Eltanin" sample 28.

General comments on the Corycaeidae:

The Corycaeidae generally live in warm oceanic waters. Off South America there are 3 shelfwater species *C. giesbrechti* in warm waters above 18°C and *C. amazonicus* in cooler waters, below 18°C on the Atlantic side of the continent, and *C. dubius* characteristic of Pacific waters with 16°C to 19°C temperature. The oceanic warm water species found off the North of Chile and off Peru are *C. speciosus, C. flaccus, C. agilis,* and *Farranulla* sp. In the warmer water of the Counter Current which flows between the Peru Coastal and the Peru Oceanic Currents, and thus on the outer fringe of the area sampled by the EMCI expedition, the other species of Corycaeidae are found: *C. clausi, C. crassiusculus, C. pacificus* and again *Farranulla* sp. *F. rostrata* is characteristic of subtropical waters off Brazil and off Northern Chile. Excepting *C. dubius, C. amazonicus, C. agilis* and *C. pacificus,* the remaining species are common to waters on both sides of the continent.

The vertical distribution of the *Corycaeus* species studied here seems to conform to the general pattern of distribution found by Zalkina (1970) for the *Farranulla.* They are epipelagic copepods which usually do not live in high concentration below 120 m depth.

FAMILY SAPPHIRINIDAE

In the EMCI and the "Eltanin" samples (number out of brackets) here studied, the following sapphirinids were found (numbers in brackets represent the number of specimens collected per min of hauling):

Sapphirina ovatolanceolata-gemma Dana 1849 — EMCI surface station: 45(14). 58(0.2), 61(1), 105(1), 111(7); EMCI 0-140 m layer stations 61(4), 111(2); and in "Eltanin" stations 186, 188, 189, 191, 192, 194, 197;

Sapphirina angusta Dana 1849 — "Eltanin" samples: 85, 186, 188, 189;

Sapphirina nigromaculata Claus 1863 — "Eltanin" samples 45, 49;

Sapphirina opalina Dana 1849 — *darwini* Haeckel 1864 — "Eltanin" samples 28, 29, 53;

Sapphirina metallina Dana 1849 — "Eltanin" sample 53;

Juvenile *Sapphirina* — EMCI stations 45(5), 97(7.6) from the 0-140 m layer; "Eltanin" sample 36 from the surface;

Copilia mirabilis Dana 1849 — "Eltanin" samples 28, 29, 53;

Corina granulosa Giesbrecht 1891 — EMCI station 78(0.7) from the 0-140 m layer.

Of the above species *S. ovatolanceolata-gemma* was the most important inhabitant of Chilean waters in the 34° to the 35° Lat. S region. There it occurred mostly at the surface in the Subantarctic Surface Water. During the day its abundance sometimes surpassed that of the other copepods in the same sample (samples 186, 188, 189). At night it diminished in number at the surface. *Sapphirina angusta,* the next most numerous sapphirinid, was also found in more or less the same environment as *S. ovatolanceolata-gemma.* The other Sapphirinae and *Copilia mirabilis* are characteristic of warmer water (Lehnhofer, 1926, 1929) and therefore were mostly found in "Eltanin" samples taken off Colombia, Ecuador and Peru.

HARPACTICOIDA

FAMILIES ECTINOSOMIDAE, AEGHISTIDAE, TACHIDIIDAE, PONTOSTRATIOTIDAE AND CLETODIDAE

The following harpacticoida were found in the "Eltanin" and EMCI samples (numbers in brackets = number of specimens per min of sampling):

Euterpina acutifrons (Dana 1852) in "Eltanin" sample 216;

Microsetella norvegica Boeck 1864 — in the EMCI sample taken in 0-140 m 103(1.1);

Microsetella rosea (Dana 1852) — in the EMCI samples 12(0.2), 72(3.8), 88(23) taken in the 0-140 m;

?Aegisthus dubius Sars 1916 — in the "Eltanin" sample 175;

Aegisthus mucronatus Giesbrecht 1891 — in the "Eltanin" samples 52, 61 and 72 taken from 1082, 306 and 900 m depth respectively.

Aegisthus aculeatus Giesbrecht 1891 in the "Eltanin" sample 53 taken from 2057 m depth;

Pontostratiotes sp. in the "Eltanin" sample 43 collected from 5.314 m;

Mesocletodes sp. in the "Eltanin" sample 83 collected from 3256 m depth.

FAMILY CLYTEMNESTRIDAE

Clytemnestra rostrata (Brady 1883)

Material and occurrence: EMCI samples containing the species (number out of brackets) and number of specimens per minute (in brackets) from the 0-140 m layer: 7(7.1), 9(3), 10(7 7), 12(3.3), 13(2.7), 14 (8.0), 16(24.0), 28(7.6), 29(7.6), 30(30.7), 31(3), 32(0.7), 36(0 7), 41(0.6), 44(23 0), 45(3.5), 46(0.7), 47(4.6), 55(2.8), 57(0.7), 60 (0.6), 61(4.6), 72(1.5), 77(10 0). Surface samples of the Marchile I expedition containing specimens of *Clytemnestra rostrata* (number per minute in brackets): 7(10), 8(70), 10(2.5), 11(5), 13(3.3), 17 (80), 28(100), 29(20), 35(10), 37(1), 47(40), 57(1), 58(0 7), 61(1), 73(1). "Eltanin" sample 94.

Remarks: It is probably a surface copepod from the data in Table XL.

TABLE XL

The distribution of *Clytemnestra rostrata* at the surface and in the 0-140 m layer by day and by night during the EMCI

Layer sampled	Surface		0-140 m	
Time	Day	Night	Day	Night
Average number of specimens per minute of hauling	21	23	8	5

Clytemnestra rostrata occurred always in the northern part of the area visited by the EMCI and its numbers and frequency, high in the North diminished gradually towards the South in colder waters.

Other Harpacticoida

An unidentified harpacticoid was found at the EMCI stations 13(2.7/min) and 97(7.2/min) in 140-0 m hauls.

THE ENVIRONMENTS AND THEIR COPEPODS

The Equatorial Surface Water: Only two samples (28 and 29) of the "Eltanin" cruise 3 were taken in this environment. The mass copepods in these two samples were *Oncaea venusta, Acrocalanus gracilis, Undinula vulgaris, Eucalanus subtenuis, Calocalanus pavo* and *Nannocalanus minor*. The next most numerous species were: *Clausocalanus mastigophorus, Farranulla gracilis, Clausocalanus furcatus, Temora discaudata, Copilia mirabilis, Euchaeta marina, Centropages furcatus, Acartia danae, Corycaeus speciosus, Scolecithrix danae, Pontellina plumata, Labidocera acutifrons, Corycaeus crassiusculus, Centropages gracilis, Oithona plumifera* and *Rhincalanus rostrifrons*.

