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MAGELLAN-ANTARCTIC: ECOSYSTEMS THAT DRIFTED APART. *W.E. ARNTZ and C. RÍOS (eds.)*

Abundance and diversity of Mollusca in the Beagle Channel*

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SUMMARY: The malacofauna of the Beagle Channel caught by an epibenthic sledge during the Joint Magellan "Victor Hensen" Campaign in 1994 was investigated. At 11 locations 16 samples were taken on a transect through the Channel. Species of Aplacophora, Polyplacophora, Gastropoda, Scaphopoda and Bivalvia were identified and quantified. Their horizontal and vertical distribution was described and possible reasons due to their feeding mode discussed. The exact number of specimens collected was 35,084 yielding 107,208 molluscs/ 1000 m^2.

Key words: Mollusca, abundance, feeding mode, Beagle Channel

RESUMEN: ABUNDANCIA Y DIVERSIDAD DE LOS MOLUSCOS EN EL CANAL DEL BEAGLE. – Se estudió la malacofauna del Canal del Beagle capturada por un trineo epibentónico durante la campaña multidisciplinaria magallánica "Victor Hensen", en el año 1994. Se tomaron 16 muestras en 11 estaciones mediante un transecto a lo largo del Canal. Se identificaron especies de aplacóforos, polyplacóforos, gasterópodos, escafópodos y bivalvos, y se cuantificó su abundancia. Se describe la distribucion horizontal y vertical, justificando esta, en parte, por su modo de alimentación. Se capturaron 35.084 individuos, lo que correspondería a 107.208 moluscos por 1000 m^2.

Palabras clave: Moluscos, abundancia, modo de alimentación, Canal del Beagle.

INTRODUCTION

From the middle of the 19th century onwards many expeditions have led to the Magellan region. Most of them focused on taxonomic studies (e.g. King and Broderip, 1831; Smith, 1885; Mabille and Rochebrune, 1889; Strebel, 1904, 1905a, b, 1906, 1907, 1908; Soot-Ryen, 1959; Dell, 1971). Chilean and Argentinian scientists like Gallardo (e.g. 1979) or de Castellanos (e.g. 1988-93) focused on reproduction and taxonomy, respectively. Brattström and Johanssen (1983) published ecological investigations carried out in southern Chile. Bastida *et al*. (1992) worked on benthic community structure including molluscs on the Argentine continental shelf.

In the southern summers 1989-90 and 1990-91 joint Chilean-Italian expeditions were carried out in the Magellan region with a focus on the Straits of Magellan and a preliminary investigation of the Beagle Channel (Brambati, 1992). Di Geronimo *et al*. (1993) worked on molluscan thanatocenoses.

The "Joint Magellan "Victor Hensen" Campaign 1994" (Arntz and Gorny, 1996) was the first expedi-

