

Size structure and sex composition of *Eurypodius latreillii* Guérin, 1828 (Brachyura) and *Pagurus comptus* White, 1847 (Anomura) in southern Chile*

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SUMMARY: The decapod crustaceans *Eurypodius latreillii* (Brachyura) and *Pagurus comptus* (Paguridae) were the most frequently occurring species in Agassiz trawl (AGT) samples obtained during the Chilean - German - Italian "Victor Hensen" Expedition in the Straits of Magellan and south of the Beagle Channel. Sex composition and length structure aspects were studied using the material from 15 stations in the two areas, which comprised 773 specimens of *E. latreillii* and 647 *P. comptus*. The size frequency of both species was characterized by the presence of small individuals in shallow waters. The sex composition varied with depth, indicating a dominance of *E. latreillii* females in deep waters, whereas no such pattern was observed in *P. comptus*. These differences may be caused by epizoites of *E. latreillii* and the availability of vacant gastropod shells for *P. comptus*, in addition to geographical aspects and life-cycle patterns of these species.

Key words: Sex composition, size structure, decapods, southern Chile.

RESUMEN : ESTRUCTURA DE TALLAS Y COMPOSICIÓN SEXUAL DE *EURYPODIUS LATREILLII* GUÉRIN, 1828 (BRACHYURA) Y *PAGURUS COMPTUS* WHITE, 1847 (ANOMURA) EN EL EXTREMO SUR DE CHILE. – Los crustáceos decápodos *Eurypodius latreillii* (Brachyura) y *Pagurus comptus* (Anomura), fueron las especies encontradas con mayor frecuencia en las muestras obtenidas durante la Expedición Chilena - Alemana - Italiana "Victor Hensen" (Octubre/Noviembre de 1994) en el Estrecho de Magallanes y al sur del Canal del Beagle, en el extremo sur de Chile. En estas localidades se obtuvieron las muestras mediante una red de tipo Agassiz. Los ejemplares fueron medidos, pesados y sexados, posteriormente se analizó la composición sexual y la estructura de tallas de estas especies. Se recolectaron un total de 773 individuos de *E. latreillii* y 647 individuos de *P. comptus*. Este material corresponde a los especímenes capturados en 15 estaciones. La estructura de tallas para ambas especies se caracterizó por la presencia de ejemplares de menor tamaño hacia zonas someras. La composición sexual presentó variaciones respecto de la profundidad, indicando una dominancia de hembras en aguas profundas para *E. latreillii*, pero este patrón no se observó en *P. comptus*. Los patrones observados dependerían de la presencia de epibiontes sobre el caparazón de *E. latreillii* y la disponibilidad de conchas vacías de gastrópodos para *P. comptus*, además de aspectos geográficos y de los ciclos de vida que presentarían ambas especies en la región.

Palabras clave: Composición sexual, estructura de tallas, decápodos, sur de Chile.

INTRODUCTION

The decapod crustaceans *Eurypodius latreillii* Guérin 1828 (Brachyura) and *Pagurus comptus* White, 1847 (Paguridae) were the most frequently

occurring species in Agassiz trawl samples obtained during the Chilean-German-Italian "Victor Hensen" Expedition (October / November 1994) in the Straits of Magellan and south of the Beagle Channel (Arntz *et al.*, 1996a; Gorny *et al.*, 1996). Both species were known previously from southern Chile, covering a wide range of geographical distribution along the

*Accepted June 8, 1999.

South American coasts, including the Magellan region in Chile and the Patagonian region in Argentina, as well as the Falkland Islands. The northern distributional limit of *E. latreillii* is Independencia Bay in Peru (Pacific), and the Gulf of San Matías (Atlantic), whereas the most northern range of *P. comptus* is Coquimbo (Chile) in the Pacific and Uruguay in the Atlantic Ocean.

Knowledge of the biology of these species is scarce and restricted to populations north of the Magellan region. Retamal (1974) studied the presence of epizoots like bryozoans, sponges and seaweed on the carapace of *E. latreillii*, and Soto and George-Nascimento (1991) analyzed the use of gastropod shells by *P. comptus* in the intertidal zone off central Chile.

The main objective of the present study was to increase the knowledge on population structures and sex composition for both species in the southernmost part of Chilean waters.