Grice (1962) studied the calanoid copepods of samples taken in the Equatorial waters between 130° E and 120° W. Abundant and frequent species listed by Grice and not present in samples 28 and 29 were: *Heterorhabdus papilliger, Haloptilus longicornis, Euaetideus acutus, Undinula darwini, Eucalanus attenuatus* and *Acartia negligens*. The species are deep-dwelling during the day, when samples 28 and 29 were collected. In the West South Equatorial region Heinrich (1960 & 1968) found *Eucalanus attenuatus, Undinula darwini, U. vulgaris, Euchaeta consimilis, E. marina, Rhincalanus cornutus* in mass quantities. *Euchaeta wolfendeni, Acrocalanus monachus, Undinula darwini, Calocalanus pavo, Acartia negligens, Pontellina plumata* and *Scolecithrix danae* also occurred in smaller numbers, but with high frequency.

In the East North Pacific in the upper 140 m layer off California where temperatures are between 11 and 27°C and salinities between 33.60-34.80‰, corresponding at the surface to the waters here studied the following species were counted in mass numbers (1-49, 999 per 1000 m^3 water) by Fleminger (1964 & 1967): *Clausocalanus furcatus*

in coastal and oceanic waters, and *Calanus helgolandicus, Ctenocalanus vanus* and *Paracalanus parvus* more numerous near to the coast. The other most frequent and abundant species were *Candacia curta, Clausocalanus jobei, C. minor, Eucalanus pileatus, E. subtenuis, Euchaeta longicornis, E. wolfendeni, Undinula vulgaris, Acartia danae, A. negligens, Paracalanus denudatus, Pleuromamma abdominalis* and *Temora discaudata.*

Most of the species in Equatorial surface waters in the East South Pacific are usually found in high salinity and temperature. The North Pacific eastern waters off California have lower salinity and temperatures and therefore the usually most numerous species off Colombia occur in small numbers off California.

The Surface Water of South Temperate latitudes or the Subantarctic Surface Water:

There are 13 "Eltanin" samples from this environment characterized by 5-15°C temperature, 34 to 35.5‰ salinity.

The most frequent and numerous species in this water were: *Clausocalanus parapergens, Metridea lucens, Paracalanus indicus, Rhincalanus nasutus, Clausocalanus furcatus, Pleuromamma piseki, Nannocalanus minor, Oncaea conifera* and *Pleuromamma abdominalis,* in decreasing order of abundance. Recurring species, in smaller numbers usually, are *Centropages brachiatus, Euchirella pulchra, Scaphocalanus echinatus, Sapphirina ovatolanceolata, Calocalanus tenuis, Calanus australis.*

In the EMCI samples *Paracalanus indicus* was the most numerous and frequent (in 26 samples it was among the three most abundant copepod species), followed by *N. minor* (most numerous in 9 samples), *Acartia tonsa* and *Rhincalanus nasutus* (in 6 samples), *Centropages brachiatus* and *Drepancpus forcipatus* (among the 3 most abundant in 5 samples), *Clausocalanus parapergens* (in 4 samples), *Calanoides patagoniensis* (in 2 samples), *Scaphocalanus echinatus, Clausocalanus arcuicornis, Calanus australis, Heterorhabdus papilliger, Clausocalanus furcatus, Oithona atlantica* (among the three most numerous in one sample).

The Peru Surface Water:

Six "Eltanin" plankton samples and one "Marchile I expedition" plankton probe of this water give a general idea of the species compo-

sition. During the daylight at sunrise or/and at sunset *Clausocalanus furcatus, Calanus australis, Paracalanus "parvus"* and *Nannocalanus minor* were found in greatest numbers. At noon *Oithona plumifera, Corycaeus pacificus* and *Acartia negligens* were the most abundant. At night *Pleuromamma piseki, Clausocalanus jobei, Lucicutia flavicornis, Acartia tonsa, Eucalanus subtenuis, Nannocalanus minor* and *Euchaeta marina* were amongst the most numerous.

Other recurring species in smaller numbers: *Oncaea venusta, Clausocalanus furcatus, Corycaeus dubius, Eucalanus inermis, Labidocera acutifrons, Sapphirina nigromaculata, Eucalanus attenuatus, Centropages brachiatus, Ischnocalanus plumulosus, Calocalanus pavo.* A *Candacia* is usually also present: either *C. curta* or *C. bipinnata.*

It is probable that the waters visited by the second Marchile expedition belong to the Peru Surface Water.

The Low Salinity Water:

It has low salinity and low temperature and occurs off the South of Chile. There were seven "Eltanin" samples, and seventeen Marchile I expedition samples of this environment.

In March and April *Centropages brachiatus* was the most abundant and frequent copepod in this habitat, both during the day and during the night at the surface. In the upper 140 m layer *Centropages brachiatus* was also numerous but not always the most abundant at that time. *Rhincalanus nasutus, Metridea lucens, Drepanopus forcipatus, Calanoides patagoniensis, Oithona atlantica, Paracalanus "parvus"* and *Acartia tonsa* were frequently the greatest in number in April. In August samples *Centropages brachiatus, Rhincalanus nasutus, Clausocalanus parapergens* and *Metridea lucens* (especially at night), *Calanus australis* (more in the higher latitudes) and *C. tonsus* (still further south) were the most numerous. *Oithona atlantica, Clausocalanus ingens, C. pergens, C. brevipes, Pleuromamma piseki, Calanus tenuicornis, Oncaea conifera, Oithona similis, Eucalanus longiceps, Dolichocerea tenuis, Candacia cheirura, Mecynocera clausi* recur frequently in the samples, though not always in high numbers.

Off São Francisco in the Northern Hemisphere there is an environment with lower salinities and higher temperatures than the Low Salinity Water (see Fleminger, 1964). There *Calanus helgolandicus, Eucalanus bungii* and *Metridea lucens* are the most abundant.

The Surface Antarctic Water:

One sample taken in the Drake Passage confirmed the data found in the literature (Bradford, 1971; Vervoort, 1965, and others) about the copepod composition of its water taken in the order of decreasing number of specimens: *Rhincalanus gigas, Calanoides acutus, Metridea lucens, Haloptilus oxycephalus, Gaidius tenuispinus, Scolecithricella ovata, Scaphocalanus brevicornis, Racovitzanus antarcticus, Heterorhabdus austrinus, Pleuromamma robusta* subsp. *antarctica, Paraeuchaeta antarctica, Metridea curticauda,* etc.

In a sample taken through Circumpolar Antarctic and in the Transition Layer waters, the following copepods were found in the order of decreasing abundance: *Calanoides acutus, Rhincalanus gigas, Metridea gerlachei* and *Gaidius tenuispinus.*

The Deep Layers:

The distribution in the deep layers in the Antarctic Intermediate Water (between 500 and 1000 m depth more or less); in the Upper Deep Water (below 1000 m); in the Lower Deep Water (from 2000 to 3500 m depth more or less); and in the Bottom Water (below 4000 m) is summarized in the List 3. Some species are probably contaminants from the upper layers. The results referring to the copepods living in the upper layers, mostly those collected during the EMCI are relatively precise, whereas those about the deep water inhabiting species are not. The samples were collected with an open trawl from different depths to the surface, thus passing through various water masses. There is no way of knowing at what precise depth the specimens were collected. The List 3 which surveys all the species found in these samples shows which occurred only in samples taken from the deepest layers and which were also present in hauls from intermediate depths or from the surface.

