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Distribution patterns of the mesozooplankton, principally siphonophores and medusae, in the vicinity of the Antarctic Slope Front (eastern Weddell Sea)

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Abstract

The composition, abundance and vertical distribution of mesozooplankton, particularly siphonophores and medusae (27 species), collected along two transects in the eastern Weddell Sea have been analysed. Both transects were characterized by a steep thermocline that on approaching the coastline defined the Antarctic Slope Front. The front acted as a strong boundary in the shelf-slope and caused a pronounced cross frontal gradient in the populations of cnidarians. Few species and low abundances were found in the upper cold waters and most of the populations concentrated in and below the thermocline. The analysis of the gastrozooids of the physonect siphonophore *Pyrostephos vanhoeffeni* showed a wide variety of prey but the relatively high contribution of krill larvae reveals a substantial trophic impact when both organisms co-occur.

Keywords: distribution; siphonophores; medusae; Antarctic Slope Front; *Pyrostephos*; diet

1. Introduction

The Antarctic Slope Front (ASF) is one of the most characteristic but least known hydrographic structures of the Southern Ocean. It is found near the Antarctic shelf break where it is topographically controlled. It is characterized by strong subsurface gradients in ocean temperature and chemistry, and by stronger alongshore currents than most of the adjacent continental shelf (Jacobs, 1991).

The implications of the continental slope region to biological productivity in Antarctic waters have been mooted, due to the potential of upwelling deep water bringing the early larval stages of krill onto the continental shelf (Jacobs, 1991). However, little is known about the physical and biological processes associated with this front, probably because of its relative inaccessibility and because it is covered by ice for a large part of the year (Krause et al., 1993).

In order to investigate the structure of the biological communities associated with the ASF and to increase our knowledge of the physical control of the biological production during sea ice formation, a *Polarstern* cruise (*Antarktis X/3*) was carried out in austral autumn 1992 to the eastern Weddell Sea (Spindler et al., 1993). The present paper deals with

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the medusae and siphonophores collected in the vicinity of the ASF and describes the species composition, abundance, distribution and the diet of some of these species.

Medusae and siphonophores are two of the most diverse zooplankton groups in the Southern Ocean but also amongst the least known. Thirty species of siphonophores and twenty five of medusae have been identified in the Weddell Gyre (Pagès and Kurbjeweit, 1994; Pagès et al., 1994). However, the structure of the populations near and over the shelf as well as the influence that ice cover, hydrographic factors, and other plankton populations exercise on these gelatinous carnivores is not well known. In addition, the role and impact exerted by these organisms in the Antarctic pelagic food web is usually disregarded, and the lack of in situ observations and gut content examinations hinders an accurate estimation of their trophodynamics.

2. Material and methods

The mesozooplankton populations in the vicinity of the ASF were studied by analyzing samples collected along two transects carried out during the period 12 April–3 May 1992 in the eastern Weddell Sea (Fig. 1) by RV *Polarstern*. A multiple opening/closing net system (0.25 m^2, 100 μm mesh-size) was hauled vertically at 12 stations. In the first transect of 4 stations, five depth ranges in the top 1000 m of the water column were chosen

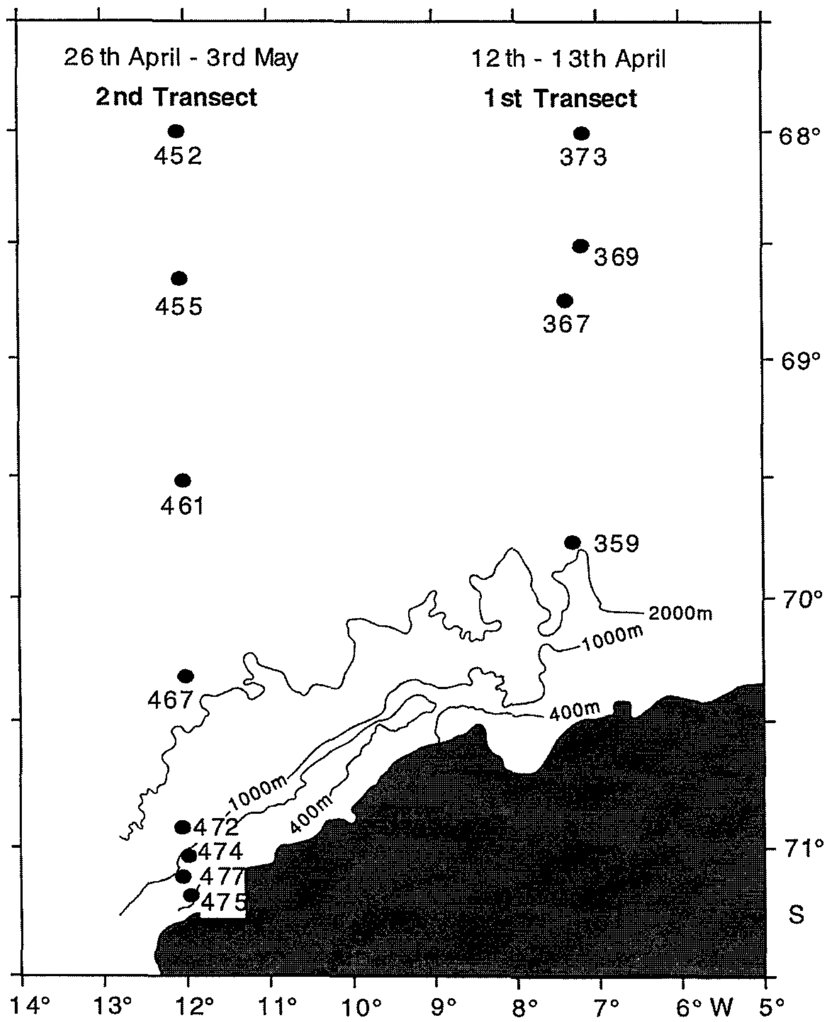

Fig. 1. Position of the Multinet stations occupied along the two transects made during *RV Polarstern* Cruise ANT X/3 in the eastern Weddell Sea.

according to the hydrographical conditions. The 4 oceanic stations of the second transect were sampled likewise, while the depth ranges sampled at the 4 slope and shelf stations varied according to the bathymetry. The samples were fixed in 4% borax buffered formalin. The volume of water filtered was calculated from the vertical distance (m) covered by the net's mouth area assuming a 100% filtration efficiency.

The medusae and siphonophores, both asexual and sexual stages, were identified according to the present knowledge of the systematics of both groups. All specimens (whole colonies in physonects; nectophores, eudoxids and bracts in calycophores) were counted and the counts standardized to number of specimens per 1000 m^3. In addition, specimens with gut contents were examined under a dissecting microscope to identify the prey items. The remaining zooplankton groups were sorted (1/10 of copepods and all euphausiids, chaetognaths, polychaetes, ostracods and pteropods), counted and sometimes identified to species.