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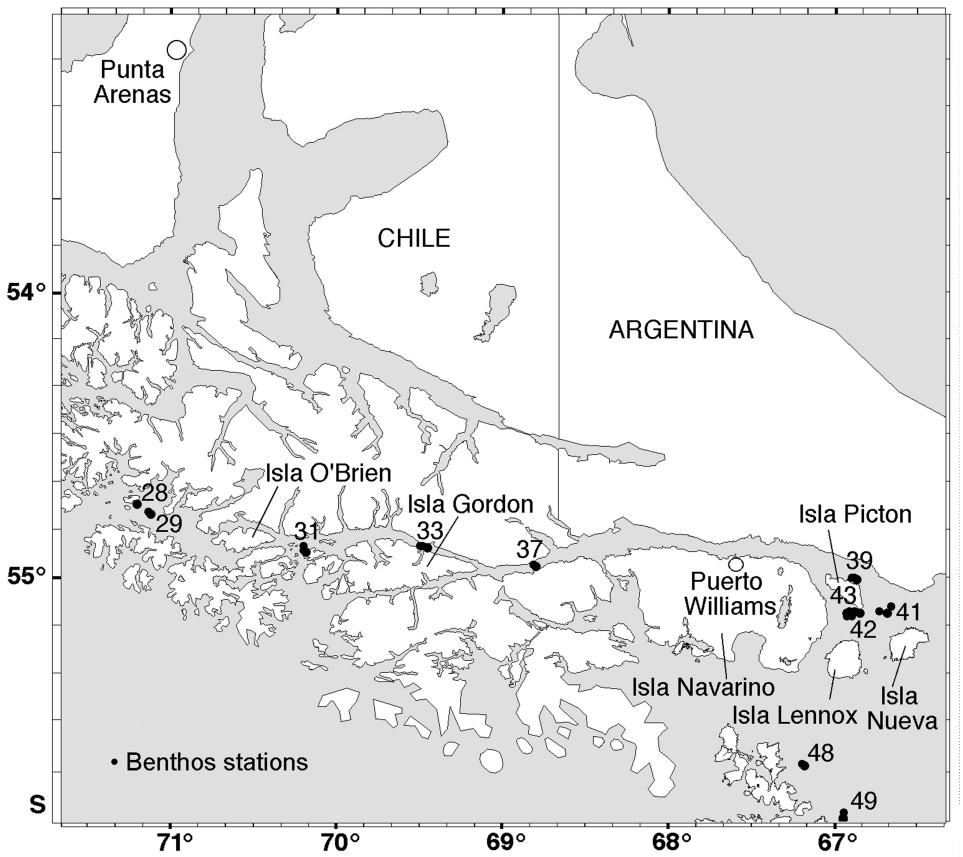

FIG. 1. – EBS stations on the transect through the Beagle Channel (modified after Arntz and Gorny, 1996). Abbreviations: 28 C. Ballenero, off Punta Baja, 29 C. Ballenero, 31 C. Beagle, I. Timbal Chico, 33 C. Beagle Romanche, 37 C. Beagle, 39. I. Gardiner, 41 SE I. Picton, 42 Pta Rico, 43 I. Picton, 48 I. Wollaston, 49 off Islas Barnevelt.

tion that focused on benthos studies in the Beagle Channel. The present study is based on molluscan samples collected during the "Joint Magellan" expedition by means of an epibenthic sledge.

This epibenthic sledge (EBS) collects small epi- and suprabenthic macrofauna. One taxon in focus were the molluscs collected with this gear. Bivalves were most abundant and diverse with 26,461 individuals and 52 species, followed by Gastropoda with 5,075 individuals and also 52 species. Aplacophora occurred with 1,456 individuals and 9 species, Polyplacophora with 1,515 individuals and Scaphopoda with 579 individuals and 5 species (Linse, 1997). The aim of the present investigation is to describe the distribution of molluscs in the Beagle Chanel.

MATERIAL AND METHODS

On a transect from off the eastern entrance through the Beagle Channel to the western entrance (Fig.1) macrobenthic Mollusca were collected. The samples were taken by means of an epibenthic sledge (EBS) (Rothlisberg and Pearcy, 1977) which was improved by Brandt and Barthel (1995) in order to catch both the epibenthic and the benthic-boundary-layer fauna. The sledge carries a sampling box with an opening of 100 cm width and 33 cm height. A 0.5 mm plankton net is attached to each sampler, the cod end is enclosed by a 0.3 mm mesh net. When the sledge touches the seafloor a shovel fixed to the box door of the epibenthic sampler opens the box. The doors are closed when the sledge leaves the bottom. The sledge was hauled over the ground for 10 min at a mean velocity of 1 knot. The haul distances were calculated on the basis of the GPS-derived positions of the ship at the start and end of the haul

$$\text{distance in m} = 1852\sqrt{(\Delta lat')^2 + (\cos lat' \times \Delta long')^2}$$

after Brattegard (pers. comm.) and Brandt and Barthel (1995). The haul length varied from 132 to 608 m (Table 1), therefore the numbers of individuals are calculated for standardized 1000 m hauls. 16 stations were sampled at 11 sample locations (Table 1). The result at station 33-1261 might be an artifact

TABLE 1. – Station list of the EBS samples from the Beagle Channel (from Brandt *et al.*, 1997).

