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Comparative Account of Benthic Community at Two Different Locations in the Continental Antarctica

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Abstract

Data on faunal communities, abundance and biomass were collected from seven stations in the Queen Maud Land shelf, Lazarev Sea, East Antarctica and three stations in Atca Ice Port, Weddell Sea, West Antarctica. The sampling depth ranged from 70 to 1000 metres. Sampling was conducted during the austral summer (January - March 1993). Twenty five major taxa were identified. Sponges (Hexactinellid), polychaetes and echinoderms were most abundant at both the sites. Faunal density ranged between 30 and 146 ($\bar{x}$: 64.86 ± 38.72 SE, n = 14) and 128 to 170 ($\bar{x}$: 148.00 ± 15.68 SE, n = 06), respectively, at East and West Antarctic stations. Mean biomass (wet weight) of 3057.65 ± 209.70 and 4467.09 ± 750.69 mg /0.017 m^2 were recorded at Queen Maud Land and at Atca Ice Port, respectively. The most common epifaunal species were particle feeding sponges, bryozoans, crinoids, and hydroids.

Introduction

Studies on the Antarctic benthos started in the early 19th century (Eights, 1833) and since then many studies have been conducted on the benthos of the Southern Ocean. However, data on the quantitative investigations of shallow water benthic communities are scattered (Parulekar *et al.*, 1983; Jazdzewski *et al.*, 1986; Arntz *et al.*, 1992). Although some of the deep water sites in the Ross Sea and Weddell Sea have been investigated in recent years (Knox, 1994), however, our knowledge concerning the biomass, density and abundance of the deepwater sites of the continental high Antarctic region is still far from comprehensive.

According to Dayton (1990), benthos of the Antarctic shelf is characterized by a very large standing crop of sessile suspension feeders. At shallower depths, soft sediment generally have high density, diversity and biomass of deposit feeding polychaetes, molluscs and crustaceans, whereas, deeper areas with a substrate of sandy mud and erratic boulders are colonized by asteroids, ophiuroids and holothurians (Picken, 1985).

Study Area

The present investigation gives a comparative account of the composition, abundance and biomass of macrobenthic fauna from two different localities in continental Antarctica. Site A was located in the Polynya of Queen Maud Land in Lazarev between latitudes 69°45′ to 70°00′S and longitudes 11°30′ to 13°30′E (Fig. 1). This is the landing site of the Indian Scientific Expeditions to Antarctica and extensive oceanographic data have been collected from this site. (Sengupta and Qasim, 1983; Parulekar *et al.*, 1983; Pant, 1986; Naqvi, 1986; Ramesh Kumar and Sadhuram, 1989; Verlencer *et al.*, 1990; Ingole and Parulekar, 1993; 1995).

Study site B was located in the Atca Ice Port at latitude 70°35′64"S, longitude 08°08′90"W along the continental shelf of the Southern Weddell Sea, west Antarctica. Since the site is located in the vicinity of the German Research Station "Georg Von Neumayer" large amount of scientific studies have been conducted around this area (Carsey, 1980; Comiso and Sullivan, 1986; Gordon, 1988; Hempel, 1988; Voss, 1988; Garrison and Buck, 1989; Gorny *et al.*, 1992; Gutt *et al.*, 1993). Based on the available information, both the sites are considered scientifically important areas for studying the basic oceanographic processes.

Materials and Methods

Sampling for the present study was conducted during the austral summer (January-February, 1993). Altogether, seven benthic stations were sampled in East Antarctica (Queen Maud Land area). Depth of the sampling station ranged between 70 to 1000 metres. Sampling in West Antarctica (Atca Ice Port) was conduced on 23 February, 1993. Three stations were sampled near to the ice shelf, between the water depth of 90–160 metres (Fig. 1). Sediment samples were collected with a La Fond Dietz Snapper (0.017 m^2 area). Duplicate samples were taken at each location. Separate samples were obtained for analysis of sediment organic carbon and faunal composition.

Macrofaunal samples were sieved through 0.5 mm mesh screen sieve in filtered seawater and residual was fixed in 5% formalin Rose Bengal solution. The animals were sorted according to different taxa and preserved in 70% ethyl alcohol. Considering the taxonomic importance of the material, only wet weight of the macrofauna was taken. Organic content of the sediment was estimated by the wet oxidation method of El Wakeel and Riley (1957).