3. Results

3.1. Hydrography and sea ice

The temperature profiles of the two transects studied show some important features (Krause et al., 1993):

- an increasing downward slope of isotherms towards the continent defining the ASF which was not evident in the surface layers,
- a summer mixed layer (−0.75°C) free of sea ice in the northern part of the first transect that was

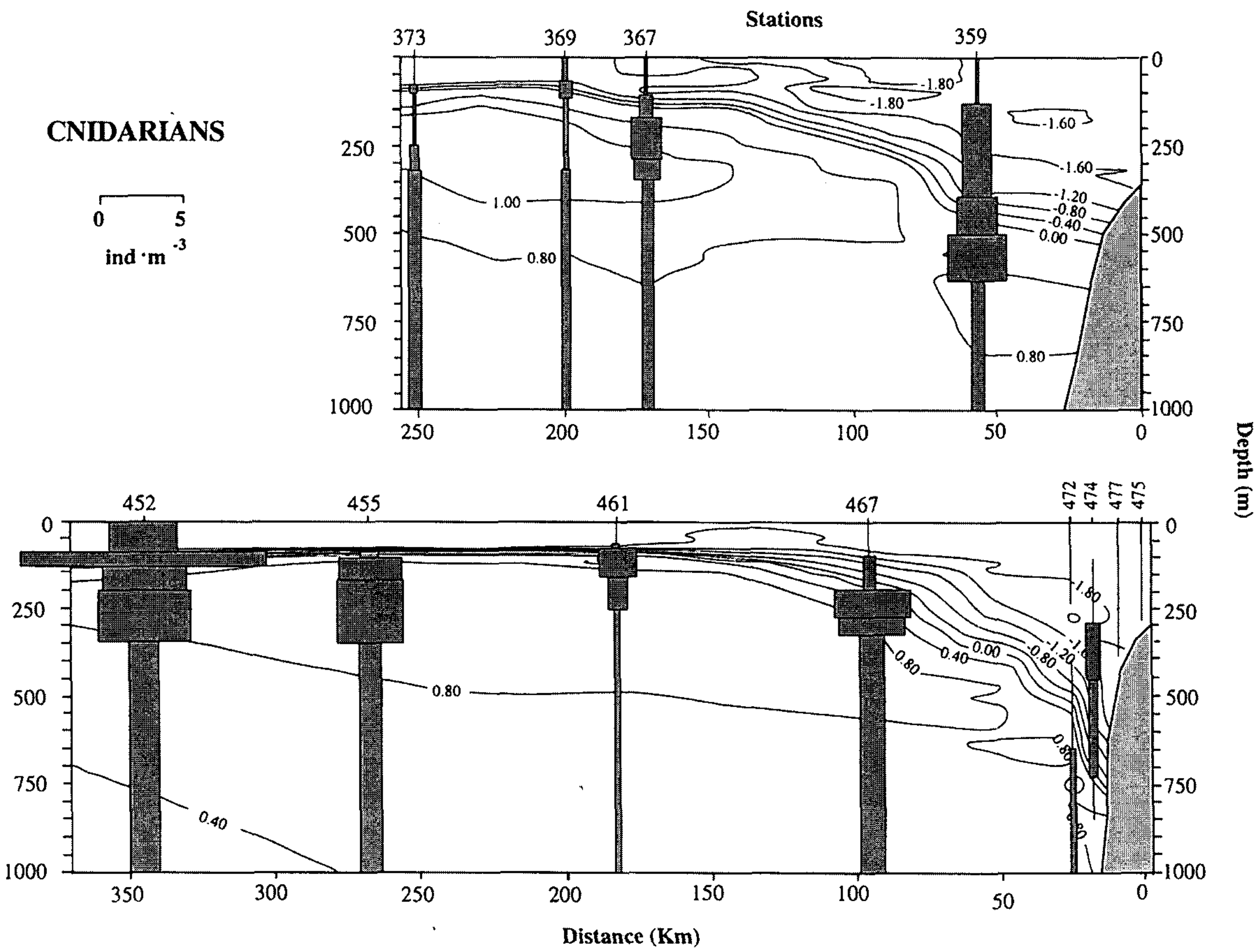

Fig. 2. Depth distribution and abundance of cnidarians along the two transects.

replaced towards the shelf by newly forming winter mixed water (−1.75°C),

- a more extensive winter mixed water layer during the second transect, which was covered 8/10 by sea ice at the oceanic stations and completely in the slope-shelf, with the exception of the southernmost station where a coastal polynyia was located,
- a tongue of warm Circumpolar Deep Water below the thermocline and extending to the continental slope.

3.2. Abundance, distribution and species composition of cnidarians

In the first transect, cnidarians occurred at all stations and in all depth ranges (Fig. 2a). The vertical distribution pattern at the two most oceanic stations was similar throughout the water column. They were more abundant around 250 m depth at St. 367 while at the fourth station, off the slope, cnidarian abundance increased in and below the thermocline coinciding with the onset of the ASF.

Total abundances were higher at the oceanic stations of the second transect (Fig. 2b) in comparison with those of the first transect. In general, abundance steadily decreased towards the shelf but a sharp decrease was apparent at St. 461. The most oceanic station (452) showed the highest mean abundance of cnidarians (6236 individuals per 1000 m^3) and also the highest number in a single depth range (12,500 ind $\cdot$ 1000 m^{-3} in the 130–90 m layer). Cnidarians occurred only in very low numbers in, or were totally absent from, the upper cold waters (−1.8°C).

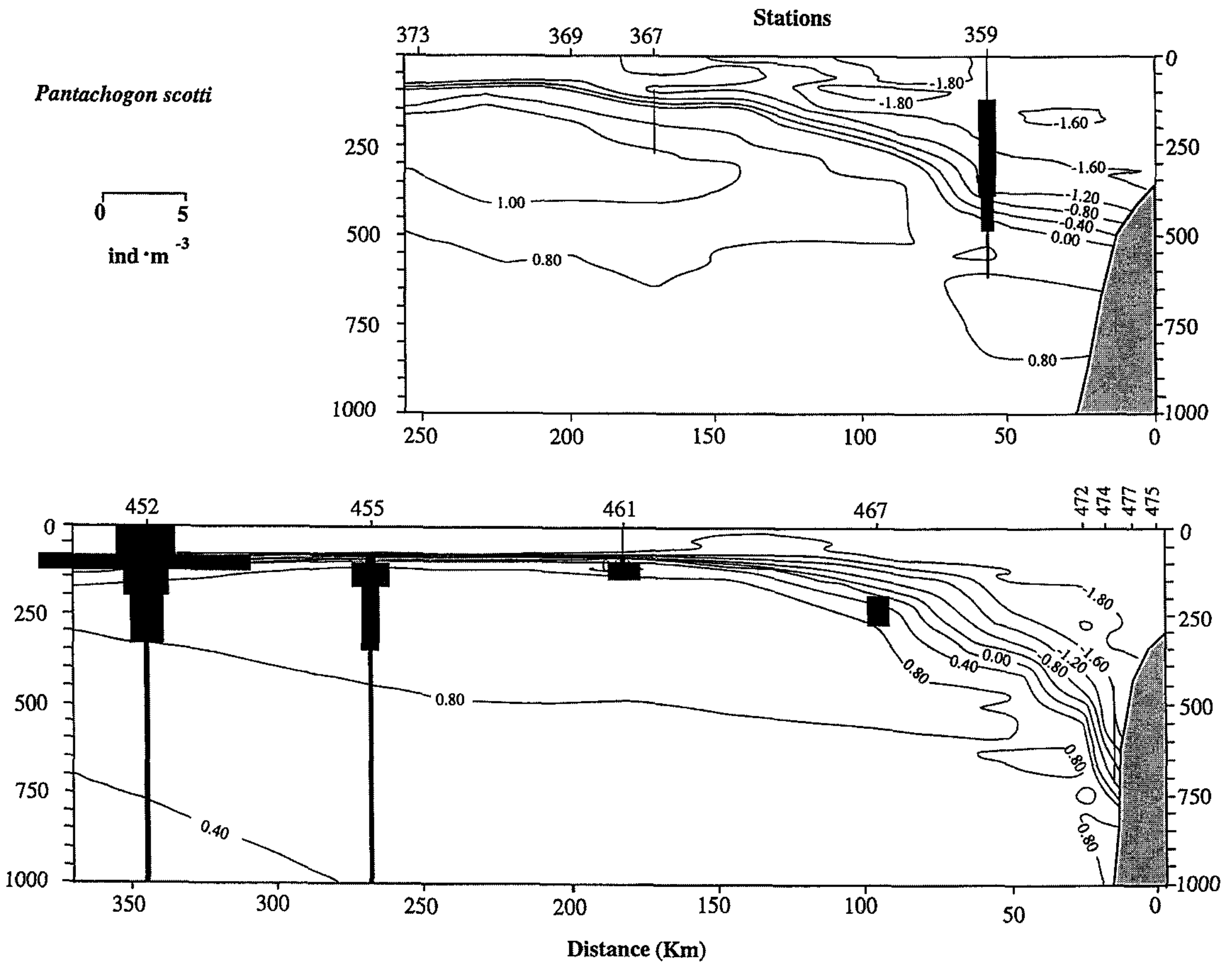

Fig. 3. Depth distribution and abundance of *Pantachogon scotti* along the two transects.