MATERIAL AND METHODS

The analyzed material was collected in October and November 1994 during the Joint Chilean-German-Italian Magellan "Victor Hensen" Campaign in southern Chile by means of an Agassiz trawl (AGT) with a mouth width of 1.5 m and 10 mm mesh. A detailed description of the sampling procedure has been presented by Arntz *et al.* (1996b).

Specimens used in the present study were caught at 15 stations in the Straits of Magellan and south of the Beagle Channel (Table 1 and 2). The material comprised 509 specimens of *E. latreillii*, collected at various locations in the Straits of Magellan, another 264 individuals caught south of the Beagle, 420 *P. comptus* specimens from the Straits of Magellan and 227 from south of the Beagle. We measured carapace length (CL), carapace width (CW), and determined wet weight (WW) without shells for *P. comptus*, and without epizoots for *E. latreillii*.

The size structure was analyzed by means of histograms of size distribution at 5 mm carapace length (CL) intervals for *E. latreillii* and at 1 mm (CL) intervals for *P. comptus*.

The sex proportion (males/females) was analyzed according to Bustos and Retamal (1985). Analyses of variance ANOVA (Sokal and Rohlf, 1987) were performed to estimate significant differences between the two areas (Straits of Magellan and south of the Beagle Channel) and two depth ranges (shallow water ≤ 75 m; deeper water > 75 m).

TABLE 1. – Station list (AGT), location and depth (m) in the Strait of Magellan (SM) and south of the Beagle Channel (SB).

<i>Eurypodius latreillii</i>			Lat. S.	Long. W.	Depth
Station	Location				
806	SM	Estrecho, Laredo	52°58'2	70°42'3	117
812	SM	Estrecho, Laredo	52°58'1	70°40'2	115
816	SM	Estrecho, Laredo	52°57'8	70°32'3	57
861	SM	Estrecho, off Pta Arenas	53°10'2	70°52'9	25
926	SM	Estrecho, Laredo	52°57'5	70°25'5	49
949	SM	Estrecho, off Pta Arenas	53°10'5	70°53'5	24
952	SM	Estrecho, P. Ancho St.20	52°59'4	70°33'0	73
960	SM	Estrecho, Laredo	52°57'9	70°43'4	36
1149	SB	Bahía Oglander	55°09'2	67°01'6	15
1158	SB	Bahía Oglander	55°08'1	67°01'5	33
1175	SB	Pta. Rico	55°07'3	66°53'0	25
1215	SB	S.E.I. Picton	55°06'7	66°40'3	65
1228	SB	I. Gardiner	55°00'8	66°54'6	30
<i>Pagurus comptus</i>			Lat. S.	Long. W.	Depth
Station	Location				
812	SM	Estrecho, Laredo	52°58'1	70°40'2	115
926	SM	Estrecho, Laredo	52°57'5	70°25'5	49
952	SM	Estrecho, P. Ancho St.20	52°59'4	70°33'0	73
960	SM	Estrecho, Laredo	52°57'9	70°43'4	36
1149	SB	Bahía Oglander	55°09'2	67°01'6	15
1162	SB	Paso Goree	55°19'0	67°04'8	25
1228	SB	I. Gardiner	55°00'8	66°54'6	30
1242	SB	Rada Picton	55°04'6	66°47'8	31

RESULTS

The sex composition of *E. latreillii* in the Straits of Magellan and south of the Beagle revealed similar characteristics, whereas the sex proportion (males: females) varied between 0.21 and 1.88 (Table 2). No significant differences between areas were found, whereas low values (from 0.21 to 0.39) were observed in deeper waters, indicating a dominance of females (Table 2). In the Straits of Magellan high percentages of ovigerous females were found toward deep waters (Table 2).