A few interesting data can be inferred from the study of the List and from the comparison of its contents to the contents of the surface samples, as follows below and in the "Discussion"

Copepods which occur in the Antarctic Surface Water and in the Subantarctic Surface Water near to the Convergence are found in smaller latitudes at great depths. An example is *Calanus simillimus* which was collected in a haul from the Bottom Water at latitude 30°S more or less, and *Rhincalanus gigas* which was taken in a haul from

lower Deep Water to the surface at lat. 13°S (Björnberg and Yamanaka, 1969).

Basin Water: It contained *Paracalanus indicus, Mecynocera clausi, Centropages brachiatus, Clausocalanus furcatus, Drepanopus forcipatus, Clausocalanus arcuicornis.*

Discussion: The explanation of the data obtained during the EMCI is rendered very difficult because of the complexity of the current system.

In the study of the plankton three gradients must be considered at each time of the year: the gradient shore-oceanic waters; the gradient surface-depth; and the cold-warm water gradient which lies on the South-Equator Meridian parallel to the coast.

Usually the first gradient is characterized by low salinity and low depth adapted forms *Acartia tonsa* and *Drepanopus forcipatus* which are successively substituted by forms adapted to higher salinity and deeper water (*Nannocalanus minor*). Off Peru and Chile the plankton grades from species adapted to colder water near the shore to species adapted to warmer water off-shore, because there is upwelling of cold water near the coast.

The surface-depth gradient, observable off-shore in the oceanic region, is commonly formed at one end by warm surface adapted omnivorous or herbivorous species and at the other end by carnivorous or dead particle feeder species adapted to cold waters, depth, and to absence of light. In the Peru-Chile region this picture is complicated by the occurrence, in the subsurface counter-current, of subtropically originated species, living below the colder water adapted species of the surface. The counter-current-warm-water species migrate to the surface at night and cold water forms are then found mixed with warmer water indicating forms.

The third gradient lying in a north-south direction is formed in the Equatorial region by a community of warm water indicator species such as *Undinula vulgaris, Temora discaudata, Farranulla* sp., etc. and in the Antarctic region by the cold water community.

A fourth gradient which registers change in time can only be considered when collections are made all the year round.

At each latitude and longitude these gradients should be considered.

If the mass plankton species are plotted at each collecting station we easily obtain the general picture of the succession of species groups in each area along each of the gradients.

The Atlantic compared to the SE Pacific copepod groups off South America:

The copepod groups characteristic of the tropical, subtropical and subantarctic regions are easily recognized in the Atlantic off South America probably because of the steeper gradients in salinity and temperature observed from one water mass to the other, and the presence of the wide shelf waters. In the South East Pacific there is a considerable mixing of cold, temperate and warm waters owing to the upwelling and to the subsurface and surface warm counter currents. All this contributes towards the striking uniformity of the group compositions off Peru and Chile. Only when the number and quality of the species are compared at the extreme latitudinal limits of the water masses, is it possible to detect a change in the composition of the groups. Usually there is a gradual modification hardly ever observed in the Atlantic South American waters.

Off Peru and Chile two main groups can be distinguished — the *Nannocalanus — Paracalanus — Clausocalanus furcatus* combination of species and, in the Low Salinity water region, the *Centropages brachiatus — Drepanopus forcipatus* group. *Metridea lucens* gradually substitudes *Paracalanus "parvus"* in numbers from 38°S latitude southwards. *Rhincalanus nasutus* and *Pleuromamma piseki* take the place of *Nannocalanus* in abundance from 34°S to 46°S over deep waters off the coast.

Low Salinity Water is found off Argentine in the Atlantic (Ramírez, 1969, 1970, 1971) with temperatures similar to those found off Chile. The copepods occurring in this water are more or less the same as those found in the Pacific in the same environment: *Centropages brachiatus, Drepanopus forcipatus, Calanus australis, Oithona atlantica* or *O. helgolandica, Paracalanus "parvus"*, and *Clausocalanus brevipes* (Ramírez, 1970). The Low Salinity Waters off Chile differ from those off Argentine by the presence of *Calanoides patagoniensis* (*Calanoides carinatus* off Argentine) and *Calanus tonsus* (*C. propinquus* off Argentine).

The Atlantic cold waters off S. America between the 30°S and 50°S near to the continent are characterized by the presence of *Cteno-*

calanus vanus, a shelf water copepod, usually absent or rare in the Pacific between the same latitudes. The southern plankton on both sides of the continent is largely influenced by the West Wind Drift. The differences observed are probably due to the presence of a very wide continental shelf on the Atlantic side. All the large vertical migrators which need depth of water for their diurnal wanderings are therefore separated from the coastal water fauna by the shelf water off Argentine.

The copepod group found by Vidal (1966) off the north of Chile is formed chiefly by *Acartia negligens* and *Paracalanus "parvus"* between the latitudes 18°S and 21°S. *A. negligens* is frequent in the oceanic waters of the Subtropical Convergence off Brazil and Argentine (Ramírez, 1971). The other abundant species occurring off Peru and found by Vidal off northern Chile (*C. pavo, I. plumulosus, M. clausi, C. "arcuicornis", Clausocalanus furcatus, C. brachiatus, C. australis,* and *N. minor*) form a "mixture" group of indicators of several habitats, which is absent in the SW Atlantic.

The copepods characteristic of Equatorial and Tropical Waters (*O. venusta, E. subtenuis, U vulgaris, A. gracilis, C. mastigophorus, T. discaudata, C. pavo, E. marina*) are more or less the same off Brazil, where *T. stylifera, E. attenuatus,* and *A. longicornis* are substitute species. The large Calanidae from the SE Pacific are found only in the cold oceanic waters off Argentine. From the 50°S to the 57°S *C. laticeps, C. propinquus* and *R. gigas* seem to form one of the chief copepod groups on both sides of the continent.

In the warmer subtropical and tropical regions the coastal waters on the Atlantic side of S. America are inhabited by *A. lilljeborgi,* the substitute of *A. tonsa,* characteristic of colder coastal waters off Argentine and in the SE Pacific.

Lists 3 and 4 summarize the horizontal and the vertical distribution of the species found in the samples of the Marchile I expedition and of the "Eltanin" cruises here studied.