Table 1
Distribution of medusae and siphonophores (numbers per 1000 m^3) in the Multinet hauls made during the first transect (Stn 373–359) of RV *Polarstern* ANT X/3 cruise in autumn 1992. Authorities: Q. and G. = Quoy and Gaimard; n = nectophores, e = eudoxids

	Stations		373					369					367					359				
	Depth range (m)		1000–320	320–250	250–110	110–75	75–0	1000–340	340–270	270–120	120–70	70–0	1000–330	330–280	280–170	170–110	110–0	1000–630	630–470	470–390	390–120	120–0
MEDUSAE																						
Solmundella bitentaculata	(Q. and G., 1833)	23.2	.	29	.	.	6	.	.	.	.	.	1040	508.2	.	.	21.6	1275	750	29.2	.	
Haliscera sp.			29.2	.	.	.	.	.	.	.	.	.	.	.	36.3	.	.	.	.	.	.	.
Pantachogon scotti	Browne, 1910		11.6	.	.	.	.	.	.	.	.	.	.	.	145.2	123.2	.	.	125	700	949.2	66.6
Pantachogon haeckeli	Maas, 1893		11.6	.	.	.	.	12	.	.	.	.	6	.	.	.	.	.	.	.	.	.
Arctapodema ampla	(Vanhöffen, 1902)		35.2	.	.	.	.	24	.	.	.	.	.	.	.	.	.	86.4	575	50	73	.
Crossota sp.			39.4	.	.	.	.	36	.	.	.	.	18	.	.	.	.	389.1	75	.	.	.
SIPHONOPHORES																						
Pyrostephos vanhoeffeni	Moser, 1925		.	.	.	.	53.4	.	.	.	.	.	.	.	.	.	36.3	.	.	.	14.6	66.6
Dimophyes	Chun, 1897	n	.	57.1	.	.	.	.	.	.	80	114.2	.	.	36.3	132.2	36.3	10.8	50	100	73	33.3
arctica		e	58	114.2	28.5	230	.	36	171.3	106.4	400	.	36	.	108.9	246.4	72.6	.	125	.	131.4	33.3
Muggiaea	Totton, 1954	n	133.4	285.5	.	115	53.4	104	.	.	240	.	102	240	726	199.8	.	43.2	125	200	131.4	.
bargmannae		e	104.4	.	171	.	.	18	171.3	239.4	.	.	108	160	72.6	199.8	.	21.6	300	400	116.8	.
Diphyes	Moser, 1925	n	.	.	.	.	.	.	.	.	.	57.1	.	.	.	.	.	.	.	.	.	.
antarctica		e	5.8	114.2	.	.	.	.	.	.	.	57.1	.	.	36.3	.	.	.	.	.	43.8	.
Lensia achilles	Totton, 1941	n	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.	25	.	.	.
		e	5.8	.	.	.	.	6	.	.	.	.	.	.	.	.	.	43.2	.	.	.	.
Lensia	Stepanjants, 1970	n	29	.	.	.	.	18	.	.	.	.	18	.	.	.	.	10.8	25	.	.	.
asymmetrica		e	23.2	.	.	.	.	6	.	.	.	.	12	.	.	.	.	21.6	25	.	.	.
Lensia havock	Totton, 1941	n	.	.	.	.	.	6	.	.	.	.	6	.	.	.	.	.	.	.	.	.
		e	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10.8	.	.	.	.
Gilia reticulata	(Totton, 1954)	e	98.6	.	.	.	.	42	.	.	.	.	114	.	.	.	.	75.6	100	.	.	.
Heteropyramis	(Moser, 1925)	n	63.8	.	.	.	.	18	.	.	.	.	60	.	.	.	.	21.6	175	.	.	.
crystallina		e	40.6	.	.	.	.	72	.	.	.	.	192	.	.	.	.	97.2	125	.	.	.
Crystallophyes amygdalina	Moser, 1925	n	46.4	.	.	.	.	24	.	.	.	.	66	.	.	.	.	64.8	25	.	.	.
Sphaeronectes		n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14.6	.
sp.n.		e	40.6	.	.	.	.	6	.	.	.	.	.	.	.	.	.	10.8	.	400	131.4	.
		Total	799	571	228	345	106.8	440	342.6	345.8	720	228.2	738	1440	1670	892.4	145.2	929.1	3150	2600	1708.4	199.8

Table 2

Distribution of medusae and siphonophores (numbers per 1000 m^3) collected by the Multinet hauls made at the oceanic stations of the second transect (Stn 452–467) of RV *Polarstern* ANT X/3 cruise in autumn 1992; n = nectophores, e = eudoxids

	Stations		452					455				461					467				
	Depth range (m)		1000–330	330–200	200–130	130–90	90–0	1000–350	350–170	170–120	120–100	1000–250	250–160	160–100	100–80	80–0	1000–330	330–280	280–180	180–10	100–0
MEDUSAE																					
Solmundella bitentaculata	(Q. and G. 1833)		549.2	1465	685.2	300	532.8	123	1620.6	240	.	5.3	222	66.6	.	50	188.8	208	320	.	80
Haliscera sp.			11.8	61.4	57.1	.	.	6.1	66.6	.	.	5.3	.	.	.	.	.	.	80	.	.
Pantachogon scotti	Browne, 1910		123.9	1852.1	2626.6	1250	3507.6	98.4	1065.6	224	400	.	.	2000	200	50	.	.	124	.	.
Pantachogon haeckeli	Maas, 1893		.	.	.	.	.	6.1	.	.	.	5.3	.	.	.	.	11.9	.	.	.	.
Arctapodema ampla	(Vanhöffen, 1902)		119.4	325	.	.	.	98.4	66.6	.	.	5.3	.	.	.	.	70.8	160	600	.	.
Crossota sp.			459.7	.	.	.	.	387.4	.	.	.	26.6	.	.	.	.	206.5	.	.	.	.
SIPHONOPHORES																					
Pyrostephos vanhoeffeni	Moser, 1925		.	.	.	.	44.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dimophyes arctica	Chun, 1897	n	23.8	61.4	104.2	600	.	6.1	111.1	80	.	5.3	.	66.6	.	.	11.9	.	160	10	.
		e	17.9	215.3	400	100	.	61	177.7	80	200	5.3	.	66.6	200	72.6	11.9	.	80	350	.
Muggiaea bargmannae	Totton, 1954	n	53.7	782.5	400	500	.	158.6	266.6	240	.	32	488.4	133.3	.	.	77.6	160	760	30	.
		e	274.6	815	285.7	.	.	152.5	577.2	560	.	79.5	355.5	.	.	.	188.8	1260	1360	.	.
Diphyes antarctica	Moser, 1925	n	.	.	.	.	44.4	.	.	.	200	.	.	.	.	.	.	.	.	50	.
		e	.	30.7	171.4	.	.	.	22.2	.	.	.	44.4	.	.	.	.	80	.	.	.
Lensia achilles	Totton 1941	n	.	.	.	.	.	6.1	.	.	.	.	.	.	.	.	5.9	.	.	.	.
		e	.	.	.	.	.	12.2	.	.	.	.	.	.	.	.	.	.	.	.	.
Lensia asymmetrica	Stepanjants, 1970	n	11.9	.	.	.	.	24.6	.	.	.	10.6	.	.	.	.	.	.	.	.	.
		e	35.8	.	.	.	.	18.4	.	.	.	.	.	.	.	.	77.6	.	.	.	.
Lensia havock	Totton, 1941	n	.	.	.	.	.	.	.	.	.	5.3	.	.	.	.	.	.	.	.	.
		e	5.9	.	.	.	.	24.6	.	.	.	.	.	.	.	.	17.9	.	.	.	.
Gilia reticulata	(Totton, 1954)	e	53.7	.	.	.	.	61.5	.	.	.	58.3	.	66.6	.	.	147.5	80	.	.	.
Heteropyramis crystallina	Moser, 1925	n	17.9	.	.	.	.	43	.	.	.	53.3	.	.	.	.	71.6	.	.	.	.
		e	29.8	.	.	.	.	55.3	.	.	.	32	.	.	.	.	182.9	.	.	.	.
Crystallophyes amygdalina	Moser, 1925	n	5.9	.	.	.	.	18.4	.	.	.	10.6	.	.	.	.	53.1	.	.	.	.
Sphaeronectes sp.		n	.	.	.	.	.	6.1	.	160	200	.	.	.	.	.	.	.	.	.	.
		e	17.9	130	400	300	.	.	44.4	240	.	.	.	.	.	.	5.9	.	160	.	.
		Total	2296.1	5738.4	5130.2	13800	4129.2	1368.8	4018.6	3840	1000	331	1110.3	2399.7	400	172.6	1150.6	3820	4760	800	80

