

## Species composition and distribution of decapod crustaceans in the waters off Patagonia and Tierra del Fuego, South America\*

WOLF E. ARNTZ<sup>1</sup>, MATTHIAS GORNY<sup>2</sup>, RAUL SOTO<sup>3</sup>, MARCO A. LARDIES<sup>4</sup>,  
MARCO RETAMAL<sup>5</sup> and INGO S. WEHRTMANN<sup>1,6</sup>

<sup>1</sup> Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven, Germany.

<sup>2</sup> Instituto de la Patagonia, Universidad de Magallanes, Punta Arenas, Chile.

<sup>3</sup> Dpto. de Oceanografía, Universidad Arturo Prat, Iquique, Chile.

<sup>4</sup> Instituto de Biología Marina "Jürgen Winter", Univ. Austral de Chile, Valdivia, Chile.

<sup>5</sup> Dpto. de Oceanografía, Universidad Concepción, Concepción, Chile.

<sup>6</sup> Instituto de Zoología "Ernst F. Kilian", Univ. Austral de Chile, Valdivia, Chile.

**SUMMARY:** This paper comprises the decapod crustacean material collected during the "Victor Hensen" campaign 1994 and during the last phase of "Polarstern" cruise ANT XIII/4 in 1996. Sampling covered waters of medium and greater depth in the Straits of Magellan, the channels towards the south, and the area south of the Beagle Channel including the northern slope of the Drake Passage. 30 species of decapods were found, which is considered a good result taking into account that the species restricted to the intertidal and the upper subtidal, which were not subject of this study, are missing. Anomurans were the dominant group, followed by brachyurans and caridean shrimps. Additionally one palinuran (*Stereomastis suhmi*; n=8) and a single specimen of the astacuran *Thymops birsteini* were found. Dominance patterns changed considerably from the Straits of Magellan to the channel system south of the Strait, and again to the area south of the Beagle and the northern slope of the Drake Passage. Among the top dominants were the galatheid *Munida* spp., which in the southernmost area numerically contributes >90% to the catches, the brachyuran crabs *Peltarion spinosulum* and *Eurypodius latreillii*, the hermit crab *Pagurus comptus*, and the caridean shrimps *Austropandalus grayi* and *Pasiphaea acutifrons*. *Munida* spp. and *P. spinosulum* also revealed the highest frequency of occurrence at 49% and 45% of the stations, respectively, followed by *E. latreillii*, *P. comptus*, and *A. grayi*. Regional and bathymetric distribution of the principal species are given. The depth range of some species was found to be very wide (*Campylonotus semistriatus*, *Munida* spp., *E. latreillii*, *P. spinosulum*) whereas others were restricted to relatively shallow waters (*Pagurus gaudichaudii*, *Lithodes santolla*, *Campylonotus vagans*, *A. grayi*) or great depth (*Nematocarcinus lanceopes*, *Stereomastis suhmi*). It should be mentioned, however, that sampling depths differed greatly in the areas of study. Contrary to the Antarctic, the Magellan region reveals a strong dominance of reptant decapods whereas caridean shrimps play a minor role in that region. This dominance pattern is valid even for the southernmost areas of the region. The northern slope of the Drake Passage is characterized by a mixture of cold-temperate and Antarctic elements which make it a transitional area between the two continents.

**Key words:** Decapoda, species composition, distribution, abundance, Straits of Magellan, Beagle Channel, Drake Passage

**RESUMEN:** COMPOSICIÓN DE ESPECIES Y DISTRIBUCIÓN DE LOS CRUSTÁCEOS DECAÓPODOS EN LAS AGUAS DE LA PATAGONIA Y DE TIERRA DEL FUEGO, AMÉRICA DEL SUR. – En este trabajo se analiza el material de crustáceos decápodos recolectado en la Campaña "Victor Hensen" 1994 y en la última etapa de la campaña "Polarstern" ANT XIII/4 en 1996. El muestreo cubrió las aguas de mediana y mayor profundidad en el Estrecho de Magallanes, los canales del sur y el área al sur del Canal del Beagle incluyendo la vertiente norte del Paso de Drake. Se registraron 30 especies de decápodos, lo cual se considera un número apreciable, teniendo en cuenta que no se incluyen las especies del intermareal y del infralitoral somero, que no fueron objeto de estudio en este trabajo. Los anomuros fueron el grupo predominante, seguidos por los braquiuros y los carídeos. También se encontraron un palinúrido (*Stereomastis suhmi*), representado por 8 ejemplares, y el astacúrido *Thymops*

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*birsteini* con un solo ejemplar. Los patrones de dominancia cambiaron sustancialmente del Estrecho de Magallanes hacia el sistema de canales al sur del Estrecho, y otra vez hacia el área al sur del Beagle y la vertiente norte del Paso de Drake. Entre las especies predominantes figuraron los galateídeos *Munida* spp., que en el área más meridional contribuyó más del 90% de las capturas, los cangrejos braquiuros *Peltarion spinosulum* y *Eurypodius latreillii*, el cangrejo ermitaño *Pagurus comptus* y los camarones carídeos *Austropandalus grayi* y *Pasiphaea acutifrons*. *Munida* spp. and *P. spinosulum* presentaron también la mayor presencia con 49 y 45% de las estaciones respectivamente, seguidas por *E. latreillii*, *P. comptus* y *A. grayi*. Se presenta la distribución regional y batimétrica de las principales especies. El ámbito de profundidad de algunas especies (*C. semistriatus*, *Munida* spp., *E. latreillii*, *P. spinosulum*) fue muy amplio mientras que otras especies se restringieron a aguas relativamente someras (*Pagurus gaudichaudii*, *Lithodes santolla*, *Campylonotus vagans*, *Austropandalus grayi*) o profundas (*Nematocarcinus lanceopes*, *Stereomastis suhmi*). Hay que mencionar, sin embargo, que las profundidades de muestreo en las diferentes áreas fueron muy distintas. Al contrario que la Antártida, la región Magallánica revela una fuerte dominancia de los decápodos reptantes, mientras que los carídeos de esta región cumplen un papel de menor importancia en cuanto al porcentaje de captura. Esta dominancia es válida incluso para las partes más al sur de la región. La vertiente norte del Paso de Drake se caracteriza por una mezcla de elementos antárticos y de aguas templadas frías, lo que la convierte en un área de transición entre los dos continentes.