LIST 3

Copepod species present in deep water "Eltanin" samples taken in the SE Pacific. The number of crosses represents the frequency of occurrence in the samples

Species	Sampling range					
	0-400 m	0-700 m	0-1000 m	0-2500 m	0-4000 m	0-6000 m
Aegisthus aculeatus				x		
Aegisthus dubius				x		
Aegisthus mucronatus	x		xx			
Aetideopsis multiserrata			xx	x	x	
Aetideus armatus			x	x	x	
Amalothrix arcuata				x		
Amalothrix curticauda				x		
Amalothrix dentipes	x	x	xx	xx	x	
Amalothrix emarginata?			x			
Amalothrix obtusifrons				x		
Amalothrix polaris				x		
Amalothrix propinqua			x	xx		x
Amalothrix robusta	x			xx	x	
Amalothrix valens				x		
Amalothrix valida				x		
Arietellus setosus	x			x		
Arietellus simplex		x		xx	x	
Augaptilina scopifera				x		
Augaptilus anceps				xx		
Augaptilus glacialis	x			x		
Bathycalanus bradyi			x	xxxx		
Bathycalanus eltaninae				x		
Bathycalanus princeps				xxxxx		
Bathycalanus unicornis				x		
Bathypontia sp.				x	x	
Bradycalanus pseudotypicus				xx		
Calanoides acutus		x				
Calanus australis	x	xx	x	xxx	xx	xx
Calanus propinquus			x			
Calanus simillimus			x			x
Calanus tenuicornis				x		
Calanus tonsus	x	x	xxxxx	xxxx		
Candacia cheirura		x	xx	x		
Candacia curta			x	x	x	x
Candacia longimana			x			
Candacia pachydactyla				x		
Centraugaptilus cuculatus					x	
Centraugaptilus horridus	xx					
Centraugaptilus rattrayi			x	xx	x	
Centropages brachiatus	x	x	xx	xxxx	x	xx
Centropages furcatus			x			x
Cephalophanes frigidus				x		
Chiridiella macrodactyla				x		
Chiridiella sp.				xx		

LIST 3 (Continuation)

Species	Sampling range					
	0-400 m	0-700 m	0-1000 m	0-2500 m	0-4000 m	0-6000 m
Chiridius armatus					x	
Chiridius gracilis				x	x	
Chiridius obtusifrons			x			
Chiridius poppei				xx		
Chiridius sp.			x			
Clausocalanus furcatus				x		xx
Clausocalanus ingens		x	xx	xx	x	
Clausocalanus laticeps			x			
Clausocalanus parapergens				x		
Copilia mirabilis				x		
Cornucalanus chelifer		x	xxx	xxxx	xx	
Cornucalanus robustus			x	xx		
Cornucalanus simplex				x		
Disseta palumboi		x	x	x		
Dolichocerea tenuis		x				
Euaetideus bradyi		x	xx	xx	x	
Euaugaptilus copepodite				x		
Euaugaptilus filiger	x			x		
Euaugaptilus fungiferus			x	xx		x
Euaugaptilus grandicornis				x		
Euaugaptilus laticeps			x	x	x	
Euaugaptilus longimanus				x	x	
Euaugaptilus magnus	x		xx	xxxx		
Euaugaptilus nodifrons				x		
Euaugaptilus sp.						x
Eucalanus attenuatus		x		x	x	x
Eucalanus bungii		x	xx	xx	x	xx
Eucalanus elongatus hyalinus	x	x	x	xxx		xxxxx
Eucalanus longiceps	x	x	xxxx	xxxxx		
Euchaeta longicornis						x
Euchaeta marina		x				xx
Euchirella bella		x	x			
Euchirella brevis		x				
Euchirella curticauda			x	x		
Euchirella formosa			x			
Euchirella galeata	x					
Euchirella pulchra	x	x			xx	
Euchirella rostrata	x					
Euchirella rostromagna	x	x	x			
Euchirella similis	xx	x	x	xxxx	x	
Euterpina acutifrons			x			
Farrania frigida				x		x
Gaetanus antarticus	x			xxxxx		
Gaetanus curvicornis				x		
Gaetanus divergens			x		x	
Gaetanus hamatus				x		
Gaetanus kruppii	xx		x	xx		
Gaetanus latifrons	x		x	x	x	

LIST 3 (Continuation)

Species	Sampling range					
	0-400 m	0 700 m	0-1000 m	0-2500 m	0-4000 m	0-6000 m
Gaetanus miles	x		x	xx		
Gaetanus pileatus		x		x		
Gaetanus recticornis	x					
Gaetanus simplex			x			
Gaidius affinis			xxxx	xxx		
Gaidius brevicaudatus				x		
Gaidius brevispinus		xx	xx	x	x	
Gaidius intermedius			x		x	
Gaidius pungens	x		xxx	xxxx		
Gaidius robustus				xx	x	
Gaidius tenuispinus		x		x		
Gaussia princeps		x		xxx	xx	
Haloptilus longicornis				x		
Hemirhabdus grimaldii		x				
Heterorhabdus abyssalis				x		
Heterorhabdus austrinus	x?	x	xx	xxx		
Heterorhabdus compactus			x	x		
Heterorhabdus farrani			x	xx		
Heterorhabdus pustulifer				xx		
Heterorhabdus robustus	x	x	xx			
Heterorhabdus spinifrons	x	x	x			
Heterostylites longicornis				x	x	
Heterostylites major			x			
Labidocera aestiva			x	x		
Labidocera acutifrons				x		
Lophothrix frontalis	x	x	x	xx	xx	
Lophothrix humilifrons				xx		x
Lophothrix quadrispinosa				x		
Lophothrix sarsi				xx		
Lophothrix similis				x	x	
Lophothrix simplex						x
Lucicutia aurita	x		x	x		
Lucicutia bicornuta			x	xx	x	
Lucicutia curta			x			
Lucicutia formosa				x		
Lucicutia grandis		x	xx	xxx	x	x
Lucicutia longicornis					x	
Lucicutia lucida	x					
Lucicutia magna	x		x		x	
Lucicutia maxima			x	xxxx		
Lucicutia pacifica				x		
Lucicutia pellucida				x		
Lucicutia rara			x			
Lucicutia tenuicauda			x			
Lucicutia wolfendeni			x	x	x	
Megacalanus princeps		x	xxx	xxx	xx	xx
Metridea brevicauda			x	xxxx	xx	
Metridea curticauda	x	x	xxx	x		

LIST 3 (Continuation)