Table 3

Distribution of medusae and siphonophores (numbers per 1000 m^3) collected by the Multinet hauls made at the slope and shelf stations of the second transect (Stn 472–477) during RV *Polarstern* ANT X/3 cruise in autumn 1992

	Stations		472			474				477				475				
	Depth range (m)		1000–650	650–400	230–0	850–720	720–450	450–290	290–100	400–300	300–200	200–100	100–0	280–200	200–150	150–100	100–50	500
MEDUSAE																		
Tubulariidae A			.	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leuckartiara brownei	Larson and Harbison, 1990		.	.	.	.	14.8	.	.	.	.	.	.	.	.	.	.	.
Malagazzia sp.			.	.	.	.	.	.	.	.	40	40	.	.	.	.	.	.
Solmundella bitentaculata	(Quoy and Gaimard, 1833)		.	.	.	30.7	14.8	300	.	.	40	.	.	.	.	.	.	.
Pantachogon scotti	Browne, 1910		.	.	.	.	148.1	.	400	.	.	.	.	.	.	.	.	.
Arctapodema ampla	Vanhöffen, 1902		34.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SIPHONOPHORES																		
Pyrostephos vanhoeffeni	Moser, 1925		.	.	17.4	.	14.8	50	21	120	120	40	40	50	.	80	80	80
Dimophyes	Chun, 1897	n	.	32	.	.	118.4	300	.	40	.	.	4	.	160	80	.	.
arctica		e	11.4	48	.	.	266.6	350	.	40	.	.	.	100	.	.	.	.
Muggiaea	Totton, 1954	n	45.7	48	.	.	29.6	75	21	.	.	.	.	50	.	.	.	.
bargmannae		e	22.8	32	.	.	14.8	.	.	.	.	.	.	.	.	.	.	.
Diphyes	Moser, 1925	n	.	16	.	30.7	14.8	.	21	.	.	.	.	.	.	.	.	.
antarctica		e	.	.	.	30.7	.	50	.	.	.	.	.	.	.	.	.	..
Lensia achilles	Totton 1941	n	11.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lensia havock	Totton, 1941	n	11.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gilia reticulata	(Totton, 1954)	e	22.8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Heteropyramis	Moser, 1925	n	11.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
crystallina		e	125.7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crystallophyes amygdalina	Moser, 1925	n	45.7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphaeronectes sp.		e	.	.	.	.	.	25	.	.	.	.	.	.	.	.	.	.
Vogtia serrata	(Moser, 1925)		34.2	.	.	.	.	.	.	.	.	.	.	50	.	.	.	.
		Total	376.7	192	17.4	92.1	636.7	1150	463	200	200	80	44	250	160	160	80	80

Table 4
Rare cnidarians species (numbers per 1000 m^3) collected during both transects

	Stations	359	359	359	369	373	452	455	461	467	467
	Depth range (m)	1000–630	630–470	390–120	1000–340	1000–320	1000–330	1000–350	1000–250	1000–330	330–280
MEDUSAE											
Paragotoea elegans	Margulis, 1989	.	.	.	6	.	.	.	.	.	80
Yakovia polinae	Margulis, 1989	.	.	14,6	.	.	5,9	.	.	.	.
Tubulariidae A		10,8	25	.	.	.	.	.	.	11,9	.
Halicreas minimum	Fewkes, 1882	.	.	.	.	.	.	6,1	.	.	.
Atolla wyvillei	Haeckel, 1888	.	.	.	6	5,8	.	.	.	.	.
Tetraplatia sp.		.	.	.	.	.	.	.	.	5,9	.
Trachymedusae		54	.	.	.	.	77,6	.	5,3	.	.
SIPHONOPHORAE											
Apolemidae D		.	.	.	.	.	5,9	.	.	.	.
Eudoxia X		.	.	.	.	5,8	.	.	.	.	.

They were mainly concentrated in and below the thermocline, decreasing in abundance below 500 m. At the four slope-shelf stations, few specimens (104–362 ind · 1000 m^{-3}) were collected, with the Antarctic physonect *Pyrostephos vanhoeffeni* being the most abundant.

In total, 28 species of mesoplanktonic cnidarians (15 siphonophores and 13 medusae) were collected (Tables 1–4). The siphonophores consisted of 2 physonects and 13 calycophores, three of them undescribed but previously recorded from the Weddell Sea (Pagès and Kurbjeweit, 1994). Most of the medusae had been already found in the Southern Ocean with the exception of two undescribed hydroidomedusae (Tubulariidae A and *Malagazzia* sp.) (Table 3).

The most abundant species was the Antarctic trachymedusan *Pantachogon scotti*. In the first transect, it mainly occurred in the region of the thermocline at the most shelfward station (Fig. 3) and it was not collected at the two most offshore stations. In contrast, it did not occur at the slope-shelf stations in the second transect, indeed its density steadily increased towards the ocean, and reached the highest value (12,500 ind. per 1000 m^3) in the 130–90 depth range at the most oceanic station, matching with the thermocline (− 1.6 to 0°C).

The narcomedusan *Solmundella bitentaculata* was found at almost all stations. Like *Pantachogon scotti*, in the first transect, it mainly occurred at the more inshore station, whereas in the second transect, the abundance increased towards the ocean (Fig. 4). In both transects, highest concentrations (2080 ind. per 1000 m^3) were observed just below the thermocline, with lowest and often zero abundance in the thermocline and an almost total absence over the shelf.