The males of *E. latreillii* varied in mean size between 24.7 and 38.8 mm CL (3.02-17.15 g WW), and females between 25.1 and 39.0 mm CL (5.20-19.17 g WW) (Table 3). The size frequency peaks of males and females in the Straits of Magellan were between 34.5 and 39.5 mm CL; males collected south of the Beagle presented the major frequencies between 29.5 and 44.5 mm CL, whereas for the females particularly high values were observed between 29.5 and 34.5 mm CL (Fig. 1). The size structure varied significantly with depth, large-sized males and females (38.7 and 37.9 mm average CL, respectively) were observed in deep waters. The smallest individuals (< 20 mm CL) were collected in the area south of the Beagle and in the Straits of Magellan at stations 812 (115 m), 926 (49 m) and 960 (36 m); large-sized ovigerous females occurred

TABLE 2. – Number of individuals per station and sex proportions (m/f) in the Straits of Magellan (SM) and south of the Beagle Channel (SB). Below, table (Ftab) and calculated (Fcalc) values from variance analysis (ANOVA) are given for the sex proportion (m/f) comparing the Straits of Magellan (SM) with the area south of the Beagle Channel (SB), and different depth (depth limit shallow/deeper at 75 m). (**) Significant differences ($p > 0.05$); ns: not significant ($p < 0.05$).

<i>Eurypodius latreillii</i>		Depth (m)	Males	Females	Ovigerous females	Total	Sex proportion
806	SM	117	22	38	65	125	0.21
812	SM	115	30	33	44	107	0.39
816	SM	57	10	7	5	22	0.83
861	SM	25	8	19	3	30	0.36
926	SM	49	32	31	4	67	0.91
949	SM	24	14	16	2	32	0.78
952	SM	73	30	14	2	46	1.88
960	SM	36	34	46	-	80	0.74
1149	SB	15	39	27	5	71	1.22
1158	SB	33	16	22	2	40	0.67
1175	SB	25	27	26	3	56	0.93
1215	SB	65	38	23	-	61	1.65
1228	SB	30	20	16	-	36	1.25

<i>Pagurus comptus</i>		Depth (m)	Males	Females	Ovigerous females	Total	Sex proportion
812	SM	115	10	11	4	25	0.91
926	SM	49	195	59	-	254	3.31
952	SM	73	31	39	2	72	0.79
960	SM	36	30	30	9	69	1.00
1149	SB	15	17	16	7	40	1.06
1162	SB	25	32	39	10	81	0.82
1228	SB	30	30	26	14	70	1.15
1242	SB	31	29	-	7	36	-

<i>Eurypodius latreillii</i>		F calc.	F crit.	
Straits of Magellan/ south of Beagle		2.031	4.844	ns
Deep/Shallow		8.455	6.608	**

<i>Pagurus comptus</i>		F calc.	F crit.	
Straits of Magellan/ south of Beagle		0.468	6.608	ns
Deep/Shallow		0.858	7.708	ns

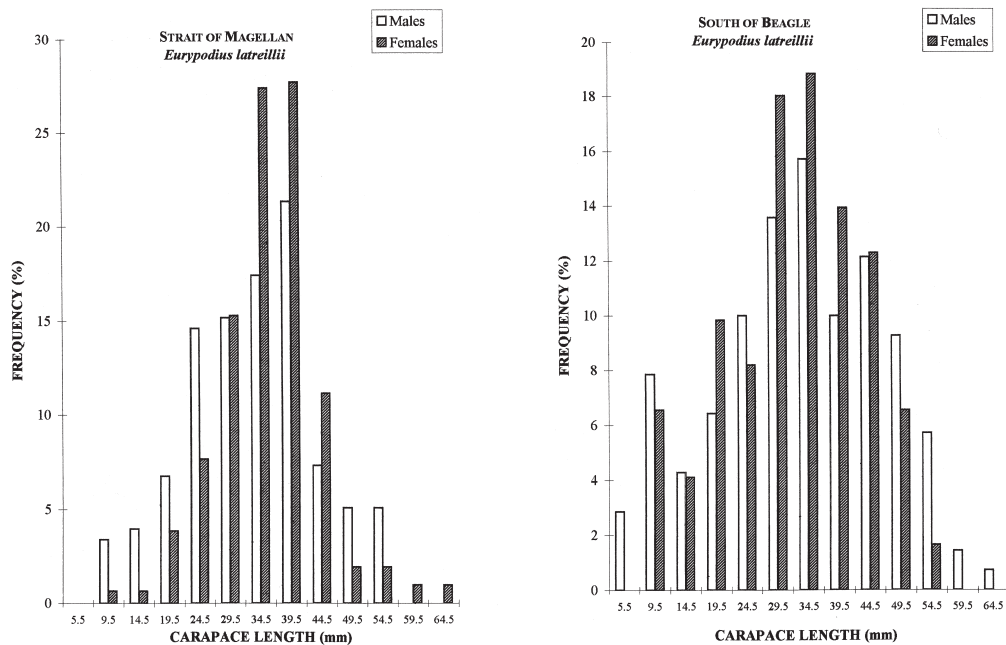


FIG. 1. – Length structure (CL mm) of *Eurypodius latreillii* in the Straits of Magellan and south of the Beagle Channel.