*Palabras clave:* Decapoda, composición de especies, distribución, abundancia, Estrecho de Magallanes, Canal del Beagle, Paso de Drake

## INTRODUCTION

The distribution of decapod crustaceans in the numerous channels and fjords, which form the southern tip of the South American continent, was poorly known until some years ago. The principal source of information had been the Hamburger Magalhaensische Sammelreise (Doflein and Balss, 1912), with various records obtained in the southernmost part, around Navarino Island. During several other expeditions, among them the University of Lund Chile Expedition 1948-49 (Brattström and Dahl, 1951), which provided the more recent base of information on the Chilean decapod fauna (cf. Brattström and Johanssen, 1983), only few occasional samples were taken in the area between 42° and 55°S. Both the species inventory and the distribution of selected decapod groups have been actualized recently (Retamal and Soto 1993, 1995; Wehrmann and Carvacho 1997), and Boschi *et al.* (1992) have summarized the present knowledge regarding the faunal composition and distribution of decapod crustaceans along the Atlantic Patagonian coast. However, these studies either focused on selected groups, or were restricted to certain sectors of our area of study.

With respect to Antarctic-South American comparisons, the decapod material obtained by the Soviet Antarctic expeditions between 1955 and 1958 was of particular interest, because the geographical scope of sampling covered not only the Antarctic but included also the waters off Chile and South New Zealand (Zarenkov, 1970). From the information available at that time, Zarenkov (loc.cit.) derived the existence of two antiboreal faunas, South American and New Zealand. Furthermore, he concluded that the connections of the decapod fauna

on the Antarctic shelves with that living in areas north of the Antarctic Convergence are weak and confined to South America and the Subantarctic islands of Kerguelen and the Scotia Arc. However, information on the decapod fauna of the Subantarctic islands was sparse at the time, and Zarenkov's samples from southern South America were scattered over a comparatively large area. A more detailed data base served for the recent description of the biogeography of decapods in the Southern Ocean by Gorny (1999).

Species composition and distribution of decapods in the Antarctic have been the subject of more intense study during the past decade, revealing that this group is not as scarcely represented as was assumed two decades ago. Current species composition of the Antarctic decapod fauna is dominated by caridean shrimps and few lithodid anomuran crabs (e.g., Kirkwood, 1984; Arntz and Gorny, 1991; Klages *et al.*, 1995; Gorny, 1999). However, the fossil record clearly documents that decapods were more abundant and diverse in the southernmost parts of the Southern Ocean during the Cretaceous and early Tertiary up to Eocene times (see Feldmann and Quilty, 1997 and references cited therein).

The purpose of the present study is to describe in more detail the species composition and distribution patterns between the Strait of Magellan and Cape Horn, considering possible trends (e.g., does species richness decrease with latitude?) and (dis)similarities with the Antarctic decapod fauna (e.g., is the northern slope of the Drake Passage a transitional area?). New biogeographical aspects that mainly emerged from the recent revision of the decapod fauna of the Southern Ocean by Gorny (1999) will be considered.

## MATERIAL AND METHODS

Samples were obtained during the Joint "Victor Hensen" Magellan Campaign (30 October-15 November 1994) and leg 4 of RV "Polarstern" cruise ANT XIII (14-18 May 1996). The study site (cf. Fig. 5) covered the areas between 52°56'S, 70°18'W and 55° 47'S, 66°57'W ("Victor Hensen"), and between 55°23'S, 66°13'W and 55°47'S, 65°49'W ("Polar-stern"). Decapod crustaceans were collected by means of a modified Agassiz trawl (AGT) with a beam length of 1.5 m and 10 mm mesh size in the codend. A total of 72 successful hauls ("Victor Hensen": 63 hauls; "Polarstern": 9 hauls) were obtained and analyzed. Trawling depths of the successful AGT hauls during the "Victor Hensen" and "Polarstern" cruises varied from 9-653 m and 99-2505 m, respectively. The average trawling depths (extremes in brackets) were 130 m (9-527) for the Straits of Magellan, 261 m (20-653) for the channels, and 50 m (15-112) viz. 915 m (98-2505) for the area south of the Beagle on "Victor Hensen" and "Polarstern", respectively. For further details see cruise reports by Arntz and Gorny (1996) and Fahrbach and Gerdes (1997).