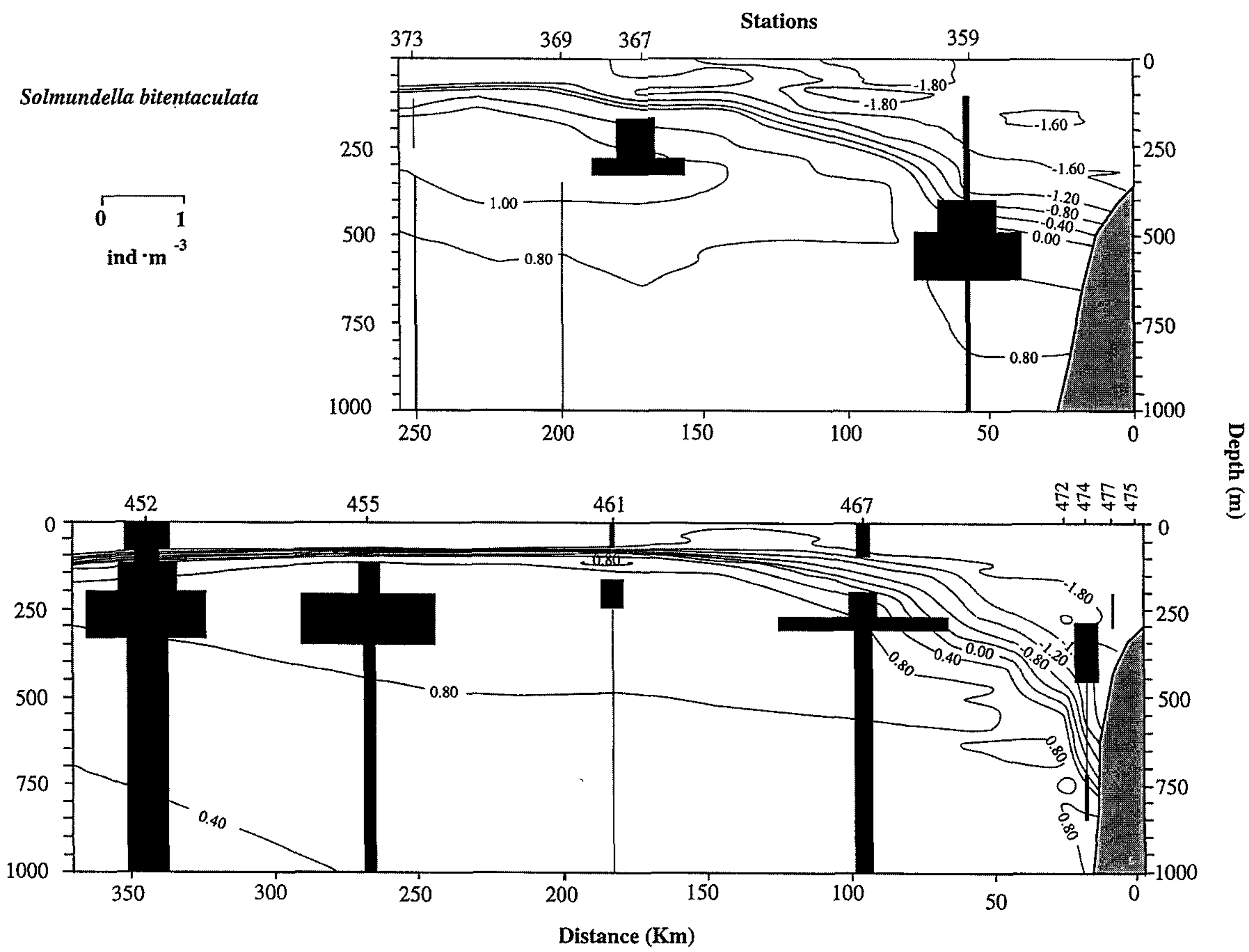

Fig. 4. Depth distribution and abundance of *Solmundella bitentaculata* along the two transects.

The bipolar calycophoran siphonophore *Muggiaea bargmannae* occurred at all oceanic stations and mainly in and just below the thermocline (Fig. 5). Asexual and sexual stages were more abundant (up to 782.5 nectophores and 1390 eudoxids per 1000 m^3, respectively) in the second transect. Near the continental slope, both stages were collected in low numbers.

Dimophyes arctica was less abundant than *Muggiaea bargmannae* (Fig. 6). It showed no clear differences in abundance, sexual stage and distribution between the oceanic stations of both transects. This species did not occur in the near surface cold waters and was concentrated in and below the thermocline, reaching highest abundance in the ASF, particularly in the vicinity of the slope.

Mesopelagic species like *Gilia reticulata* (whose systematics has been recently reviewed by Pugh and Pagès (1995)), *Crystallophyes amygdalina* and *Heteropyramis crystallina* occurred below 350 m at oceanic stations, in the warm Circumpolar Deep Water. Their vertical distributions were strongly affected by the ASF near the slope where they were collected only at St 472 in the deepest depth range (Fig. 7; Table 3).

The Antarctic physonect *Pyrostephos vanhoeffeni* showed an unique distribution pattern among all the cnidarians. All specimens were young and were collected only in the colder surface waters above the thermocline (Fig. 8). Abundance was very low (up to 120 colonies per 1000 m^3). However, each colony may contain up to twenty pairs of nectophores, plus a long siphosome that can occupy a large volume (Totton, 1965). In the first transect, this species

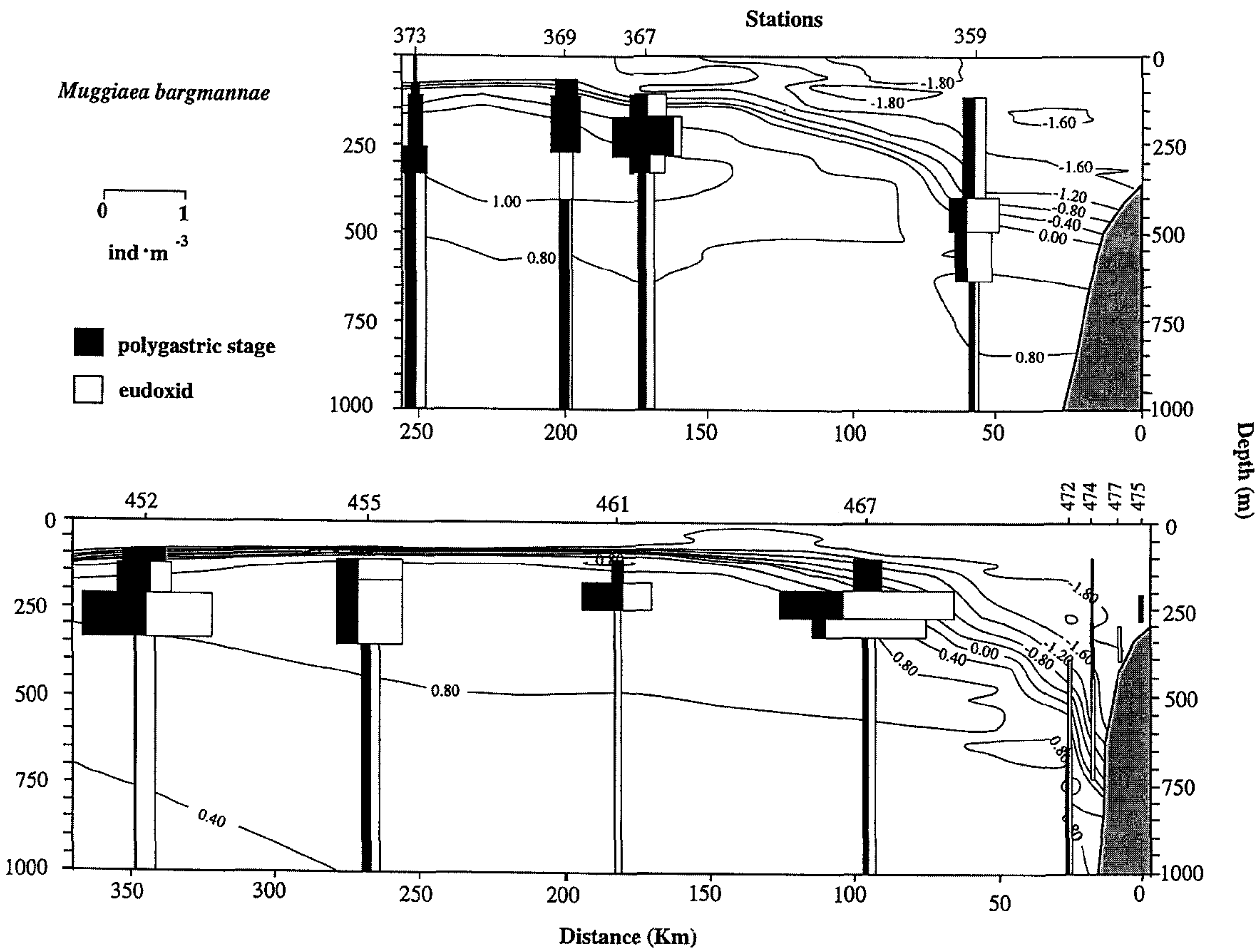

Fig. 5. Depth distribution and abundance of *Muggiaea bargmannae* along the two transects. Nectophores are shaded, eudoxids are outlined.

showed a wide horizontal distribution whereas it was concentrated over the continental slope in the second one.