TABLE 3. – Size and weight ranks, average sizes and average weights of *Eurypodius latreillii* per station in the Straits of Magellan (SM) and south of the Beagle Channel (SB). CL = carapace length (mm), CW = carapace width (mm), and WW = wet weight (g).

	Males Rank	Average	Females Rank	Average	Ovigerous females Rank	Average
Station 806 (SM, 117m)						
CL	24.20-52.80	37.76	28.70-46.00	37.94	24.00-62.90	40.51
CW	14.40-42.30	25.24	17.00-34.00	27.03	21.00-42.50	28.09
WW	17.37-54.54	3.02	6.20-28.76	19.17	10.49-60.96	21.97
Station 812 (SM, 115m)						
CL	13.40-48.00	31.75	21.00-46.00	31.59	28.00-44.90	35.78
CW	8.00-31.50	20.35	13.00-32.00	21.66	18.00-30.20	24.38
WW	0.71-28.34	9.66	2.27-31.40	10.86	7.21-24.70	15.35
Station 816 (SM, 57m)						
CL	26.00-51.00	38.76	27.00-41.80	33.64	33.30-50.50	40.50
CW	18.00-37.00	26.00	18.00-29.00	22.90	23.00-40.00	29.62
WW	5.36-20.84	13.06	5.35-20.71	10.83	10.04-39.66	22.21
Station 861 (SM, 25m)						
CL	20.00-35.00	27.58	10.70-51.00	29.22	48.00-68.40	58.13
CW	11.00-20.00	16.21	5.50-38.00	19.39	35.00-44.50	39.50
WW	1.58-5.73	3.43	0.17-36.13	7.28	34.76-51.04	38.67
Station 926 (SM, 49m)						
CL	12.00-47.00	24.73	16.00-41.00	26.07	29.50-35.00	31.88
CW	7.50-32.00	15.69	11.00-29.00	16.98	7.62-25.50	19.03
WW	0.2-29.17	6.07	0.75-21.07	5.20	7.43-11.43	8.49
Station 949 (SM, 24m)						
CL	25.00-54.50	32.44	22.00-51.00	32.19	38.50-52.00	45.25
CW	13.50-34.00	20.39	13.00-36.00	21.40	26.00-37.00	31.50
WW	2.20-35.48	6.97	3.34-11.54	7.92	14.74-24.99	22.37
Station 952 (SM, 73m)						
CL	21.00-55.40	38.71	28.00-39.50	33.31	36.30-37.7	37.00
CW	12.00-42.40	26.22	17.40-27.80	22.50	42.10-29.00	26.55
WW	1.56-53.52	17.15	5.62-15.03	9.56	13.91-14.40	14.16
Station 960 (SM, 36m)						
CL	7.00-51.00	30.25	8.00-45.5	31.63	-	-
CW	4.00-38.00	20.01	4.90-32.20	21.90	-	-
WW	0.10-37.31	9.17	0.47-20.69	8.72	-	-
Station 1149 (SB, 15m)						
CL	5.00-52.00	32.49	8.00-52.00	33.76	31.00-48.00	42.96
CW	2.50-34.00	19.83	4.00-33.80	22.42	22.40-31.00	28.58
WW	0.02-39.43	10.57	0.30-26.28	10.96	10.05-27.93	21.63
Station 1158 (SB, 33m)						
CL	11.00-53.4	36.38	9.30-52.50	38.98	35.40-36.00	35.7
CW	6.50-32.50	23.18	6.00-33.00	26.04	24.00-25.60	24.8
WW	0.32-26.33	12.09	6.24-20.25	12.68	8.41-10.23	9.32
Station 1175 (SB, 25m)						
CL	6.00-52.00	32.76	0.90-46.70	25.14	29.00-37.40	34.46
CW	4.00-33.00	20.43	0.50-31.00	15.71	18.00-25.50	21.83
WW	0.05-34.58	10.19	0.13-29.06	5.48	7.26-16.55	11.36
Station 1215 (SB, 65m)						
CL	12.00-57.40	33.15	14.00-47.2	29.85	-	-
CW	7.00-37.00	20.08	8.00-36.00	19.63	-	-
WW	0.33-51.87	11.67	0.71-20.59	7.38	-	-
Station 1228 (SB, 30m)						
CL	0.80-68.5	29.82	8.00-48.00	27.48	-	-
CW	0.40-41.00	18.05	4.00-29.00	17.79	-	-
WW	0.08-53.16	11.61	0.06-25.38	7.94	-	-