Decapods were picked quantitatively from the total catch at nearly all stations. An exception were some extraordinarily large or repetitive (in terms of depth) hauls from stations VH 1203, 1209, 1215, 1223, 1225 and 1242 located south of the Beagle Channel (marked with an \* in Table 1). From these hauls, the most abundant decapod *Munida* spp. was registered as "no. of baskets" only, using haul VH 1149, where the number of specimens per basket was counted (n=3000), as a reference station. Numbers of the two most abundant brachyuran species, *Peltarion spinosulum* and *Eurypodius latreillii*, also had to be backcalculated for stations 1215, 1223, 1225, 1242 and 1223, 1225, 1242, respectively, using their mean value per basket calculated from 9 viz. 10 stations in the same depth range in the area, to account for different sizes. For *Peltarion*, this average value was 14, and for *Eurypodius*, it was 10. This procedure did not influence the data on species occurrence and distribution but enables us to arrive at rough data of species dominance. All other species were collected quantitatively from all hauls. Collected specimens were preserved aboard in 10% buffered formaldehyde.

Species identification was carried out using the following literature: Holthuis, 1952; Tiefenbacher, 1990 a, b (Caridea); Haig, 1955; Retamal,

1973,1992 (Anomura); Garth, 1957; Boschi *et al.*, 1992 (Brachyura, Astacura, Palinura).

To compare the geographical distribution of the decapod fauna, we arbitrarily divided the area covered by the AGT hauls into three regions: (1) Strait of Magellan (52°57'S, 70°46'W - 53°59'S, 70°33'W; 21 stations); (2) channel system between the Straits of Magellan and the Beagle Channel (54°00'S, 71°00'W - 54°58'S, 69°01'W; 26 stations), and (3) "southern islands" off the eastern mouth of the Beagle Channel (55°00'S, 66°44'W - 55°47'S, 65°49'W; 25 stations).

## RESULTS

### Species composition and abundance

The 72 AGT contained a total of 30 species (Table 1) comprising representatives of a total of 16 families (Caridea: 7 families/14 species; Astacura: 1 family/1 species; Palinura: 1 family/1 species; Anomura: 3 families/8 species; Brachyura: 4 families/6 species).

Hippolytidae (Caridea) with 5, and Lithodidae, Galatheidae (Anomura), and Majidae (Brachyura), each with 3 species, were the most important families in terms of species richness; all of the remaining families were represented by 1 or 2 species only. Several specimens of the genera *Eualus* and *Metacrangon* could not be identified to species level and may represent two species new to science (Holthuis, pers. comm.).

Of a total of >30,000 individuals caught during the two cruises, the overwhelming majority was contributed by *Munida* spp. due to its large share in the area south of the Beagle, where it contributed >90% by number. However, in the Strait of Magellan this species had a numerical percentage of less than one-third, sharing its dominant position with the crabs *Peltarion spinosulum* and *Eurypodius latreillii* and the hermit crab *Pagurus comptus* (Fig. 1, above). In the channel system south of the Strait including the Beagle, *Munida* spp. was not among the dominants whereas *P. spinosulum*, *P. comptus* and *E. latreillii* continued to play an important part. In this area, also caridean shrimps were numerically dominant, above all *Campylonotus semistriatus* and *Austropandalus grayi* (Fig. 1, centre). South of the Beagle Channel most catches were entirely dominated by extremely high numbers of galatheids (Fig. 1, bottom).

TABLE 1. – Species list of decapods caught by AGT in the Magellan region (“Victor Hensen” and “Polarstern” material combined).

Stat.-Nr	Straits of Magellan																				Pa	Msp	MspP	Mo	Ela	Elo	Lsm	Hp	Ps	Pv						
	Pa	Pd	Nl	Nsp	Cs	Cv	Bt	Nm	Ed	Esp	La	Ct	Ag	M	Tb	Ss	Lsa	Pgr	Psp	Pc																
VH 805	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	18	0				
VH 806	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	125	0	0	4	6	0				
VH 812	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	107	0	0	1	10	0				
VH 816	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	26	0	0	0	0	0				
VH 821	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	0	5	0	0	0	20	0			
VH 834	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105	0				
VH 846	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
VH 861	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	176	0				
VH 863	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0			
VH 865	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
VH 870	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
VH 875	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
VH 881	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
VH 888	0	0	0	0	12	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0		
VH 920	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
VH 926	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
VH 949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
VH 952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
VH 960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
VH 969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 976	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Stat.-Nr	Channel system south of Straits of Magellan																				Pa	Msp	MspP	Mo	Ela	Elo	Lsm	Hp	Ps	Pv							
	Pa	Pd	Nl	Nsp	Cs	Cv	Bt	Nm	Ed	Esp	La	Ct	Ag	M	Tb	Ss	Lsa	Pgr	Psp	Pc																	
VH 1031	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
VH 1036	0	0	0	0	0	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1042	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1046	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1074	2	0	0	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
VH 1080	0	0	0	0	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1086	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1121	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1133	6	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1137	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1264	3	1	0	0	6	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1269	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1274	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1275	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1277	3	1	0	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1278	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1286	0	0	0	0	0	0	0	0	0	0	0	0	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1290	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1294	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1300	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1306	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1316	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1319	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Stat.-Nr	Southern islands																				Pa	Msp	MspP	Mo	Ela	Elo	Lsm	Hp	Ps	Pv								
	Pa	Pd	Nl	Nsp	Cs	Cv	Bt	Nm	Ed	Esp	La	Ct	Ag	M	Tb	Ss	Lsa	Pgr	Psp	Pc																		
VH 1141	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
VH 1149	0	0	0	0	0	3	0	3	0	0	0	0	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VH 1153	0	0	0	0	0	0	4	33	1	0	0	0	1	0	0	0	0	2																				