Species	Sampling range					
	0-400 m	0-700 m	0-1000 m	0-2500 m	0-4000 m	0-6000 m
Metridea gerlachei	x	x	xxx	xx		
Metridea gurjanovae		x		x		
Metridea longa						x
Metridea lucens	x	x	xxxx	xxx	x	
Metridea princeps		x	xxx	xxxxx	x	
Metridea venusta					x	
Nannocalanus minor		x		xxx		xx
Neocalanus gracilis	x					
Neocalanus robustior					x	
Oithona plumifera				x		
Oithona similis						x
Oncaea conifera		x				
Oncaea media				x		
Onchocalanus magnus			x?	x		
Onchocalanus trigoniceps				xxxx		
Pachyptilus eurygnathus				xx		
Pachyptilus lobatus				x		
Pachyptilus pacificus			x			
Paracandacia simplex		x	x			
Phyllopus bidentatus					x	
Phyllopus impar	x			x		
Phyllopus integer					x	
Pleuromamma abdominalis	xx	xx	xxxxx	xxxxxx	x	x
Pleuromamma borealis		x		x		
Pleuromamma gracilis				xx	x	
Pleuromamma piseki		x	x	xx	x	
Pleuromamma quadrungulata	x	x	x	x	x	
Pleuromamma xiphias	x		x	x	x	
Pseudeuchaeta brevicauda				xxx		
Pseudeuchirella crytospina				x	x	
Pseudeuchirella divaricata				x		
Pseudeuchirella dubia				x		
Pseudeuchirella hirsuta		x	xx	xxxxx		
Pseudeuchirella mawsoni	x	x		xxxxx		
Pseudeuchirella notacantha			x			
Pseudeuchirella obtusa				xx		
Pseudeuchirella polyspina				x		
Pseudeuchirella pustulifera		x		xx		
Pseudeuchirella semispina			x			
Pseudeuchirella squalida	x		x	x		
Racovitzanus antarcticus			x	x		
Rhincalanus gigas	xx	xx	xxx	xxxxx	xx	xx
Rhincalanus nasutus	x	x	xx	xxxxx		x
Rhincalanus rostrifrons		x				
Sapphirina metallina				x		
Sapphirina opalina-darwini				x		
Scaphocalanus affinis	x		x			
Scaphocalanus brevicornis			x	x	x	

Species	Sampling range					
	0-400 m	0 700 m	0-1000 m	0-2500 m	0-4000 m	0-6000 m
Scaphocalanus curtus	x					
Scaphocalanus echinatus	x	x		xx		
Scaphocalanus longifurca			x	x		
Scaphocalanus magnus	x	xx		xxxxx	x	
Scolecithricella dentata	xx	x				
Scolecithrix bradyi		x	x	x		
Scolecithrix danae		x				
Scottocalanus persecans		x			x	
Scottocalanus terranovae						x
Snelliaetideus arcuatus				x		
Spinocalanus abyssalis				xx		
Spinocalanus magnus				x		
Spinocalanus sp.			xx	x		x
Spinocalanus spinosus				x		
Temorites brevis				x		x
Undeuchaeta intermedia			x	x	x	
Undeuchaeta major	x			xxx		
Undeuchaeta plumosa		x	x	x	x	
Undinulla darwini				x		
Undinulla vulgaris					x	
Valdiviella brevicornis				x		
Valdiviella insignis		x	xx	xxxxx		
Valdiviella minor			x	x		
Valdiviella oligarthra				xx		
Xanthocalanus calaminus				x		
Xanthocalanus muticus?				x		

LIST 4

The known horizontal distribution range of the plankton copepods (Brodsky 1964, 1967; Fagetti 1962; Frost and Fleminger 1968; Grice 1963; Heinrich 1971; Hülsemann 1966; Vervoort 1948, 1957; Vidal 1966; Wilson 1942, 1950) off West South America compared to their distribution area during the EMCI and the "Eltanin" cruises

Species	Extreme latitudes of occurrence in EMCI and "Eltanin" samples	Known latitudinal distribution off West South America
Acartia clausi +	34°08'S	—
Acartia danae	02°35'N — 40°55'S	06°32'N — 39°S
Acartia negligens ++	16°02'S — 38°17'S	06°32'N — 34°35'S
Acartia tonsa ++	08°24'S — 42°16'S	12°S — 33°S
Acrocalanus gracilis	02°35'N — 31°51'S	06°32'N — 40°S
Acrocalanus longicornis	29°55'S	06°32'N — 29°S
Aegisthus aculeatus ++	18°19'S — 18°21'S	03°S
Aegisthus mucronatus ++	16°30'S — 31°07'S	03°S
Aetideopsis multiserrata +	16°12'S — 56°09'S	—
Aetideus armatus ++	08°23'S — 56°12'S	06°32'N — 29°29'S
Amalothrix arcuata	16°30'S — 16°31'S	06°32'N — 17°26'S
Amalothrix curticauda	18°19'S — 18°21'S	17°26'S — 22°50'S
Amalothrix dentipes +	16°30'S — 47°26'S	—
Amalothrix emarginata +	37°28'S — 37°30'S	—
Amalothrix obtusifrons ++	38°09'S	02°40'S — 17°26'S
Amalothrix polaris +	16°30'S — 40°54'S	—
Amalothrix propinqua ++	13°15'S — 58°00'S	—
Amalothrix robusta +	08°19'S — 45°19'S	—
Amalothrix valens +	16°12'S — 18°21'S	—
Amalothrix valida ++	18°19'S — 18°21'S	31°54'S
Arietellus setosus ++	18°19'S — 52°53'S?	00°27'N — 15°07'S
Arietellus simplex ++	07°47'S — 46°35'S	02°40'S — 20°29'S
Augaptilina scopifera +	40°46'S — 40°54'S	—
Augaptilus anceps ++	18°19'S — 38°30'S	06°30'S — 21°36'S
Augaptilus glacialis ++	23°32'S — 40°54'S	33°08'S
Augaptilus longicaudatus ++	38°17'S	06°32'N — 29°06'S
Bathycalanus bradyi +	38°09'S — 58°00'S	—
Bathycalanus eltaninae +	38°09'S	—
Bathycalanus inflatus +	56°06'S	—
Bathycalanus princeps +	38°09'S — 58°00'S	—
Bathycalanus unicornis +	40°46'S — 40°54'S	—
Bradycalanus pseudotypicus +	38°09'S	—
Bryaxis brevicornis +	52°53'S	—
Calanoides acutus ++	54°54'S — 64°54'S	57°S — 71°S
Calanoides patagoniensis ++	29°57'S — 42°16'S	33°S — 53°S
Calanus australis	07°43'S — 44°45'S	01°S — 52°S
Calanus propinquus +	54°54'S — 56°12'S	—
Calanus simillimus ++	25°39'S? — 56°09'S	45°S — 70°S
Calanus tenuicornis	29°57'S — 45°19'S	02°54'N — 55°S
Calanus tonsus	23°12'S — 52°53'S	03°15'S — 60°S
Calocalanus contractus +	29°55'S	—
Calocalanus pavo	02°35'N — 34°08'S	06°32'N — 38°30'S
Calocalanus pavoninus +	29°55'S — 40°55'S	—
Calocalanus styliremis ++	29°55'S — 40°55'S	Equator — 38°S
Candacia bipinnata	13°15'S	05°22'N — 27°S

LIST 4 (Continuation)