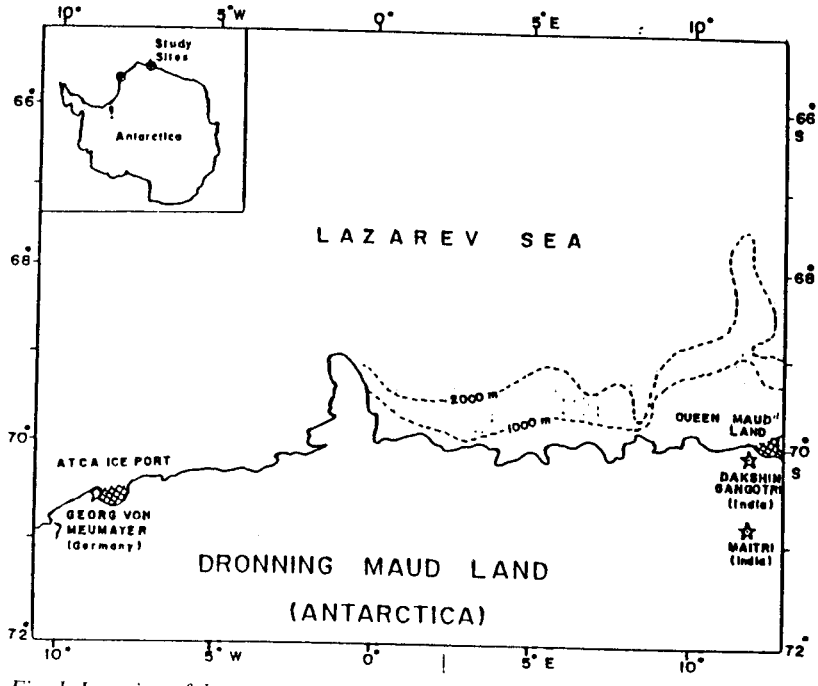

Fig. 1. Location of the sampling stations in Queen Maud Land and at Atca Ice Port, Antarctica

Results

Macrofaunal Composition and Abundance

Station A (the Queen Maud Land): Macrofauna of the littoral zone of the Queen Maud Land, East Antarctica comprised of 25 faunal groups (Table 1). Macrofaunal density varied between 30 to 146 individuals/0.017 m^2 ($\bar{x}$: 64.86 ± 38.72 SE, n= 14). Major components of the community were polychaetes, crustaceans, molluscs, and echinoderms (Table 1). Crustacea was numerically dominant (25.59%) followed by Annelida (20.98%), Mollusca (16.83%) and Echinodermata (10.50%). All other taxa combined contributed 26.10% to the faunal density (Fig. 2).

Station B (the Atca Ice Port): Benthic macrofauna of the Atca Ice Port comprised of 23 major faunal groups (Table 2). Faunal density ranged between 128 and 170 individuals/0.017 m^2 ($\bar{x}$: 148±15.68 SE, n=06). Crustacea (25.47%), Molluscs (25.48%), Polychaeta (20.04%), Ostracoda (15.80%) and Echinodermata (5.71%) contributed to the faunal density (Fig. 2).

The epifauna was made up of sponges, holothurians, ophiuroids, bryozoans and hydroid. The sponge fauna was dominated by glass sponges (*Rosella* spp.) rather than calcareous forms. These were present in large number and variety, especially hexactinellid sponges with their large siliceous spicules (Fig. 3). Molluscan fauna was dominated by bivalves *Limopsis marionensis, Limatula hodgsoni*? and *Philobrya* sp. with relatively stable population and *Trophon longstaffi* and *Chlanidota* sp. of the gastropods. Brachiopods were very common at all the stations, most of them attach to other organisms (Fig. 4). The attachment was to sedimentary plants and animals such as, algae, hydroids,

Table 1: Macrofaunal abundance (Nos./0.017 m^2) and biomass (wet wt. mg/0.017 m^2) in the Queen Maud Land, Lazarev Sea, East Antarctica

Taxon	Density			Biomass		
	Range	mean	%	Range	mean	%
Porifera	1-8	03.57±02.51	05.50	120.0-309.0	210.10±60.2	07.48
Anthozoa	1-4	01.29±01.50	01.99	01.53 - 04.20	01.03±0.30	00.03
Bryozoa	**	**		106.0-580.0	308.06±105	10.97
Polyplacophora	1-4	01.43±01.40	02.20	04.00-20.50	08.50±3.20	00.30
Brachiopoda	1-6	03.29±02.75	05.08	37.23-62.27	43.20±18.4	01.54
Bivalvia	1-4	02.29±01.70	03.53	04.62-09.50	06.20±1.28	00.22
Gastropoda	1-8	03.14±2.55	04.84	00.80-05.82	03.08±2.25	00.11
Scaphopoda	1-2	00.80±0.90	01.23	03.47-12.40	09.20±06.25	00.33
Polychaeta	5-60	17.71±19.41	27.32	105.5-458.6	203.20±62.7	07.24
Acarina	0-5	00.71±01.89	01.09	00.06-00.45	00.12±00.15	00.01
Amphipoda	1-21	08.86±7.63	13.66	12.38-28.20	19.49±08.01	00.69
Cumacea	1-2	00.57±0.79	00.88	00.80-02.40	00.86±00.62	00.03
Isopoda	1-11	03.86±4.09	05.95	05.43-22.30	10.13±08.35	00.36
Pycnogonida	1-12	03.00±4.08	04.63	00.98-02.00	01.26±00.64	00.05
Ostracoda	1-3	00.43±1.13	00.66	00.04-01.52	00.18±00.40	00.01
Holothuroidea	1-4	02.00±1.29	03.08	46.40-218.6	88.12±62.05	03.14
Asteroidea	1-3	00.86±1.22	01.32	20.62-120.0	47.26±48.90	01.68
Ophiuroidea	2-7	04.00±2.00	06.17	02.07-310.2	60.32±98.42	02.15
Crinoidea	1-2	00.71±0.95	01.09	189.0-645.6	439.49±262.0	15.65
Tunicate	1-5	01.29±1.98	01.99	283.4-1809.6	668.43±712.2	23.81
Hemichordata	**	**	-	389.9-815.5	654.18±154.32	23.30
Nematoda	2-6	02.86±186	04.41	00.26-00.89	00.58±00.29	00.02
Oligochaeta	1-3	01.29±0.95	01.99	01.15-22.18	14.57±05.18	00.52
Shrimp	0-1	00.43±0.53	00.66	01.28-08.00	03.09±00.65	00.11
Sea urchin	1-2	00.43±0.79	00.66	04.60-08.90	06.54±01.20	00.23