Station	Date	Position				Depth	Haul	Sediment
		S beg. (lat)	S end	W beg. (long)	W end	(m)	(m)	
west								
28* - 1279	11/21/94	54°46,84	54°46,90	71°08,48	71°08,35	580	178	fine terrigenous sediment
29* - 1270	11/21/94	54°55,17	54°55,23	70°45,15	70°44,81	135	379	coarse stony shells, foraminifera
31* - 1263	11/20/94	54°54,04	54°54,00	70°12,76	70°12,52	665	266	mud and crushed shells
33* - 1261	11/20/94	54°53,64	54°53,81	69°58,98	69°59,03	120	319	sponge spicules
33* - 1257	11/19/94	54°53,43	54°53,32	69°30,94	69°31,14	350	295	Foraminifera
37* - 1253	11/19/94	54°55,12	54°55,11	69°19,89	69°20,13	265	256	very fine mud
37* - 1248	11/19/94	54°58,80	54°58,78	69°01,75	69°01,98	217	247	fine mud and sand
37* - 1247	11/19/94	54°59,43	54°59,51	69°04,64	69°04,28	100	410	fine mud, coarse stones, foraminifera
37* - 1246	11/19/94	54°58,00	54°57,85	68°49,31	68°49,04	253	400	very fine mud
39* - 1237	11/18/94	55°00,51	55°00,48	66°53,14	66°53,29	103	169	very fine mud
41* - 1213	11/15/94	55°06,89	55°06,72	66°39,95	66°39,92	63	316	crushed mollusc shells
42* - 1178	11/12/94	55°07,30	55°07,28	66°52,78	66°52,90	25	132	red algae and crushed Cirripedia fragments
43* - 1194	11/13/94	55°08,48	55°08,19	66°57,81	66°58,08	118	608	fine mud
43* - 1184	11/12/94	55°06,84	55°06,95	66°55,54	66°55,67	110	246	no sediment sampled
48* - 1200	11/14/94	55°38,52	55°38,57	67°12,86	67°13,26	40	428	crushed mollusc shells
49* - 1206	11/14/94	55°48,13	55°48,10	66°58,45	66°58,62	66	186	fine crushed mollusc shells
east								

* = for station data see Fig.1

due to a failure, because the vessel steamed with 3 knots instead of 1 knot and turned in the channel; therefore the sledge might have left the bottom for some time. At station 28-1279 the plankton net was slightly damaged but as the cod end was intact the sample was considered to be complete.

When the samples reached the deck of the vessel, they were washed on a 300 μm screen. The complete samples were fixed in 4 % buffered formaldehyde and later transferred into 70 % ethanol. All molluscs from the samples were analyzed for the comparison of the 16 stations.

Aplacophora, Gastropoda, Scaphopoda and Bivalvia were counted and identified (e.g. de Castellanos, 1988-1993; Dell, 1964; Hain, 1990; Soot-Ryen, 1959; Strebel, 1904, 1905a, b, 1906, 1907, 1908), Polyplacophora were only counted, their identification is still in progress (Table 2).

Information about the feeding mode was taken from the literature (e.g. Hain, 1990) or personal dissection of stomach contents. Most species with unknown feeding modes are bivalves, and most of these will be filter feeders.

In this paper various components of "species

TABLE 2. – Molluscan abundance and species richness (per station). Abbreviations: Polyplac = Polyplacophora; n = number of specimens per station; n/1000m^2 = number of specimens per station calculated for 1000 m^2 trawled area; S = species numbers.