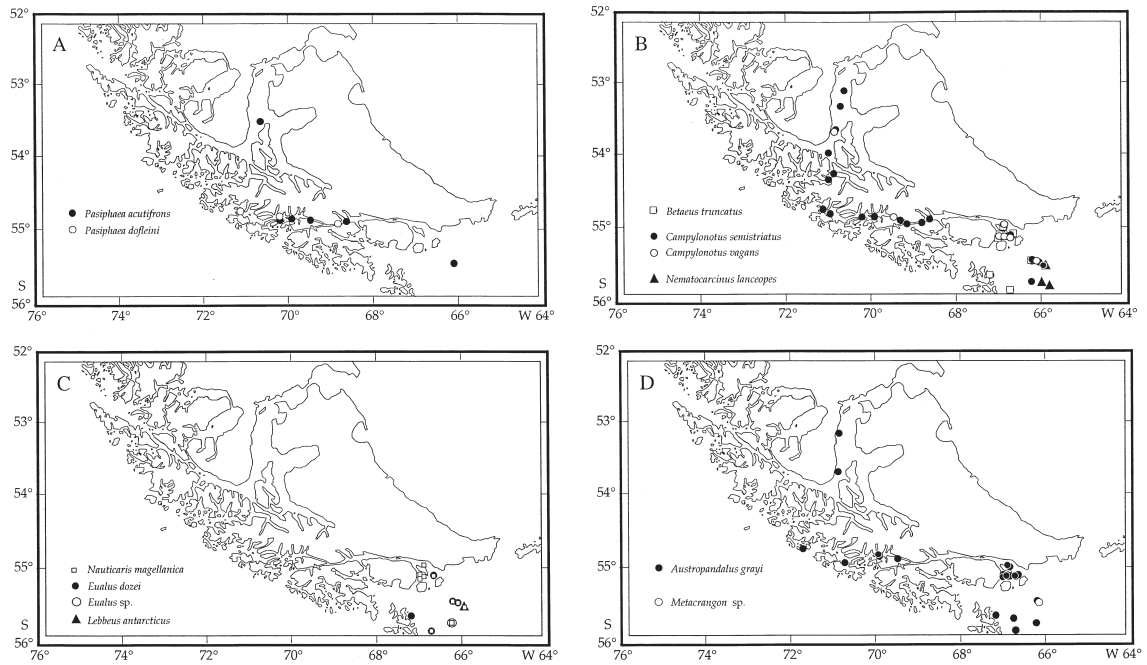


FIG. 2. – Locations for caridean shrimps collected during the “Victor Hensen” campaign, 1994: A Pasiphaeidae; B Alpheidae-Campylonotidae-Nematocarcinidae; C Hippolytidae; D Pandalidae - Crangonidae.

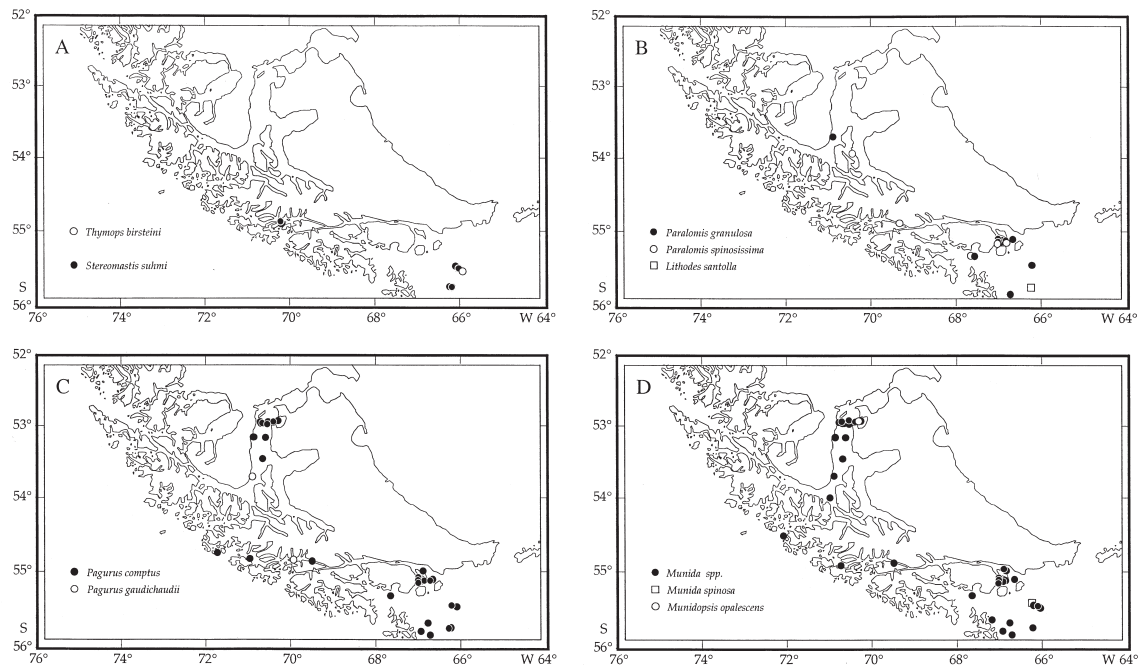


FIG. 3. – Locations for astacuran and palinuran lobsters and anomuran crabs collected during the “Victor Hensen” campaign, 1994: A Astacura - Palinura; B Lithodidae; C Paguridae; D Galatheidae.