Species	Extreme latitudes of occurrence in EMCI and "Eltanin" samples	Known latitudinal distribution off West South America
Candacia curta	02°34'N — 42°16'S	05°22'N — 50°20'S
Candacia cheirura +	39°58'S — 56°09'S	(45°S — 52°S)
Candacia longimana ++	38°17'S — 58°00'S	00°27'S — 32°S
Candacia pachydactyla ++	07°45'S — 31°06'S	05°22'N — 40°S
Candacia tenuimana ++	31°02'S — 33°03'S	04°19'S — 11°13'S
Centraugaptilus cuculatus ++	46°15'S — 46°35'S	10°17'S — 15°05'S
Centraugaptilus horridus ++	23°32'S — 44°45'S	10°17'S — 12°00'S
Centraugaptilus rattrayi ++	31°10'S — 56°09'S	10°17'S — 22°50'S
Centropages brachiatus	07°45'S — 45°19'S	02°05'S — 53°S
Centropages bradyi	29°37'S — 39°20'S	20°10'S — 42°43'S
Centropages furcatus ++	02°34'N — 52°55'S	04°21'S — 22°41'S
Centropages gracilis ++	02°35'N	18°29'S — 19°35'S
Cephalophanes frigidus +	16°30'S	—
Chiridiella macrodactyla +	18°19'S — 18°20'S	—
Chiridius armatus ++	31°14'S	04°02'S
Chiridius gracilis +	16°12'S — 16°30'S	—
Chiridius obtusifrons +	52°55'S	—
Chiridius poppei ++	40°54'S — 45°19'S	31°54'S
Clausocalanus arcuicornis	23°21'S — 23°42'S	05°N — 40°S
Clausocalanus brevipes ++	33°06'S — 39°59'S	46°35'S — 60°S
Clausocalanus farrani ++	38°17'S — 39°58'S	(20°S — 35°S)
Clausocalanus furcatus ++	02°34'S — 42°00'S	08°N — 35°S
Clausocalanus jobei ++	29°56'S — 39°58'S	10°N — 35°S
Clausocalanus ingens ++	31°02'S — 52°53'S	30°S — 40°S
Clausocalanus laticeps ++	35°48'S — 56°12'S	(45°S — 60°S)
Clausocalanus lividus ++	32°59'S — 35°34'S	34°S — 40°S
Clausocalanus mastigophorus ++	02°34'N — 38°17'S	34°S — 40°S
Clausocalanus parapergens ++	23°21'S — 51°07'S	05°N — 45°S
Clausocalanus pergens	31°01'S — 40°54'S	Equator — 40°S
Clytemnestra rostrata ++	29°56'S — 39°02'S	06°32'N — 33°59'S
Copilia mirabilis ++	02°35'N — 18°20'S	02°18'S — 22°54'S
Cornucalanus chelifer +	25°42'S — 56°09'S	—
Cornucalanus robustus +	46°15'S — 58°00'S	(Antarctic)
Cornucalanus simplex +	18°19'S — 18°21'S	—
Corycaeus agilis	02°34'N — 32°01'S	06°32'N — 37°S
Corycaeus clausi ++	07°04'S — 39°01'S	06°16'N — 33°59'S
Corycaeus crassiusculus	02°35'N — 38°17'S	06°32'N — 37°S
Corycaeus dubius ++	08°23'S — 39°03'S	06°16'N — 31°49'S
Corycaeus flaccus	29°57'S — 39°59'S	06°32'N — 39°51'S
Corycaeus pacificus ++	02°35'N — 39°59'S	06°32'N — 31°49'S
Corycaeus speciosus ++	02°35'N — 31°02'S	Equator — 12°S
Ctenocalanus vanus ++	29°57'S — 40°53'S	03°S
Disseta palumboi ++	07°47'S — 45°01'S	03°S
Dolichocerea tenuis +	29°57'S — 42°16'S	—
Drepanopus forcipatus ++	29°56'S — 44°46'S	49°S — 53°01'S
Euaetideus bradyi ++	16°12'S — 56°09'S	19°00'S — 32°S
Euaugaptilus filiger ++	33°09'S — 33°00'S	32°03'S
Euaugaptilus fungiferus +	16°30'S — 40°54'S	—
Euaugaptilus grandicornis +	18°19'S — 18°21'S	—
Euaugaptilus laticeps ++	16°12'S — 40°54'S	04°02'S — 22°50'S
Euaugaptilus longimanus ++	18°19'S — 31°14'S	05°11'S — 22°50'S
Euaugaptilus magnus ++	16°30'S — 56°09'S	05°11'S — 12°07'S

LIST 4 (Continuation)

Species	Extreme latitudes of occurrence in EMCI and "Eltanin" samples	Known latitudinal distribution off West South America
Eucalanus attenuatus	02°34'N — 40°55'S	06°32'N — 45°31'S
Eucalanus bungii +	07°47'S — 52°53'S	—
Eucalanus crassus ++	29°57'S — 37°08'S	06°16'N — 35°59'S
Eucalanus elongatus-hyalinus ++	08°00'S — 45°19'S	06°32'N — 39°51'S
Eucalanus inermis ++	07°45'S — 34°56'S	18°25'S — 20°50'S
Eucalanus longiceps ++	31°55'S — 52°53'S	45°S — 60°S
Eucalanus monachus ++	29°56'S — 31°49'S	06°32'N — 22°54'S
Eucalanus pileatus ++	52°53'S — 52°55'S	00°27'N
Eucalanus subcrassus ++	16°02'S	00°27'N — 12°30'S
Eucalanus subtenuis ++	02°34'N — 31°55'S	01°32'S — 27°S
Euchaeta acuta	25°43'S — 35°34'S	06°32'S — 37°S
Euchaeta longicornis	07°45'S — 08°05'S	04°35'N — 12°07'S
Euchaeta marina	02°34'N — 29°57'S	07°37'N — 42°43'S
Euchaeta weberi +	29°57'S — 34°56'S	—
Euchirella bella	07°47'S — 16°30'S	00°27'N — 22°54'S
Euchirella brevis	07°47'S	07°37'N — 38°29'S
Euchirella curticauda ++	46°15'S — 47°26'S	12°39'S — 26°30'S
Euchirella formosa +	47°03'S — 47°26'S	—
Euchirella galeata	23°32'S	01°36'N — 27°S
Euchirella mawsoni +	41°01'S	(Antarctic)
Euchirella pulchra ++	35°31'S — 41°01'S	02°30'S — 29°S
Euchirella rostrata ++	41°41'S — 41°45'S	06°32'S — 39°51'S
Euchirella rostromagna +	23°32'S — 52°09'S	(Antarctic)
Euchirella similis +	07°45'S — 46°35'S	—
Euchirella truncata +	38°17'S	—
Farrania frigida +	32°03'S — 32°01'S	—
Farranulla gracilis	02°34'N	06°10'N — 33°59'S
Farranulla rostrata ++	29°56'S — 39°59'S	06°32'N — 38°29'S
Gaetanus antarcticus +	18°19'S — 46°35'S	—
Gaetanus curvicornis +	38°09'S — 38°30'S	—
Gaetanus divergens +	31°10'S — 51°45'S	—
Gaetanus hamatus +	18°19'S — 18°21'S	—
Gaetanus kruppii ++	16°30'S — 51°45'S	01°31'N — 31°54'S
Gaetanus latifrons +	18°19'S — 47°26'S	—
Gaetanus miles ++	18°19'S — 45°19'S	05°59'N — 31°54'S
Gaetanus minor	29°56'S	04°16'N — 31°54'S
Gaetanus pileatus ++	07°47'S — 47°26'S	06°30'S — 22°50'S
Gaetanus recticornis ++	23°32'S — 23°34'S	04°02'S — 18°47'S
Gaetanus simplex +	16°30'S — 16°31'S	—
Gaidius affinis ++	16°30'S — 58°00'S	12°00'S — 31°54'S
Gaidius brevicaudatus ++	45°01'S — 45°19'S	12°53'S — 20°29'S
Gaidius brevispinus ++	07°47'S — 56°09'S	00°27'N — 08°07'S
Gaidius intermedius +	31°05'S — 31°14'S	—
Gaidius pungens ++	18°21'S — 64°54'S	01°03'N — 25°27'S
Gaidius robustus +	31°10'S — 40°54'S	—
Gaidius tenuispinus ++	18°19'S — 63°04'S	01°37'S — 27°04'S
Gaussia princeps +	07°48'S — 51°43'S	—
Haloptilus acutifrons ++	29°57'S — 38°15'S	06°32'N
Haloptilus longicornis ++	29°56'S — 40°46'S	06°32'N
Haloptilus oxycephalus ++	63°01'S — 63°05'S	13°53'S
Haloptilus spiniceps ++	34°59'S	06°32'N
Hemirhabdus grimaldi +	07°45'S	—