Station	Aplacophora		Polyplaco		Gastropoda		Scaphopoda		Bivalvia		Mollusca	
	n \ n/1000m^2	S	n \ n/1000m^2	S	n \ n/1000m^2	S	n \ n/1000m^2	S	n \ n/1000m^2	S	n \ n/1000m^2	S
west												
28-1279*	37 \ 208	4	5 \ 28	-	5 \ 28	7	7 \ 39	3	42 \ 236	8	91 \ 534	19
29-1270	-	-	3 \ 8		14 \ 34	11	19 \ 53	2	611 \ 1612	17	647 \ 1707	30
31-1263	567 \ 2244	5	-	-	143 \ 538	7	228 \ 857	4	4682 \ 17605	21	5620 \ 21244	37
33-1261*	-	-	-	-	-	-	-	-	10 \ 31	5	10 \ 31	5
33-1257	2 \ 7	1	-	-	-	-	1 \ 3	1	53 \ 180	5	56 \ 190	7
37-1253	-	-	-	-	75 \ 293	3	9 \ 35	1	160 \ 680	13	244 \ 1008	17
37-1248	5 \ 20	4	-	-	13 \ 32	6	103 \ 417	1	366 \ 1482	19	487 \ 1951	30
37-1247	29 \ 71	7	82 \ 183		122 \ 222	17	2 \ 5	1	709 \ 1729	23	314 \ 2210	48
37-1246	583 \ 1458	5	1 \ 3		124 \ 310	4	207 \ 468	5	14295 \ 35688	22	15210 \ 37927	36
39-1237	-	-	2 \ 12		5 \ 30	4	-	-	306 \ 1811	12	313 \ 1853	16
41-1213	233 \ 737	3	1293 \ 4092		3015 \ 9500	36	-	-	2653 \ 8392	30	6094 \ 22721	69
42-1178	-	-	10 \ 76		106 \ 788	12	-	-	54 \ 409	16	170 \ 1273	28
43-1194	-	-	-	-	-	-	-	-	2 \ 3	2	2 \ 3	2
43-1184	-	-	1 \ 4		5 \ 20	3	-	-	261 \ 1061	5	267 \ 1085	8
48-1200	-	-	123 \ 287		746 \ 1731	25	-	-	1462 \ 3416	19	2331 \ 5424	44
49-1206	-	-	-	-	702 \ 3763	14	-	-	795 \ 4274	10	1497 \ 8037	24
east												

*= possible failures.