### Regional distribution

Decapod crustaceans were common within all three areas of investigation, however, species number varied between the regions. The regional distribution of selected species is shown in Figures 2-4. South of the Beagle Channel, a total of 27

species occurred; only *Pasiphaea dofleini*, *Munidopsis opalescens* and *Libidoclaea smithii* were missing in this area. A total of 14 species was found in the Strait of Magellan and 13 species were distributed in the channels located between the Strait and the eastern mouth of the Beagle Channel.

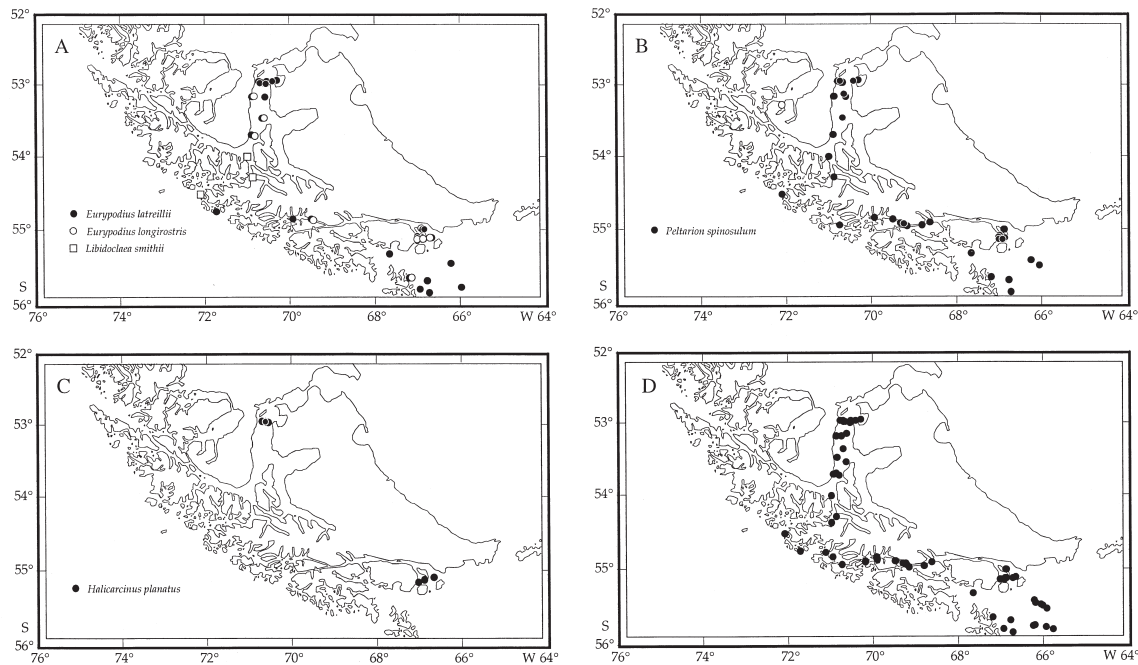


FIG. 4. – Locations for brachyuran crabs collected during the “Victor Hensen” campaign, 1994: A Majidae; B Atelecyclidae; C Hymenoso-  
matidae; D Location of sampling sites (“Victor Hensen”-cruise and “Polarstern”-cruise ANT XIII/4 combined).

Nine species were found in all three areas, whereas all other decapod crustaceans revealed distinct horizontal distribution ranges (cf. Table 1). The widest geographic distribution was demonstrated by the two brachyuran crabs *P. spinosulum* and *E. latreillii*, which were present between the north-westernmost station in the Straits of Magellan and the southernmost point of investigation, on the continental slope south of the Beagle Channel. The most restricted range was found in all members of the Hippolytidae (Caridea), which occurred only south of the Beagle Channel. Rare species such as *Metacrangon* sp., *Eualus* spp., *Lebbeus antarcticus*, *Nematocarcinus lanceopes* and *Thymops birsteini* have been recorded only far in the south, and *Stereomastis suhmi* has been found exclusively in the channel system.

Species with the greatest frequency of occurrence were *P. spinosulum* (Brachyura: Atelecyclidae), *Munida* spp. (Anomura: Galatheidae), present in 38 and 35 hauls, respectively, *E. latreillii* (Brachyura: Majidae), present in 32 and *P. comptus* (Anomura: Paguridae), present in 30 hauls. Also the caridean shrimps *C. semistriatus* (Campylonotidae) and *A. grayi* (Pandalidae) were well represented with 26 and 21 records, respectively. All the remaining species were less common (less than 10% occurrence).

### Bathymetric distribution

The median depth where species have been collected is shown in Figure 5, revealing also the respective minima and maxima. The largest species group (n=11) occurred mainly between 50 and 100 m depth; 7 of them (3 Caridea, 3 Anomura and 1 Brachyura) were restricted to the range above 110 m. Exceptions within this shallow-water group were *Nauticaris magellanica*, *P. comptus*, *Munida* spp., *E. latreillii* and *P. spinosulum*, which revealed a much wider depth range. A second group, represented by 6 species, was obtained from depths ranging between approximately 300 and 800 m. Representatives of this medium-water group generally showed a wider bathymetric distribution, as can be seen from the extremes in Figure 5. A depth range between 214 m and 480 m places *Libidoclea smithii* in between the first two groups. Four species (*Nematocarcinus lanceopes*, *Nematocarcinus* sp., *Lebbeus antarcticus* and *Thymops birsteini*) were recorded exclusively from stations well below 1000 m.

The species with the widest vertical distribution ranges were *C. semistriatus*, from 70–2165 m, *E. latreillii*, found between 9 and 1507 m, and *P. spinosulum* occurring between 9 and 1270 m. *N. lanceopes* was caught between 1270 and 2505 m depth.