in shallow waters of the area south of the Beagle (station 1149: 15 m) and the Straits of Magellan at station 816 (57 m), 861 (25 m) and 949 (24 m).

The carapace of *E. latreillii* was covered frequently by epizoites such as green and red seaweeds, poriferans, bryozoans, foraminiferans, polychaetes (Sabellidae and Serpulidae), molluscs (*Aulacomya ater*, *Hiatella solida*), ascidians, nematodes, pycnogonids, crustacean decapods (*Liopetrolisthes patagonicus*), amphipods and isopods.

The sex proportion of *P. comptus* in the Straits of Magellan and south of the Beagle Channel was similar, fluctuating from 0.79 to 3.31, but no significant differences were found between areas and depths (Table 2).

The males of *P. comptus* in the Straits of Magellan varied in average size between 5.5 and 7.6 mm CL (0.27-0.65 g WW), and females between 5.1 and 7.3 mm CL (0.21-0.46 g WW) (Table 4). Males and females collected south of the Beagle

TABLE 4. – Size and weight ranks, average sizes and average weights of *Pagurus comptus* per station in the Straits of Magellan (SM) and south of the Beagle Channel (SB). CL = carapace length (mm), CW = carapace width (mm), and WW = wet weight (g).

	Males Rank	Average	Females Rank	Average	Indeterminate Rank	Average
Station 812 (SM, 115m)						
CL	4.00-12.00	7.1	5.00-12.00	6.68	-	4.00
CW	2.00-6.50	4.65	3.50-7.50	3.95	2.00-2.50	2.13
WW	0.11-1.32	0.45	0.21-1.76	0.46	0.06-0.10	0.07
Station 926 (SM, 49m)						
CL	1.00-12.00	7.64	4.00-11.50	7.29	-	-
CW	2.00-7.00	4.27	2.50-7.50	4.17	-	-
WW	0.07-1.35	0.57	0.09-2.13	0.49	-	-
Station 952 (SM, 73m)						
CL	4.50-10.00	7.23	4.50-9.00	6.26	-	4.00
CW	2.50-6.00	4.23	2.00-5.50	3.73	-	2.00
WW	0.13-1.38	0.65	0.20-0.82	0.39	0.15-0.19	0.17
Station 960 (SM, 36m)						
CL	4.00-11.00	6.28	5.00-11.00	6.28	2.00-4.00	3.38
CW	2.50-8.50	3.70	3.00-8.00	3.62	1.00-2.00	1.72
WW	0.10-1.22	0.38	0.16-2.33	0.38	0.05-0.13	0.07
Station 1149 (SB, 15m)						
CL	4.00-9.00	5.53	5.00-8.00	5.13	2.00-4.00	3.07
CW	2.50-5.50	3.19	2.50-4.50	3.09	1.00-2.00	1.64
WW	0.15-1.01	0.35	0.13-0.57	0.30	0.03-0.15	0.08
Station 1162 (SB, 25m)						
CL	4.00-10.00	6.47	4.00-8.50	5.60	2.00-4.00	3.25
CW	2.00-7.50	3.80	2.50-6.00	3.17	1.50-2.00	1.80
WW	0.15-1.81	0.46	0.12-0.99	0.31	0.03-0.11	0.07
Station 1228 (SB, 30m)						
CL	4.00-10.00	6.05	4.00-8.00	5.67	2.50-4.00	3.75
CW	2.00-5.00	3.21	2.00-4.00	3.12	1.50-2.50	2.11
WW	0.06-0.96	0.28	0.08-0.49	0.21	0.02-0.08	0.05
Station 1242 (SB, 31m)						
CL	4.00-9.00	5.75	-	-	-	4.00
CW	2.20-5.00	3.23	-	-	1.80-2.50	2.04
WW	0.10-0.62	0.27	-	-	0.04-0.16	0.08