LIST 4 (Continuation)

Species	Extreme latitudes of occurrence in EMCI and "Eltanin" samples	Known latitudinal distribution off West South America
Heterorhabdus abyssalis +	18°19'S — 45°01'S	—
Heterorhabdus austrinus +	18°19'S — 63°04'S	—
Heterorhabdus compactus ++	16°30'S — 25°44'S	31°54'S
Heterorhabdus farrani +	40°46'S — 58°00'S	—
Heterorhabdus papilliger ++	07°45'S — 45°19'S	06°32'N — 38°29'S
Heterorhabdus pustulifer? +	41°01'S — 41°19'S	—
Heterorhabdus robustus +	23°32'S — 56°06'S	—
Heterorhabdus spinifrons ++	07°47'S — 44°45'S	03°15'S — 31°49'S
Heterostylites longicornis ++	31°01'S — 40°46'S	06°32'N — 38°29'S
Heterostylites major +	29°56'S — 56°09'S	—
Ischnocalanus plumulosus ++	13°15'S — 44°46'S	06°32'N — 38°29'S
Labidocera acutifrons ++	02°35'N — 52°53'S	00°40'S — 20°10'S
Labidocera acuta	07°45'S	07°37'N — 31°54'S
Labidocera aestiva +	18°19'S — 52°55'S	—
Lophothrix frontalis +	23°32'S — 47°26'S	—
Lophothrix humilifrons ++	18°19'S — 18°21'S	31°54'S
Lophothrix quadrispinosa +	40°54'S	—
Lophothrix sarsi ++	38°09'S — 40°54'S	22°50'S
Lophothrix similis +	18°19'S — 46°35'S	—
Lophothrix simplex +	14°13'S	—
Lubbockia aculeta ++	38°17'S	06°32'N — 33°59'S
Lubbockia brevis +	38°17'S — 39°58'S	—
Lucicutia aurita ++	16°30'S — 46°35'S	34°S
Lucicutia bicornuta ++	16°30'S — 46°35'S	05°59'N — 34°S
Lucicutia clausi	07°45'S — 35°33'S	06°32'N — 36°51'S
Lucicutia curta ++	16°30'S — 33°04'S	29°17'S — 31°49'S
Lucicutia flavicornis ++	02°34'N — 42°16'S	06°32'N — 33°52'S
Lucicutia formosa +	40°46'S	—
Lucicutia gemina +	29°56'S	—
Lucicutia grandis ++	07°47'S — 58°00'S	01°N — 22°50'S
Lucicutia longicornis ++	31°14'S — 33°06'S	03°46'N — 31°54'S
Lucicutia lucida +	23°34'S	—
Lucicutia macrocera +	25°42'S	—
Lucicutia magna ++	08°00'S — 31°14'S	34°S
Lucicutia maxima ++	18°19'S — 56°09'S	34°S
Lucicutia ovalis ++	04°04'S — 42°16'S	03°S — 20°48'S
Lucicutia pacifica +	40°54'S	—
Lucicutia pellucida +	40°46'S	—
Lucicutia rara +	56°06'S — 56°09'S	—
Lucicutia tenuicauda +	31°07'S	—
Lucicutia wolfendeni +	31°10'S — 40°54'S	—
Megacalanus princeps ++	07°45'S — 58°00'S	03°46'S — 36°54'S
Mecynocera clausi	02°34'N	07°46'N — 40°24'S
Metridea brevicauda ++	16°10'S — 46°36'S	16°49'S — 29°17'S
Metridea curticauda ++	07°47'S — 63°05'S	04°02'S — 20°29'S
Metridea gerlachei ++	39°01'S — 64°54'S	07°37'N
Metridea gurjanovae +	23°32'S — 45°19'S	—
Metridea longa	08°05'S	00°08'S — 31°54'S
Metridea lucens ++	08°05'S — 64°54'S	04°48'N — 31°07'S
Metridea princeps ++	16°30'S — 56°09'S	00°27'N — 31°54'S
Metridea venusta ++	25°43'S — 63°05'S	01°31'N — 06°27'N
Microsetella norvegica ++	40°53'S	07°37'N — 22°54'S

LIST 4 (Continuation)