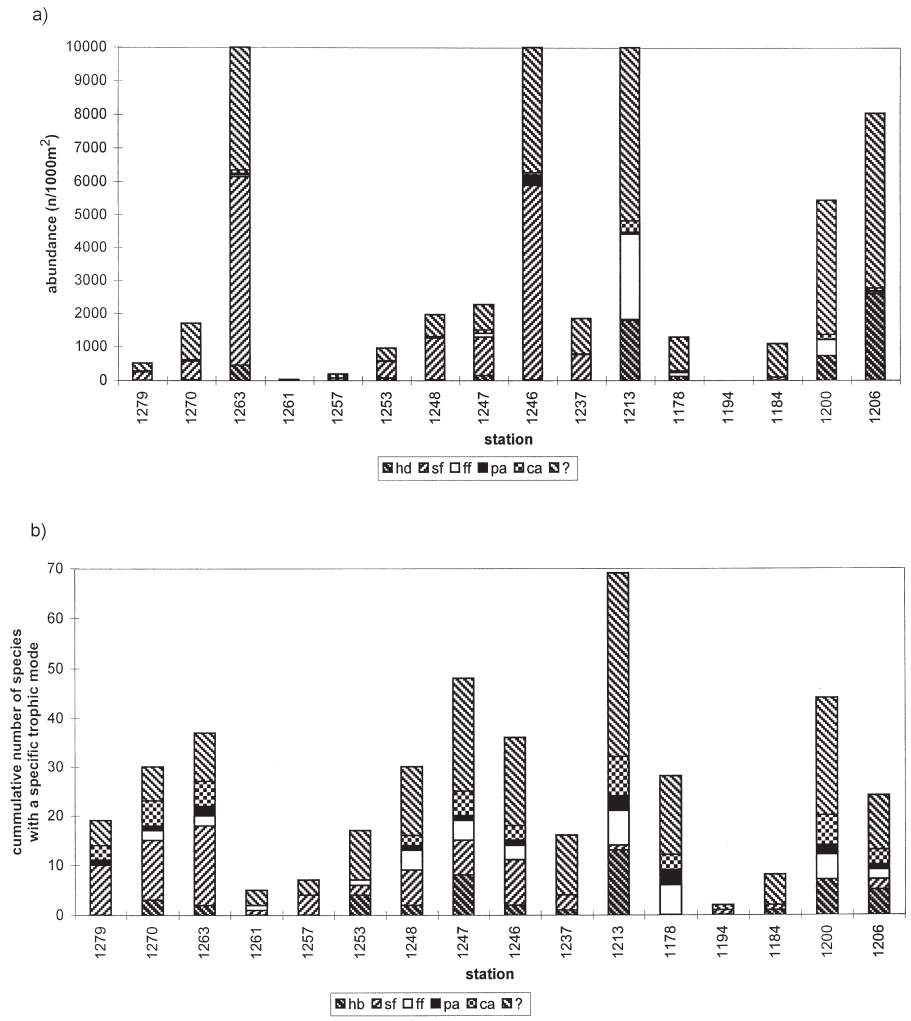

FIG. 2. – (A) abundance of molluscs and (B) number of species with a specific trophic mode, calculated per station from west to east through the Beagle Channel. hd = herbi- or detritivores; sb = substrate feeders; ff = filter feeders; pa = parasites; ca = carnivores; ? = feeding mode unknown.

diversity" are used: species richness, i.e. the number of species sampled at a station (Hurlbert, 1971); the Shannon-Wiener index of diversity H' (using $\log_e$; Shannon and Weaver, 1949), and the evenness J (Pielou, 1966) were estimated for each sampling station.

RESULTS

In total 35,084 specimens belonging to 118 species of 86 genera and 58 families were collected. For comparisons between stations samples were standardized for 1000 m^2 hauls, yielding a total of 107,208 individuals (Table 2).

The molluscan abundances differed strikingly between hauls ranging from three to over 10,000 individuals/1000m^2 (Table 2, Fig.2a). The highest abundances were found at the deepest station 31-1263, at station 37-1246 in the inner channel and at station 41-1213 at the eastern entrance of the Beagle. Abundance was low at the other stations; only the stations off the eastern entrance (Stns. 48-1200, 49-1206) showed a higher number of specimens (Table 2).

At stations at and off the eastern entrance herbivorous, detritivorous and filter feeding taxa were very abundant (Fig.2a) compared with bivalve taxa with an unknown feeding mode such as species of Cyamiidae, Neoleptonidae, and Carditidae. At stations in the inner Channel substrate feeding taxa were more important in terms of specimen numbers. The high abundance of taxa with an unknown feeding mode refers to 3 very abundant species of the families Thyasiridae and Erycinidae (Fig. 2a).

Species richness varied between stations, ranging from 2 to 69. It was highest at Stn 41-1213 off the eastern entrance and also quite high at Stn. 37-1247 in the inner channel (Table 2, Fig.2b).