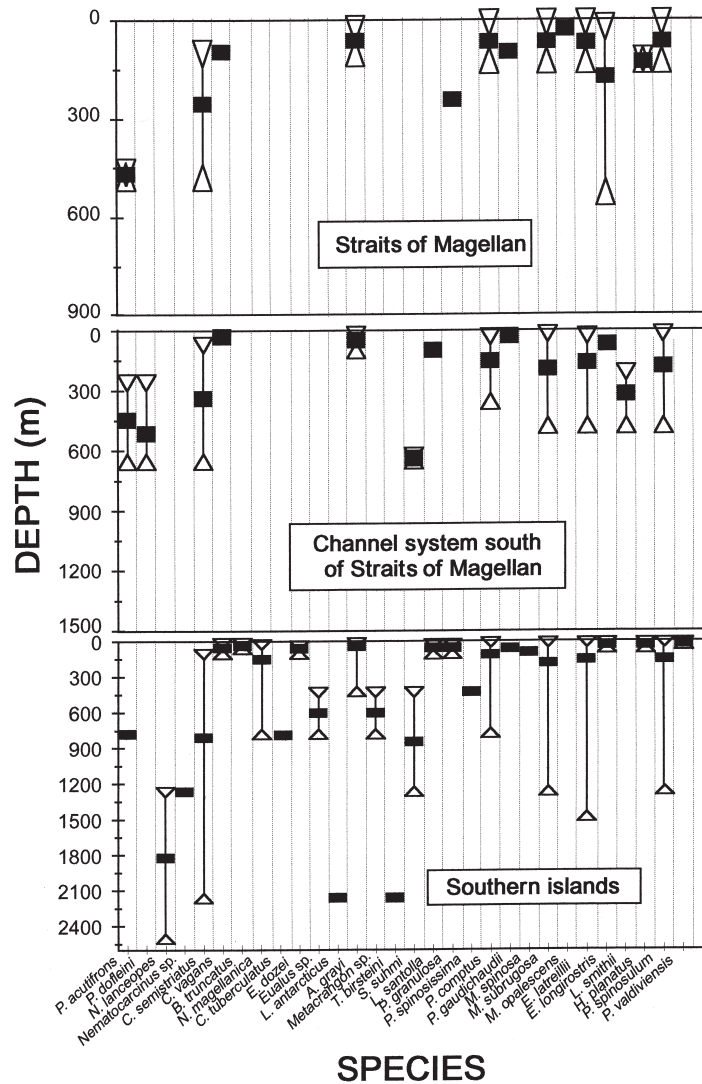


FIG. 5. – Depth ranges (medians and extremes) of decapod species in the three study areas.

## DISCUSSION

The type of gear used in this study, which provided the most substantial material ever obtained in the Magellan region, does not yield strictly quantitative samples (see Ekau, 1988, and Voss, 1988), but it provides large amounts of material with relatively little effort and can be used for large-scale comparisons of benthic epifauna. For this reason numbers and percentages of the different species caught should be considered crude estimates, even more so as some numbers had to be recalculated (see Methods). As an additional means for estimating abundance, we took photographs of each haul and noted the biomass of the catch. Anyway, we can use this information only to compare benthic species. Only two of the 13 pelagic shrimp species known for the South American antiboreal zone have been caught

whereas all known benthic caridean shrimp species were taken. For this reason, pelagic decapods will not be discussed further.

More than half of the 50 species, which are distributed between the Pacific entrance of the Straits of Magellan and Cape Horn (Gorny, 1999) have been caught on both expeditions during 1994 and 1996, among them two species likely to be new to science (Table 2). Furthermore, the known distribution range of 12 species was extended towards the south. Most benthic species formerly recorded but missing in our samples are anomuran and brachyuran crab species distributed between 0 and 250 m depth. As 65% of our AGT samples were carried out in this depth zone, the relatively poor presence of crab species in the samples is at first glance surprising. However, no catches were taken from the intertidal and shallow subtidal < 9m which might have provided further species, e.g., the



brachyurans *Halicarcinus planatus* and *Acanthocyclus albatrossis*. On the other hand, some of the species encountered had very high densities. Various catches close to the Atlantic entrance of the Straits of Magellan and south of the Beagle Channel yielded several kg of *P. spinosulum* and even higher weights of *Munida* spp., the two dominant decapod species of the area, which occur on sandy bottoms and muddy grounds, respectively. Underwater camera transects (Gutt and Schickan, 1996) confirmed exceptionally

high densities of anomuran and brachyuran decapods in these areas, which are in sharp contrast to video and camera transects from the high Antarctic (Gutt *et al.*, 1991). From UW photos, a maximum density of 2560 specimens per 100 m<sup>2</sup> of *Munida* spp. was calculated for stn. 1219 south of the Beagle, and average densities of 700 specimens per 100 m<sup>2</sup> were encountered in the “crustacean community” both in the Paso Ancho area of the Straits of Magellan and south of the Beagle (Gutt, pers. comm.).

TABLE 2. – Species composition and distribution of decapods in the waters off Patagonia and Tierra del Fuego (this study) compared to earlier records in the Chilean part of the antiboreal region of South America and around Antarctica (\* cf. Gorny, 1999).