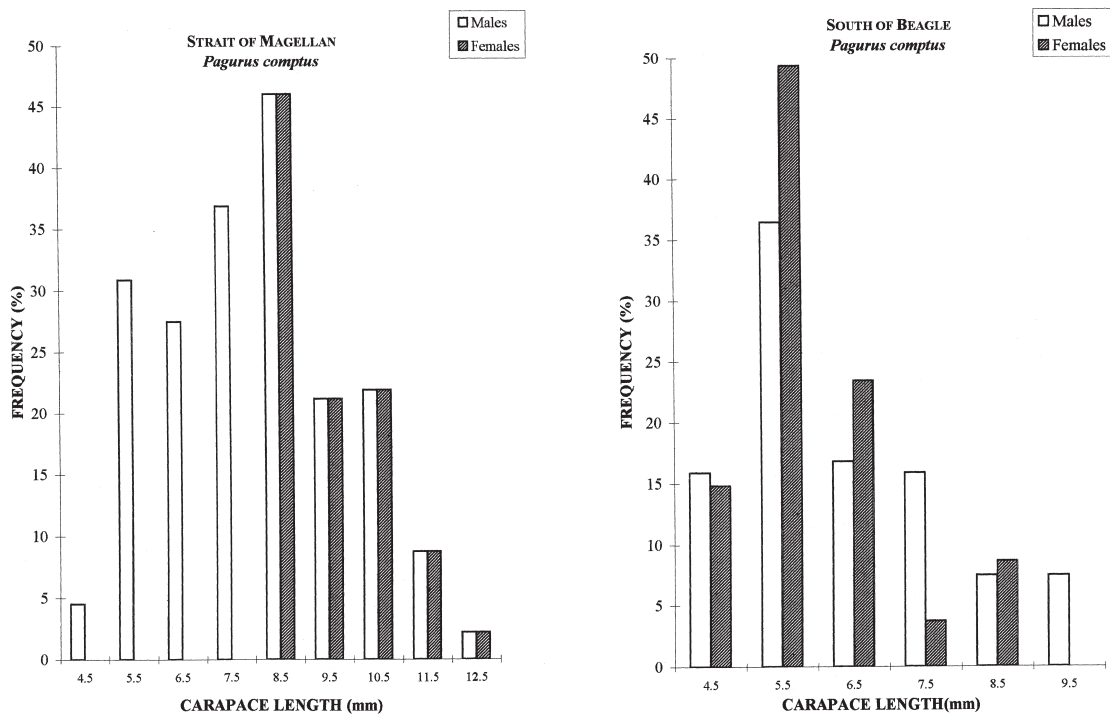


FIG. 2. – Length structure (CL mm) of *Pagurus comptus* in the Straits of Magellan and south of the Beagle Channel.

presented the major frequencies between 4.50 and 6.50 mm CL (Fig. 2).

The size structure of males and females varied with depth, with the largest mean sizes [individuals of 7.6 mm CL (males) and 7.2 mm CL (females)], occurring at intermediate depths. Significant differences were observed in the Straits of Magellan (Table 5). Individuals of *P. comptus* smaller than 7 mm CL were collected in the area south of the Beagle at depths between 15 and 30 m (stations 1149, 1162 and 1228), and in the Straits of Magellan at 36 m (station 960). Larger-sized specimens (> 10 mm CL) occurred in the Straits of Magellan at station 812 (115 m) and 926 (49 m).

DISCUSSION

The sex composition of *E. latreillii* in the Straits of Magellan and the area of south of the Beagle Channel was characterized by high proportions of females, especially ovigerous females in deep waters, and smaller females in shallow waters (≤ 25 m depth). The sex composition of *P. comptus* varied with depth and between areas, particularly at station 926 (Estrecho Laredo) of the Straits of Magellan (m/f = 3.31). The variation of the sex composition may be related with ontogenetic migrations, because female crabs have been observed close to the shore during austral spring (Gorny, pers. comm.), probably to release the larvae in shallow water. This may explain the low presence of females at greater depth and displacing of large ovigerous females of *E. latreillii* toward shallow waters.