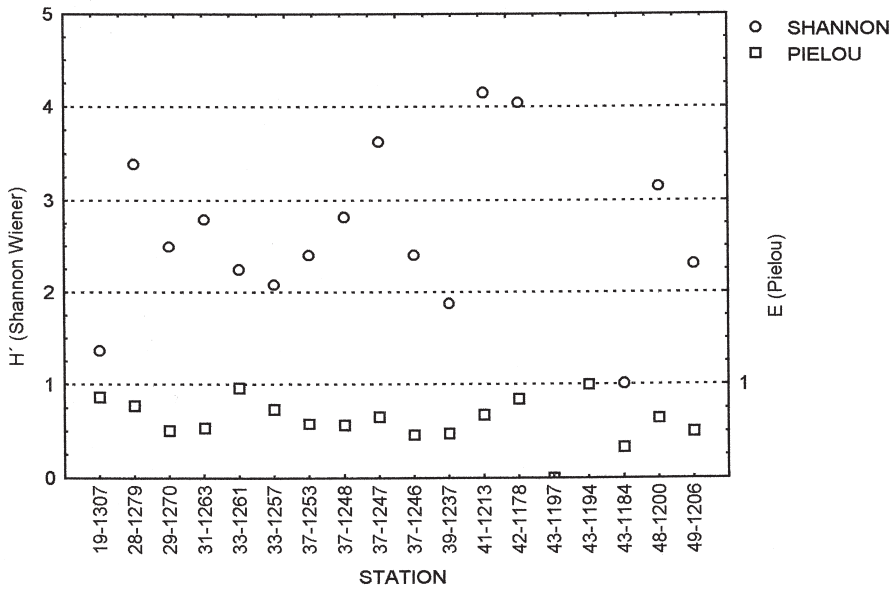

FIG. 3. – Molluscan Shannon-Wiener index of diversity H' (Shannon and Weaver, 1949) and evenness J (Pielou, 1966) per station from west to east through the Beagle Channel.

TABLE 3. – Molluscan abundances (n/1000 m^2) with depth. Abbreviations: Aplac = Aplacophora; Poly = Polyplacophora; Gastr = Gastropoda; Scaph = Scaphopoda; Biv = Bivalvia.

Depth (m)	Aplac	Poly	Gastr	Scaph	Biv
25 - 100	808	4638	16504	5	18120
103 - 135	0	24	84	53	4518
217 - 271	1458	3	635	929	37856
350 - 665	2459	0	566	922	18021

Polyplacophora and Gastropoda were most frequently sampled down to 200 m. Scaphopoda, however, occurred predominantly at deeper stations (200->300 m). Higher abundances of Aplacophora and Bivalvia were also found at deeper stations but these taxa occurred in shallow water too (Table 3).

At and off the eastern entrance the Shannon-Wiener diversity H' varied between 1.0 and 4.2 and J between 0.5 and 1.0, in the inner channel H' varied between 1.9 and 3.6 and J between 0.5 and 1.0.

DISCUSSION

The abundance and species richness of the molluscs varied significantly (Figure 2, Table 2) among the stations on the longitudinal transect. This patchy distribution observed in the Beagle Channel could be caused by food availability, feeding mode or sediment composition.

Brandt *et al.* (1997) found that stations in the Beagle Channel and off the eastern entrance were characterized by great abundances of small taxa such as Mollusca and Peracarida whereas larger epibenthic macrofauna such as Echinodermata, Anthozoa or Porifera is often absent (Gutt and Schickan, 1996; Gutt, pers. comm.; Witte, 1996). The absence of large filter feeding taxa could increase the presence of small taxa, because, as in the Magdalena Channel (Gutt and Schickan, 1996; Linse and Brandt, 1998) large filter feeders might reduce the amount of particulate organic matter in the benthic boundary layer available for other benthic taxa. Food competition could occur between vagile taxa such as Amphipoda or Mysidacea that can feed in the water column and epi- and endobenthic Mollusca that are restricted to feeding on particles at the sediment surface. At stations (Stns. 37-1253, 39-1237) with high peracarid abundance especially of vagile Amphipoda (Brandt *et al.*, 1997) molluscan abundance was low. The few occurring molluscs were mostly substrate feeding bivalves like *Ennucula grayi* (Orbigny, 1846) and *Yoldiella granula* (Dall, 1908) or *Lucinoma lamellata* (Smith, 1881). Conversely, off the eastern entrance and in the eastern entrance both taxa (Peracarida and Mollusca) were highly abundant. At these stations (Stns. 41-1213, 48-1200, 49-1206) herbivorous, detritivorous and filter feeding molluscs like *Colpospirella algida* (Melville and Standen, 1912), *Margarella violacea* (King and Broderip, 1831), *Calliostoma* sp., *Crenella* sp. and *Limatula pygmaea* (Philippi, 1845) occurred in high numbers, as well as other dominant species with unknown feeding mode, such