Species	Off Patagonia and Tierra del Fuego (this study)			Previously known distribution range*	
	Present	Extension of the distribution range to the south to the north	Possibly new species	Antiboreal region of South America (Chiloé-Cape Horn)	Antarctic continental shelf and Subantarctic islands
<i>Nematocarcinus lanceopes</i> Bate, 1888	+		+		+
<i>Pasiphaea acutifrons</i> Bate, 1888	+	+		+	
<i>Pasiphaea dofleini</i> Schmitt, 1932	+			+	
<i>Campylonotus semistriatus</i> Bate, 1888	+	+		+	
<i>Campylonotus vagans</i> Bate, 1888	+			+	+
<i>Betaeus truncatus</i> Dana, 1852	+	+		+	
<i>Hippolyte coerulescens</i> (Fabricius, 1775)	+			+	
<i>Chorismus tuberculatus</i> Bate, 1888	+	+			+
<i>Eualus dozei</i> (A. Milne Edwards, 1891)	+	+		+	
<i>Eualus</i> sp.	+		+		
<i>Lebbeus antarcticus</i> Hale, 1941	+		+		+
<i>Nauticaris magellanica</i> A. Milne Edwards, 1891	+			+	+
<i>Austropandalus grayi</i> (Cunningham, 1871)	+			+	
<i>Metacrangon</i> sp.	+		+		
<i>Thymops birsteini</i> (Zarenkov and Semenov, 1972)	+	+		+	
<i>Stereomastis suhmi</i> (Bate, 1878)	+	+		+	+
<i>Munida gregaria</i> (Fabricius, 1793)				+	+
<i>Munida spinosa</i> Henderson, 1885	+	+		+	+
<i>Munida subrugosa</i> Henderson, 1847	+			+	+
<i>Munidopsis opalescens</i> Benedict, 1903	+				+
<i>Liopetrolisthes patagonicus</i> (Cunningham, 1871)	+	+		+	
<i>Pagurus comptus</i> White, 1847	+			+	
<i>Pagurus forceps</i> H. Milne Edwards, 1836				+	
<i>Pagurus gaudichaudii</i> H. Milne Edwards, 1836	+			+	
<i>Lithodes confundens</i> MacPherson, 1988				+	
<i>Lithodes santolla</i> (Molina, 1782)	+			+	
<i>Lithodes turkayi</i> MacPherson, 1988				+	+
<i>Paralomis granulosa</i> (Jaquinot, 1847)	+			+	+
<i>Paralomis spinosissima</i> Birstein and Vinogradov, 1972	+	+			+
<i>Eurypodius latreillii</i> Guérin, 1828	+			+	
<i>Leptomitrax longimanus</i> Miers, 1886	+	+		+	
<i>Leucippa pentagona</i> Milne Edwards, 1833				+	
<i>Libidoclaea granaria</i> (M. Milne Edwards and Lucas, 1842)					+
<i>Libidoclaea smithii</i> (Miers, 1886)	+			+	+
<i>Pisoides edwardsii</i> Bell, 1835				+	
<i>Halicarcinus planatus</i> (Fabricius, 1775)	+			+	+
<i>Peltarion spinosulum</i> (White, 1843)	+	+		+	
<i>Cancer edwardsii</i> Bell, 1835				+	
<i>Cancer coronatus</i> Molina, 1782				+	
<i>Gomezia serrata</i> Dana, 1852				+	
<i>Pseudocorystes sicarius</i> (Poeppig, 1836)				+	
<i>Ovalipes punctatus</i> (de Haan, 1933)				+	
<i>Eurypanopeus crenatus</i> (Milne Edwards & Lucas, 1843)					+
<i>Homalaspis plana</i> (H. Milne Edwards, 1843)				+	
<i>Pilumnoides hassleri</i> A. Milne Edwards, 1880				+	
<i>Pinnaxodes chilensis</i> Milne Edwards, 1837				+	
<i>Acanthocyclus albatrossis</i> Rathbun, 1898				+	
<i>Planes minutus</i> Linné				+	
<i>Pinnixa transversalis</i> (Milne Edwards and Lucas, 1843)				+	
<i>Pinnixa valdiviensis</i> Rathbun, 1907	+	+		+	

Depth ranges of AGT hauls differed substantially in the three areas of study during the two cruises. These ranges had to be accepted for technical reasons: "Victor Hensen" could not trawl much beyond 600 m due to the length of its wires, "Polarstern" found few trawlable shallow grounds on the northern slope of the Drake Passage, and both ships did not enter the shallow sublittoral. The poor species number from the hauls taken in the Straits of Magellan may also be a result of trawling depths. Some decapods which exhibit a high degree of eurybathy (*E. latreillii*, *P. spinosulum*, *Munida* spp.) were caught in large numbers in this area whereas other species were missing, among them typical shallow-water species such as the brachyuran *A. albatrossis*.

Despite this bias, formerly published depth ranges for some decapod species of the Magellan region (Holthuis, 1952; Zarenkov, 1970; Retamal, 1973, 1974; Vinuesa, 1977) have been extended towards greater depths from our AGT catches for the following species: *C. semistriatus*, *N. magellanica*, *L. antarcticus*, *A. grayi*, *Munida* spp., *P. comptus*, *E. latreillii*, *P. spinosulum*, *L. smithii* and *T. birsteini*. On the other hand, some species were confirmed to be restricted to quite shallow waters hardly exceeding 100 m: *B. truncatus*, *E. dozei*, *C. vagans*, *L. santolla*, *P. gaudichaudii*, *H. planatus* and *P. valdiviensis*.