The length structure distributions within both species were similar in both areas, but characterized by the presence of larger-sized individuals (males and females) toward deep waters, and of larger-sized ovigerous females toward shallow water in the Straits of Magellan area (Table 6) which may be related to their life cycle. The habitat of benthic early stages is unknown, but there exists some evidence for *Paralomis granulosa* (Lithodidae) (see Castilla, 1985; Lovrich, 1997) of differential distribution in the adult populations with smaller individuals (5-50 mm CL) living in holdfasts of *Macrocystis pyrifera* and rifts, moving into deeper water as they grow.

The sex composition and length frequency of *P. comptus* are regulated by disponibility, diversity and amount of vacant gastropod shells in the environment, due to the intra-specific competition by size and behaviour in pagurids (Abrams, 1980; Camare-

TABLE 5. – Table (Ftab) and calculated (Fcalc) values from variance analysis (ANOVA) for carapace length (CL mm) comparing the Strait of Magellan (SM) with the area south of the Beagle Channel (SB), and different depths (depth limit shallow/deeper at 75 m). (**) Significant difference ($p > 0.05$); ns: not significant ($p < 0.05$).

<i>Eurypodius latreillii</i>	F calc.	F crit.	
Males			
Strait of Magellan/ south of Beagle	0.007	5.317	ns
Deep/Shallow	6.954	5.317	**
Females			
Strait of Magellan/ south of Beagle	1.056	5.317	ns
Deep/Shallow	5.978	5.317	**
<i>Pagurus comptus</i>			
Males			
Strait of Magellan/ south of Beagle	10.089	5.987	**
Deep/Shallow	25.885	5.987	**
Females			
Strait of Magellan/ south of Beagle	13.277	6.608	**
Deep/Shallow	8.194	6.608	**

na and Carvacho, 1987). Regarding diversity of gastropod shells observed in our study, specimens were found to inhabit shells of *Polinices uber*, *Photimula caerulescens*, *Pareuthria plumbea*, *Adelomelon* sp. *Margarella violacea* and *Priene rude*, species that vary in size and form. In the intertidal zone of central Chile (Soto and George-Nascimento, 1991), *P. comptus* used shells of *Tegula atra*, *Tegula tridentata*, *Prisogaster niger*, *Crassilabrum crassilabrum* and *Nucella calcar*.

Based on our results, it seems plausible that the population structure of both species is related to geographical patterns of the region, as well as to the life cycle of the species.

Information about populational aspects of decapods inhabiting the southernmost part of Chilean waters is scarce and restricted to the northern area of the Magellan region. Exceptions are the studies on *Paralomis granulosa* and *Lithodes santolla* (Molina 1782) published by Campodónico (1977), Guzmán and Ríos (1986, 1987), and Lovrich (1997). These authors noted differences in population parameters, and related them to characteristics of coast line morphology, sediment composition (Brambati, 1991; Colizza, 1991) and oceanographical patterns in the region.

Our findings concerning the epizoites on the carapace of *E. latreillii* are in agreement with the results of other studies: Retamal and Yañez (1973) found poriferans and hydrozoans on the carapace and the pereopods of *E. latreillii* collected in Bahía Concepción. In the Magellan region (Bahía Inútil, Seno Otway, La Madre de Dios and Canal Trinidad),

Retamal (1974) reported bryozoans, poriferans and seaweeds as epizoites on the carapace of *E. latreilli*. We assume that size distribution patterns of *E. latreilli* may be related to the presence of epizoites, as high biomasses of ascidians and molluscs (*Aulacomyza ater*) may affect the motility and the behaviour of these crabs.

ACKNOWLEDGEMENTS

We would like to thank the Alfred-Wegener-Institut für Polar- und Meeresforschung, especially Prof. Dr. W. Arntz and Dr. M. Gorny (Universidad de Magallanes). We are thankful to Prof. Walter Sielfeld of Universidad Arturo Prat, Departamento de Ciencias del Mar, who revised the English version of the manuscript.

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