as rissoiform gastropods or the bivalves *Cyamiocardium denticulatum* (Smith, 1907), *Neolepton falklandicum* Dell, 1964 and *N. umbonatum* (Smith, 1885).

The elevated molluscan abundance at stations 31-1263 and 37-1246 refers to high individual numbers of substrate feeding bivalves like *E. grayi*, *Yoldia chilenica* (Dall, 1908), *Propeleda longicautada* (Thiele, 1912) and *Tindaria virens* Dall, 1889 or *Lasea* sp. with an unknown feeding mode. These five species comprise 73 % and 84 % of the stations' respective specimen number.

A possible reason for the high densities at these stations might be a more favourable food supply. Witte (pers. comm.; Linse, 1997) found that Chlorophyll *a* and especially phaeopigment concentrations are favourable in the upper centimetres of sediment. Gutt and Schickan (1996) and Witte (1996) mentioned "a thick layer of fluff" (deposited organic matter) occurring on the sediment of the sample locations in the Beagle Channel. Food availability does not seem to be a limiting factor in the Beagle Channel during southern spring.

Different depth ranges of the molluscan species may also be related to their feeding mode. Herbivorous taxa such as the gastropod families Trochidae (e.g. *Calliostoma* spp.) or Cerithiidae were highly abundant down to 100 m depth (Table 3). Deeper than 100 m they occurred only rarely, with two to eight specimens at some stations.

Filter- and sediment feeding species, such as Caudofoveata of the genera *Limifossor*, *Falcidens* or *Chaetoderma*, Scaphopoda (e.g. *Fissidentalium majorinum* (Mabille and Rochebrune, 1889), *Cadulus dalli* Pilsbry and Sharp, 1898) and most Bivalvia showed a higher degree of eurybathy. They range over more than 500 m in depth in the EBS samples and some have a range of over 1000 m in depth (Hain, 1990, Linse, 1997). Some taxa, like the gastropod *Admete magellanica* Strebel, 1905 or the bivalve *Neolepton umbonatum*, seem to prefer shallow water depth (as deduced from their abundance), but also occur in deeper water (Linse, 1997). Vertical distribution of predators such as *Metheutria martensi* Strebel, 1905, *Lamellaria ampla* Strebel, 1906, *L.elata* Strebel, 1906 (Gastropoda), *Poromya mactroides* Dall, 1889 and *Cuspidaria chilensis* (Dall, 1908) (Bivalvia), and parasites, like the gastropod genera *Balcis*, *Strombiformis* or *Turbonilla* (Gastropoda), depends on the presence of either prey or hosts. For example *Balcis subantarcticus* (Strebel, 1908) and *Strombiformis carforti* Rochebrune and Mabille, 1889, ectoparasites on Echinodermata, occurred at stations (e.g. 31-1263, 37-1247), where irregular sea urchins were sampled (personal observation). The **c**arnivores *Poromya* and *Cuspidaria*, which are known to be eurybathic (Hain, 1990) and deep-sea taxa, were mostly found below 250 m depth (Linse, 1997). These deep, soft-bottom stations contained many crushed, drilled shells of *Nucula* sp.1 and *Yoldia chilenica*.

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