The highest number of species was always collected in the deepest haul at each oceanic station, in the Circumpolar Deep Water (Tables 1–3). Of note was the high abundance (up to 459.7 ind. per 1000 m^3) in these waters of a small (3 mm in diameter), translucent and undescribed medusa of the genus *Crossota* in the deep-water samples (Tables 1–3).

3.3. Other zooplankton

Copepods were the most abundant zooplanktonic organisms. They occurred in greatest densities at the slope stations (359, 472) and the abundances decreased towards the open ocean (Fig. 9). This trend was followed by the small cyclopoids *Oithona* spp., the poecilostomatoids *Oncaea* spp., and the large calanoids *Calanoides acutus, Calanus propinquus* and *Metridia gerlachei*. However, the most numerous calanoid species, the small *Microcalanus pygmaeus*, occurred only in low numbers at the slope stations, and with uniformly high concentrations at the oceanic sites.

Three euphausiid species were found. *Euphausia superba* and *Thysanoessa macrura* were mainly concentrated in the top 100 m at oceanic sites but in deeper water layers over the slope (Fig. 10). The overall abundance was greater during the first transect, particularly at station 367. During the second transect highest abundances were encountered at the slope station 474 in the 450–300 m depth range. *Euphausia crystallorophias* occurred only in low numbers over the shelf and slope.

Chaetognaths were more numerous during the

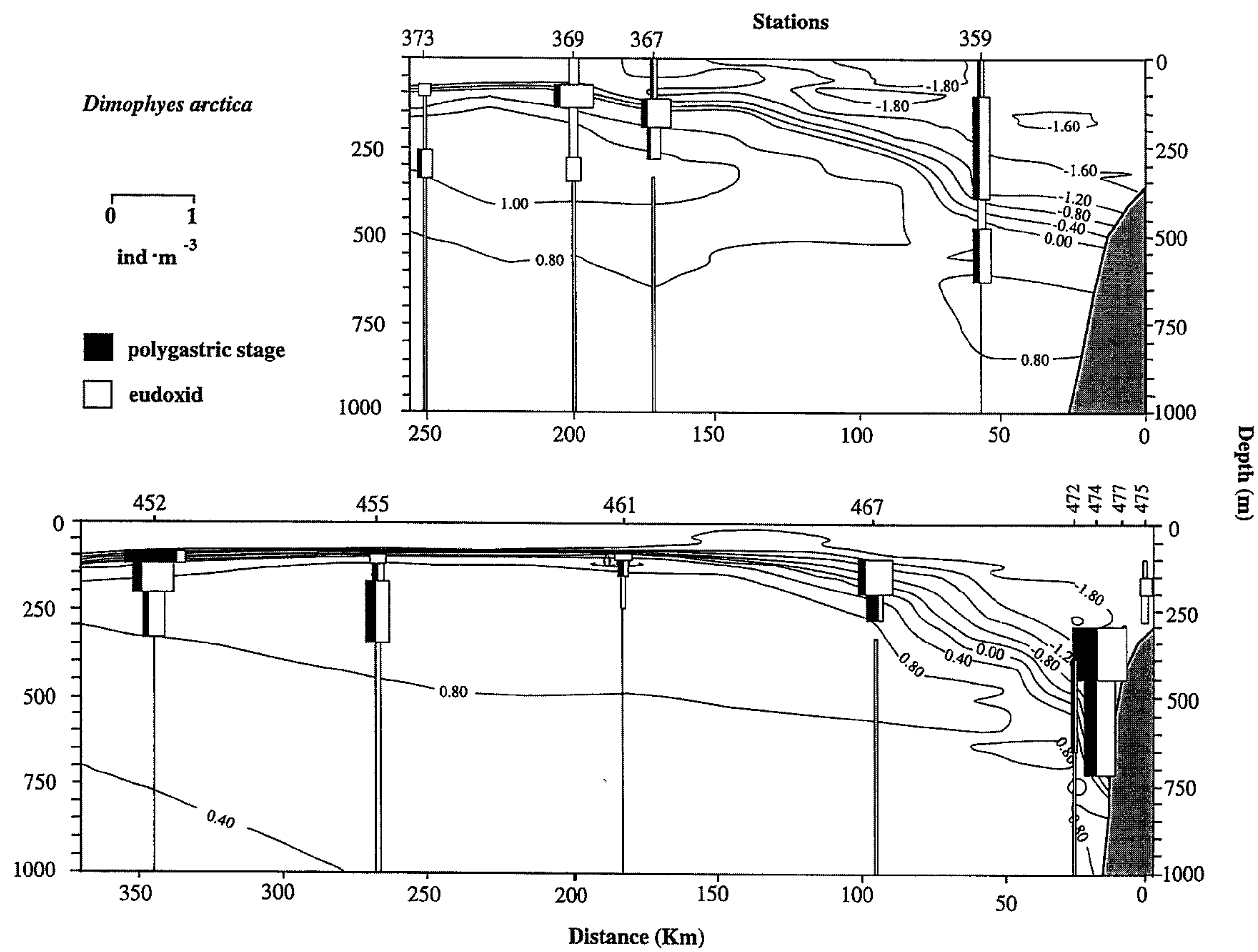

Fig. 6. Depth distribution and abundance of *Dimophyes arctica* along the two transects. Nectophores are shaded, eudoxids are outlined.

second transect with highest concentrations mainly above and below the thermocline (Fig. 11). Polychaetes and pteropods were encountered mostly in the cold waters in the top 100 m, while ostracods were collected throughout the water column, but principally below the thermocline (between 350 and 1000 m).

3.4. Diet of the cnidarians

The stomachs of the medusae and the gastrozooids of the siphonophores contained few prey items. The gastrozooids of *Pyrostephos vanhoeffeni* contained the highest numbers due to the high number of them per colony. A large percentage of them (57.9) were empty but copepods, crustacean exoskeletons and krill larvae were prominent among the wide variety of prey items identified (Table 5). No prey was found in the stomachs of *Pantachogon scotti* specimens but almost all of them had an oil droplet inside indicating energy reserves.

Several copepod species at various developmental stages were found in other cnidarian species. *Solmundella bitentaculata* fed upon *Microcalanus pigmaeus* and copepod nauplii. Some stomachs of *Arctapodema ampla* contained a few specimens of *Spinocalanus longicornis, Oncaea* sp. and *Oithona* sp. Specimens of *Crossota* sp. held a few *Oncaea curvata, O. parila* and copepod nauplii. Three eudoxids of *Muggiaea bargmannae* contained *Microcalanus pigmaeus* whereas *Dimophyes arctica* had fed on *Oithona frigida*. One ostracod was found in an eudoxid of *Diphyes antarctica*.