From the antiboreal zone towards the "true" Antarctic (i.e., south of the Antarctic Convergence) there is a steep decline in species richness of decapods (Gorny, 1999, with numerous references). Only 11 benthic and 12 pelagic decapod species have been recorded in these Antarctic waters which are characterized not only by very low temperatures but also an extremely short productive season, and 6 species are known from the continental slope and the deep-sea basins surrounding Antarctica. Towards the Antarctic continental shelf the species number of decapods is reduced once again; only 5 benthic and 3 pelagic species, all of them caridean shrimps, were reported by Arntz and Gorny (1991) from the Weddell sea shelf. These shrimps locally attain relatively high densities; from UW photographs, >33 *Chorismus antarcticus* per 100 m<sup>2</sup> were calculated nearshore at Halley Bay, and of *Nematocarcinus lanceopes* up to 9 specimens per 100 m<sup>2</sup> were counted in the deep Weddell Sea (Gutt *et al.*, 1991). However, these values are 1-2 orders of magnitude lower than the anomuran densities cited above for the Magellan region. The only other decapod group reaching strictly high Antarctic waters are

lithodid crabs (Anomura), with 2 species (Klages *et al.*, 1995; Gorny, 1999). Brachyuran crabs, palinurans and astacurans are absent on the Antarctic continental shelves which may be due to the present-day existence of deep-sea areas between the Antarctic and the surrounding continents, but may have physiological causes as well (Frederich *et al.*, in press). The large areas between the antiboreal zone and the Antarctic Convergence, on the other hand, reveal quite a high species richness of decapods as can be seen from Gorny's (1999) compilation. Particularly from the brachyurans and galatheid anomurans which are so common in the Magellan region and absent in the high Antarctic, one would expect considerable pressure to re-extend their area towards the Antarctic continent if the present warming trend continues (Arntz, 1998). However, contrary to the situation in the early Tertiary when decapod groups were still diverse and abundant around Antarctica (Zinsmeister and Feldmann, 1984; Feldmann and Tshudy, 1989; Crame, 1994), a shallow-water connection to South America is no longer existent.

This first detailed inventory of the Magellan decapod fauna after many years has largely clarified its biogeographic position and its relations to the Antarctic, where more intense sampling has been carried out during past years. The Magellan region as a refuge area in glacial times has maintained a much higher number of species and a greater diversity of decapod groups compared with the Antarctic proper which suffered extinction of many groups that seem to have flourished at least until the Eocene (Crame, 1994). Our results reveal an overlap between species occurring in the Antarctic and the southern tip of the Magellan region which caused Gorny (1999) to subdivide the formerly described South American antiboreal fauna into a cold-temperate and a cold-water/Antarctic fauna. *Lebbeus antarcticus*, *Nematocarcinus lanceopes*, *Stereomastis suhmi* and *Paralomis spinosissima* were found for the first time south of the Beagle, i.e. on the northern slope of the Drake Passage. Additionally, two species probably new to science have been caught. *N. lanceopes*, which belongs to the deep-sea fauna of the Southern Ocean, was registered for the first time north of the Antarctic Convergence, as was *L. antarcticus*, a shrimp formerly known from the continental shelves of East and West Antarctica (Arntz and Gorny, 1991; Gorny, 1999). The specimens of *S. suhmi* were the southernmost adults ever caught, since only some larvae had appeared before in plankton samples taken close to South Georgia

(Tiefenbacher, 1994). The other deep-sea species, the astacuran lobster *T. birsteini*, was known from the Atlantic sector before (cf. Boschi *et al.*, 1981).

Thus, for the decapods, the southern tip of the Magellan region (or northern slope of the Drake Passage) does indeed seem to be a transitional area between the Antarctic and cold-temperate faunas. Our data appear to indicate species richness to be higher around the "southern islands" than in the Straits of Magellan and the channel system, but this may be a consequence of our sampling scheme (see above). Further sampling will have to reveal whether the formerly described pattern of decreasing species number with increasing latitude between Chiloé Island and Cape Horn continues to be valid (Gorny, 1999). Species numbers of most groups clearly decrease further into Antarctic waters. From our data it is obvious, however, that towards the Antarctic continent there is a second pattern: a shift from reptant to natant (caridean) decapods. Surprisingly some groups - above all the brachyurans and the galatheid anomurans - thrive well right up to the northern slope of the Drake Passage, where they even attain exceptionally high densities. The only group that has successfully reconquered the high Antarctic is the caridean shrimps whose high frequencies of occurrence and, sometimes, high densities are in contrast with their low number of species. Conversely, shrimps are rich in species but mostly reveal low densities in the Magellan area.

Future work should complete the inventory of the Magellan region (which is presently done on several "Vidal Gormaz" cruises; see Mutschke and Gorny, 1999) and intensify investigations on the southern slope of the Drake Passage using the same gear and methodology as in the Magellan region and the high Antarctic. This would be helpful in finding out to what extent the Drake Passage as a whole is a transitional area between the Antarctic Peninsula and Magellan waters. For this same purpose, cooperation should be intensified with Spanish scientists who have sampled the Scotia Arch for some years (see Ramos, 1999).

Furthermore, the rich decapod material obtained during the various cruises in the Magellan region should be used to extend the study of latitudinal gradients in population dynamics and reproductive biology encountered from the high to the low Antarctic (Gorny *et al.*, 1992) into cold temperate waters. In this context it will be helpful that several Antarctic species also occur in the Magellan region, thus enabling a comparison on species level. Latitudinal

gradients are under investigation also in decapod physiology (Pörtner, pers. comm.), aiming at clarifying potential physiological constraints that may cause the striking absence of some decapod groups from Antarctic waters.

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