Species	Extreme latitudes of occurrence in EMCI and "Eltanin" samples	Known latitudinal distribution off West South America
Microsetella rosea	29°57'S — 39°03'S	06°32'N — 40°24'S
Mimocalanus cultrifer ++	34°59'S — 39°58'S	(Antarctic)
Nannocalanus minor	02°35'N — 46°15'S	06°32'N — 47°S
Neocalanus gracilis	16°02'S — 31°02'S	06°32'N — 40°S
Neocalanus robustior	25°43'S — 31°55'S	06°32'N — 37°S
Oithona atlantica +	02°35'N — 54°57'S	—
Oithona hamata +	25°43'S — 51°06'S	—
Oithona plumifera ++	02°35'N — 39°59'S	06°16'N — 00°18'S
Oithona setigera ++	04°04'S — 39°20'S	21°28'S — 31°07'S
Oithona similis ++	02°35'N — 56°12'S	07°37'N — 40°22'S
Oncaea conifera ++	07°45'S — 46°15'S	06°32'N — 36°51'S
Oncaea dentipes? +	37°08'S — 37°09'S	—
Oncaea media ++	18°19'S — 44°46'S	06°32'N — 40°24'S
Oncaea mediterranea	29°57'S — 39°58'S	02°54'N — 39°51'S
Oncaea venusta ++	02°35'N — 40°53'S	07°37'N — 45°31'S
Onchocalanus magnus?	38°09'S	(Antarctic)
Onchocalanus trigoniceps ++	38°09'S — 51°43'S	05°11'S — 31°54'S
Pachyptilus eurygnathus ++	38°09'S — 40°54'S	12°07'S — 17°26'S
Pachyptilus lobatus +	40°46'S — 40°54'S	—
Pachyptilus pacificus +	57°49'S — 58°00'S	—
Paracalanus indicus	02°34'S — 42°16'S	06°32'N — 40°22'S?
Paracalanus quasimodo?	35°33'S	—
Paracandacia simplex ++	04°04'S — 58°00'S	06°32'N — 37°S
Paraeuchaeta weberi +	29°57'S — 34°56'S	—
Phaenna spinifera ++	29°57'S — 42°16'S	06°32'N — 33°59'S
Phyllopus bidentatus ++	31°10'S — 31°14'S	00°30'N — 25°27'S
Phyllopus impar ++	07°47'S — 18°21'S	11°30'S
Phyllopus integer +	25°43'S	—
Pleuromamma abdominalis	07°45'S — 52°53'S	06°32'N — 53°35'S
Pleuromamma borealis ++	23°19'S — 41°10'S	07°37'N
Pleuromamma gracilis ++	07°45'S — 51°43'S	07°37'N — 40°22'S
Pleuromamma piseki ++	07°45'S — 51°43'S	02°13'S
Pleuromamma quadrungulata +	16°30'S — 41°10'S	(23°16'S)
Pleuromamma robusta ++	07°45'S — 63°04'S	07°21'N — 31°54'S
Pleuromamma xiphias ++	23°32'S — 41°10'S	07°17'N — 31°54'S
Pontellina plumata +	02°34'S — 02°35'S	06°32'N — 32°S
Pontostratiotes sp.	25°44'S	—
Pseudeuchaeta brevicauda ++	18°20'S — 45°19'S	02°40'S — 22°50'S
Pseudeuchirella cryptospina +	18°19'S — 31°14'S	—
Pseudeuchirella divaricata ++	46°15'S — 46°35'S	31°54'S
Pseudeuchirella dubia +	40°46'S — 40°54'S	—
Pseudeuchirella hirsuta +	38°09'S — 58°00'S	(Antarctic)
Pseudeuchirella mawsoni +	38°09'S — 51°43'S	(Antarctic)
Pseudeuchirella notacantha +	52°53'S — 52°55'S	—
Pseudeuchirella obtusa ++	45°19'S — 46°15'S	04°21'S — 22°50'S
Pseudeuchirella polyspina +	40°46'S — 40°54'S	—
Pseudeuchirella pustulifera +	41°05'S — 56°09'S	—
Pseudeuchirella semispina +	16°30'S	—
Pseudeuchirella squalida +	16°30'S — 51°43'S	—
Racovitzanus antarcticus	63°04'S	(Antarctic)
Ratania flava +	36°30'S	—
Rhincalanus gigas +	13°15'S — 63°04'S	—

LIST 4 (Continuation)

Species	Extreme latitudes of occurrence in EMCI and "Eltanin" samples	Known latitudinal distribution off West South America
Rhincalanus nasutus	25°42'S — 47°26'S	06°32'N — 53°S
Rhincalanus rostrifrons ++	02°35'N — 07°47'S	06°32'N
Sapphirina angusta	32°01'S — 34°55'S	04°16'N — 33°05'S
Sapphirina metallina ++	18°20'S	27°04'S
Sapphirina migromaculata	13°15'S — 16°02'S	06°32'N — 43°S
Sapphirina opalina-darwini ++	02°34'N — 18°20'S	01°32'S — 32°27'S
Sapphirina ovatolanceolata-gemma	34°07'S — 42°16'S	04°16'N — 42°S
Scaphocalanus affinis ++	23°32'S — 58°00'S	01°03'N — 17°26'S
Scaphocalanus brevicornis +	16°12'S — 63°05'S	(Antarctic)
Scaphocalanus curtus +	23°37'S — 42°16'S	—
Scaphocalanus echinatus +	29°56'S — 44°45'S	—
Scaphocalanus longifurca +	07°45'S — 41°01'S	—
Scaphocalanus magnus ++	07°47'S — 56°06'S	02°18'S — 31°54'S
Scolecithricella abyssalis ++	04°04'S — 37°27'S	06°32'N — 05°45'S
Scolecithricella arcuata +	16°30'S	—
Scolecithricella dentata ++	23°32'S — 44°45'S	20°29'S
Scolecithricella dentipes +	16°30'S — 46°35'S	(Antarctic)
Scolecithricella marginata	34°07'S	05°22'N — 37°S
Scolecithricella minor ++	51°07'S	05°59'N — 31°49'S
Scolecithricella ovata +	37°27'S — 63°04'S	—
Scolecithricella tenuiserrata +	38°17'S	—
Scolecithricella vittata?	29°56'S — 35°34'S	01°31'N — 20°29'S
Scolecithrix bradyi	18°19'S — 18°21'S	06°32'N — 37°S
Scolecithrix danae	02°35'N — 07°47'S	06°32'N — 40°24'S
Scottocalanus australis +	3102'S	—
Scottocalanus persecans ++	29°59'S — 41°05'S	12°S — 16°32'S
Scottocalanus terranovae +	25°42'S	—
Spinocalanus abyssalis	18°19'S — 18°21'S	11°20'S — 37°34'S
Spinocalanus magnus +	45°19'S	(Antarctic)
Spinocalanus parabyssalis +	29°56'S — 37°09'S	—
Spinocalanus spinosus +	46°35'S	—
Temora discaudata	02°35'N — 02°34'N	06°32'N — 22°54'S
Temorites brevis +	18°19'S — 25°42'S	—
Undeuchaeta intermedia +	25°43'S — 56°19'S	—
Undeuchaeta major ++	23°32'S — 45°19'S	02°18'S — 40°22'S
Undeuchaeta plumosa ++	23°19'S — 47°26'S	00°30'N — 32°25'S
Undinula darwini	02°35'N — 18°20'S	07°37'N — 42°43'S
Undinula vulgaris	13°15'S	07°37'N — 22°54'S
Valdiviella brevicornis +	40°54'S	—
Valdiviella insignis ++	18°20'S — 51°45'S	06°30'S
Valdiviella minor ++	16°30'S — 40°54'S	31°54'S
Valdiviella oligarthra +	18°20'S — 40°54'S	—
Xanthocalanus calaminus +	46°35'S	—
Xanthocalanus muticus +	40°46'S	—

Note: The occurrence of most of the *Paraeuchaeta* was not considered in this distribution list because it is part of another work (Yamanaka, 1970).

Species marked with an asterisk (+) are new occurrences (97) for the region. Species marked with two asterisks (++) have had their distribution range off South America enlarged.

Localities or latitudes between brackets refer to the occurrence of the species very far from the South East Pacific off South America.

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