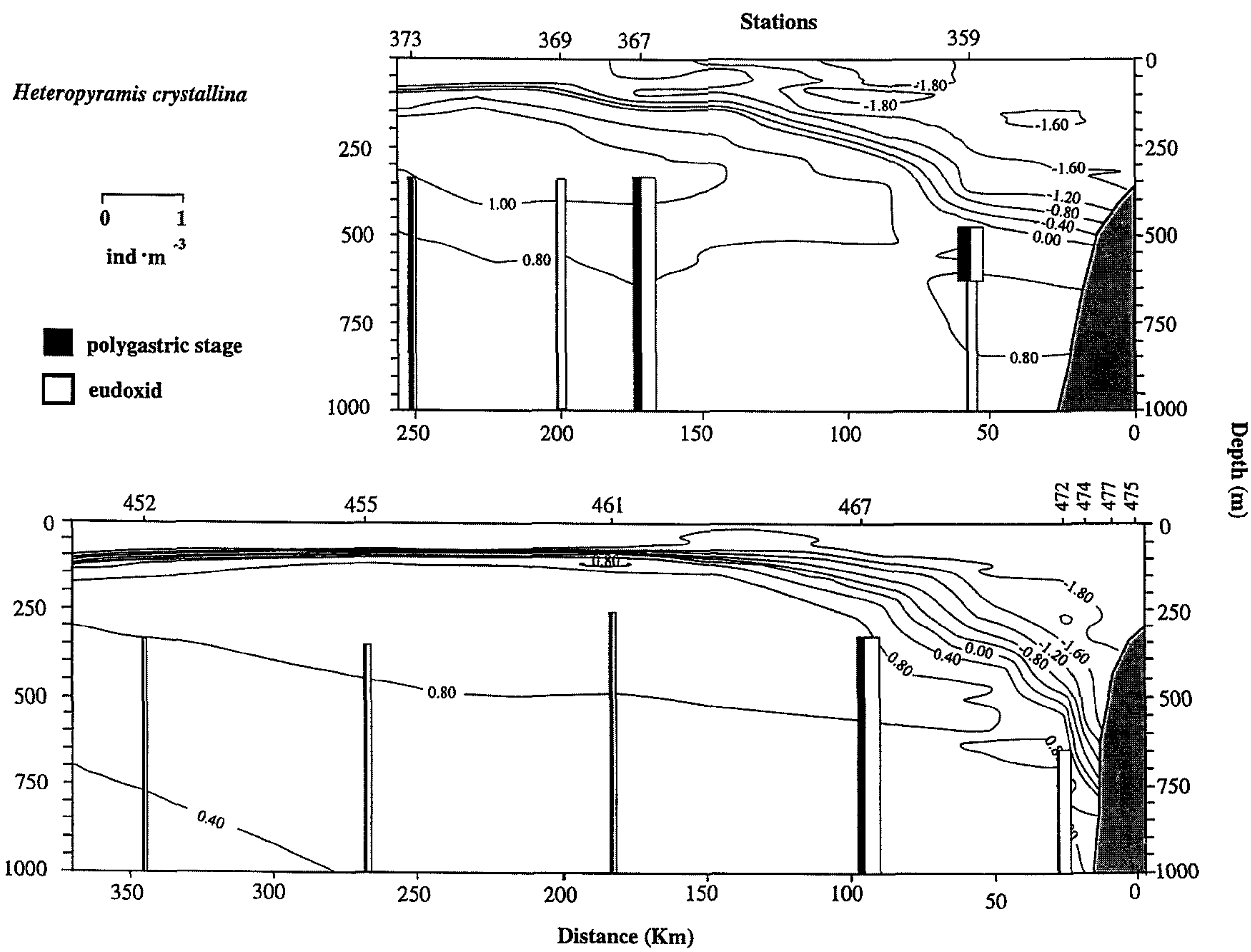

Fig. 7. Depth distribution and abundance of *Heteropyramis crystallina* eudoxids along the two transects.

4. Discussion

The species composition shows a very high similarity (20 coincident species) with that given by Pagès and Kurbjeweit (1994), from a transect across the Weddell Sea in summer (December, 1991). It suggests a reasonable knowledge of the cnidarian fauna in these waters but in fact there are several undescribed species and early stages of others that are currently under description (Pagès, in prep.). The present study reveals similar or slightly higher abundances in autumn, particularly for the species *Solmundella bitentaculata* and *Muggiaea bargmannae*. All the specimens collected were adults of small-size medusae and siphonophores, whereas early stages and juveniles of macromedusae and large siphonophores (see Pagès et al., 1994) were almost entirely absent.

The vertical distributions of the species do not show any substantial differences in comparison with summer, and we have no data on the possibility of vertical migration because sampling always was made during darkness. However, the strong thermocline clearly influenced the vertical distribution of the cnidarians in the upper 200 m (Fig. 2). Siphonophores and medusae rarely occurred in the cold (−1.8°C) near surface waters, where copepods were extremely abundant (Fig. 9).

When the thermocline deepened approaching the shelf, forming the ASF, it separated the oceanic community from a neritic one: the latter constituted by a few Antarctic species well adapted to cold

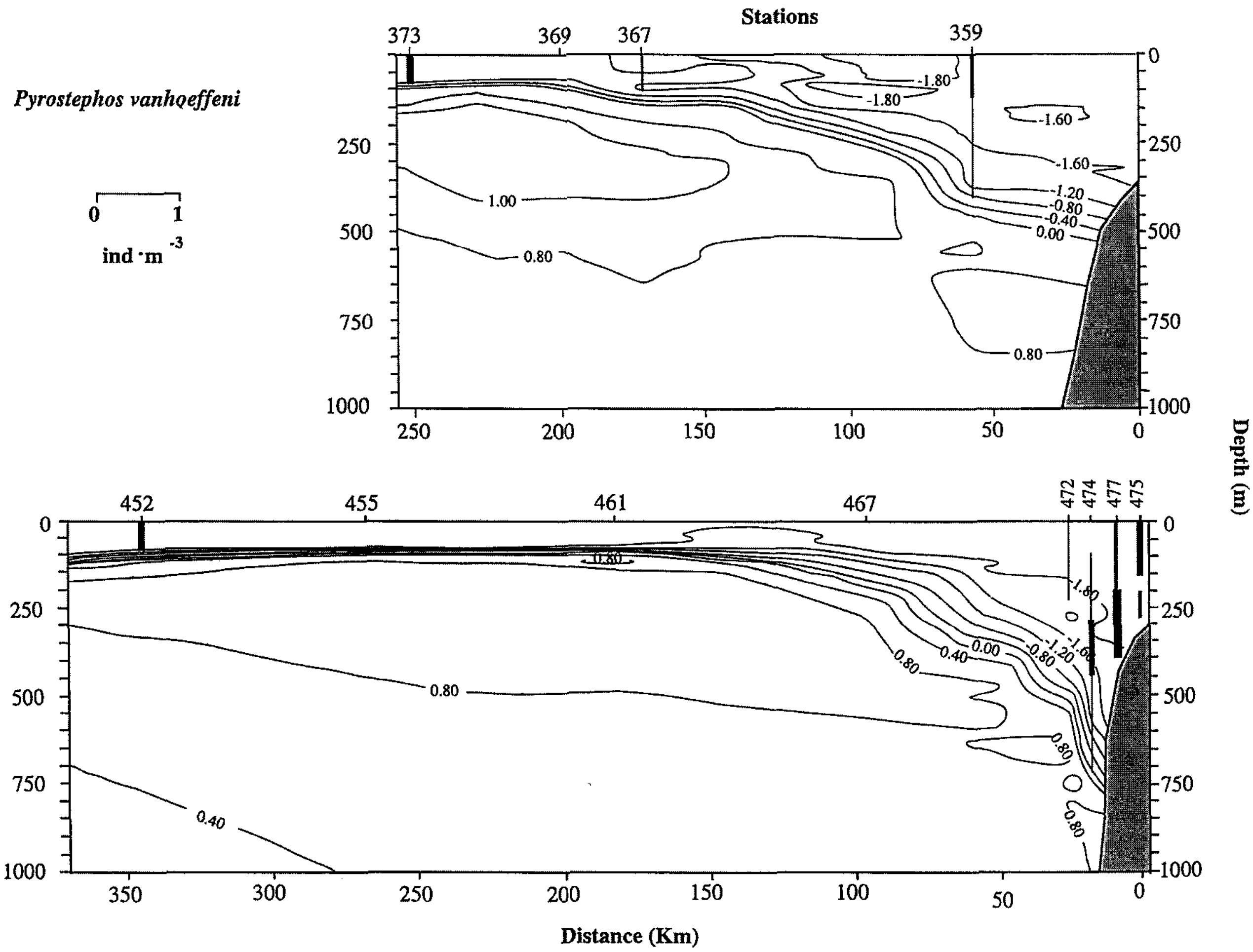

Fig. 8. Depth distribution and abundance of *Pyrostephos vanhoeffeni* along the two transects.

ence on the distribution of zooplankton in aggregating organisms in their vicinities (Wolanski and Hamner, 1988; Olson et al., 1994). Medusae and siphonophores certainly aggregated in and below the sub-surface thermocline, but scarcely concentrated in the proximities of the ASF where copepods (Fig. 9), their main prey (Purcell and Mills, 1988; Pagès et al., in press), were very abundant. A comparison of the total abundance of planktonic cnidarians throughout the water column sampled (Fig. 2) with that of copepods (Fig. 9) indicates an uncoupling. To suggest that this is due to strong predatory impact on copepods is unlikely since copepod concentrations were three orders of magnitude greater. However, the uncoupling might be related to the ambient temperatures being rather too low for the survival of cnidarians and to the presence of high concentrations of phytoplankton (Dowe et al., 1996) and radiolarians in the upper waters which may not offer appropriate environmental conditions to cnidarians. There, chaetognaths are the most abundant carnivores (Fig. 11). They prey mainly upon copepods in Antarctic waters, each consuming on average 0.3–0.7 copepods per day (Øresland, 1990, 1995). However, the trophic impact exerted by chaetognaths on copepods in the sampling area was probably low according to their respective abundances. There was a tendency for water column partitioning among the carnivorous mesozooplankton. In oceanic waters, chaetognaths were more abundant in the upper cold waters while cnidarians predominated in and below the thermocline. Likewise the former were relatively abundant in the shelf-slope waters where the latter only appeared occasionally. Aside from temperature, this

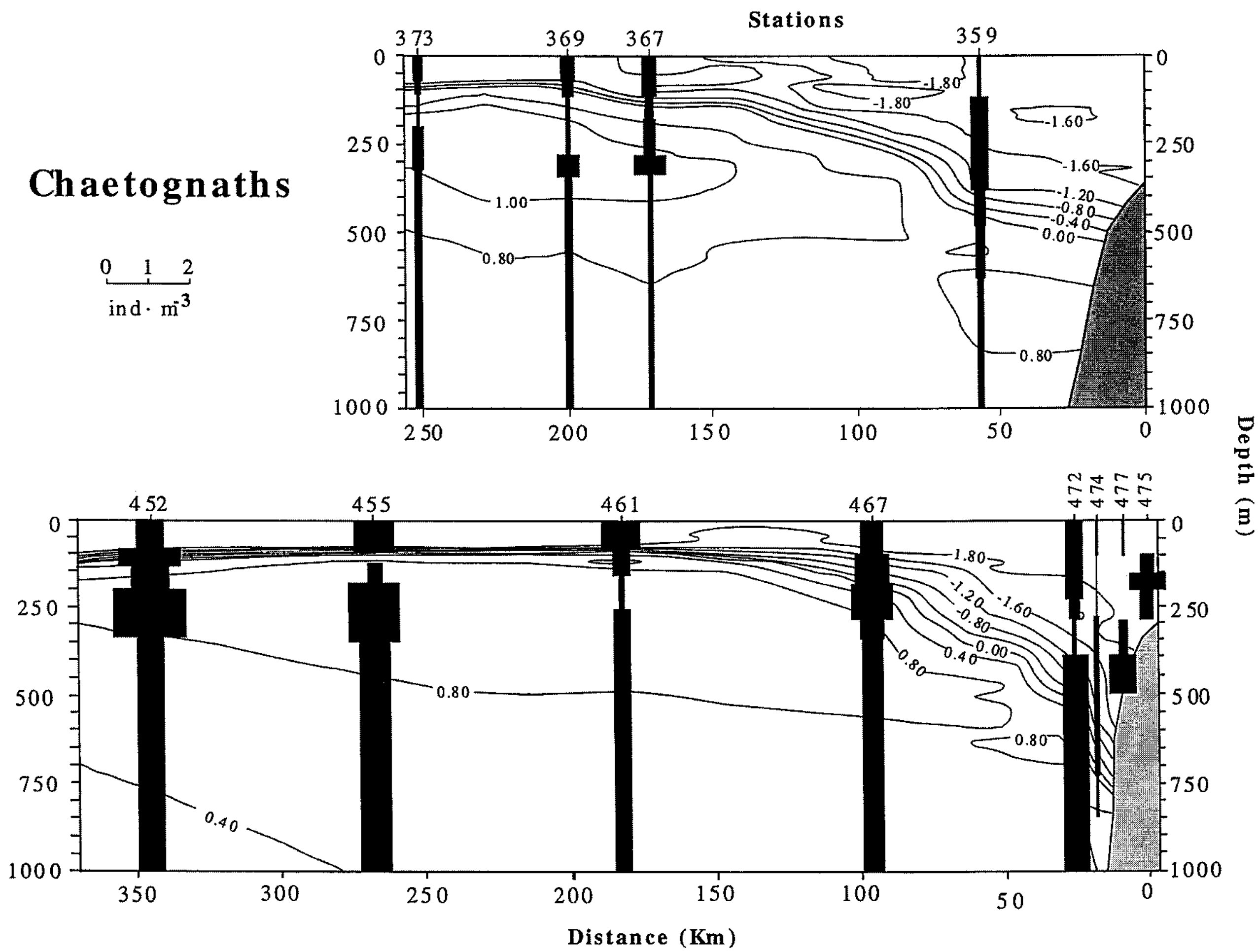

Fig. 11. Depth distribution and abundance of chaetognaths along the two transects.

Table 5
Prey items (in numbers) found in the gastrozooids of *Pyrostephos vanhoeffeni* colonies. N = number of gastrozooids examined, n = number of gastrozooids with prey. Station 354 was occupied before the first transect and the Multinet was tested there

	Stations	354	359	367	452	452	452	477	477
	Depth range (m)	50–0	120–0	110–0	90–0	400–300	300–200	200–100	100–0
	N	573	110	35	9	18	36	17	33
	n	257	14	10	1	17	34	3	14
Euphausia superba		4	1	9	.	1	.	.	1
Thysanoessa macrura		3	.	.	.	.	.	.	.
Calanus propinquus		15	.	.	.	.	1	.	.
Metridia gerlachei		12	.	1	.	.	.	.	.
Oithona similis		6	2	.	.	.	2	2	.
Ctenocalanus citer		1	.	.	.	.	.	1	.
Oncaea spp.		.	1	.	.	.	.	.	.
Copepod exosqueletons		55	2	.	.	.	.	.	.
Limacina helicina		1	.	.	.	.	.	.	.
Unidentified liquid		187	.	.	.	16	31	.	13
Foraminifers		.	1	.	.	.	.	.	.
Diatoms		.	1	.	.	.	.	.	.
Ostracods		1	.	.	.	.	.	.	.
Organic matter		18	3	.	1	.	.	.	.
Lipid drop		9	.	.	.	.	.	.	.
Intracellular digestion		30	.	.	.	.	.	.	.

partitioning is probably related to the distribution of prey: chaetognaths appear to feed exclusively upon copepods whereas medusae and siphonophores also prey upon other invertebrates.

In conclusion, the distribution of the siphonophores and medusae was greatly influenced by the thermocline in oceanic waters and by the ASF in the shelf break area. They were abundant and showed a partitioning throughout the water column that seemed to be related to optimum temperature at species level. Thus, it appears that only a few species of cnidarians are well adapted to life in the lowest temperatures of the Southern Ocean. Further studies are needed to investigate the life cycles of some key species. These studies also have to take into account the trophic impact that cnidarians exert, which seems to be high in the case of *Pyrostephos vanhoeffeni*.

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