**: Quantitative evaluation was difficult due to fragments.

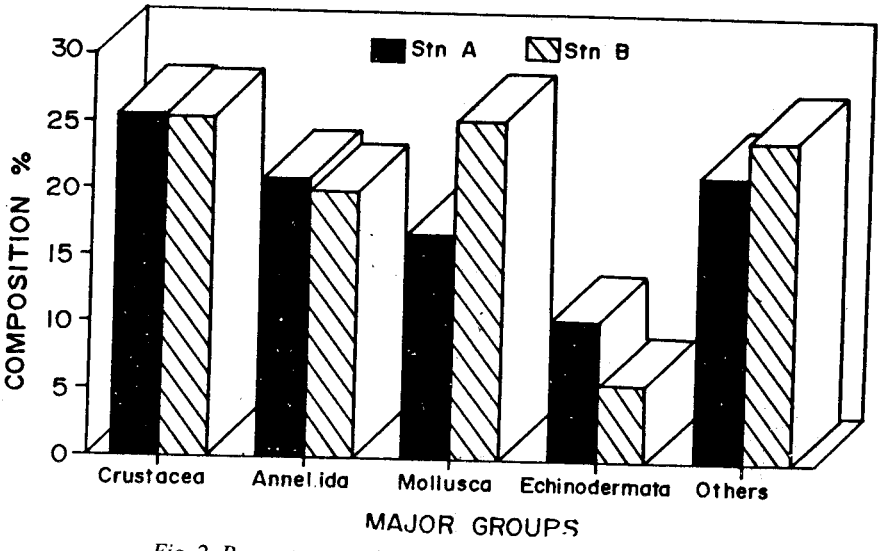

Fig. 2. Percent composition of major macrofaunal groups

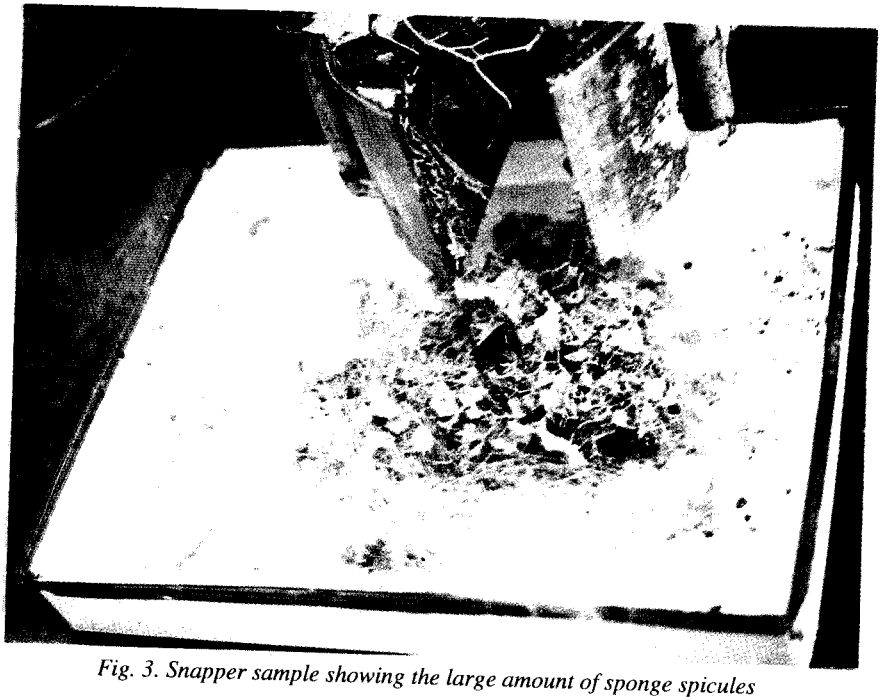

Fig. 3. Snapper sample showing the large amount of sponge spicules

Table 2: Macrofaunal abundance (Nos./0.017 m^2) and biomass (wet wt. mg/0.017 m^2) in the Atca Ice Port, Weddell Sea, West Antarctica

Taxon	Density			Biomass		
	Range	mean	%	Range	mean	%
Porifera	**	**	-	196.2-330.06	272.02±58.09	05.56
Anthozoa	1-2	01.30±0.50	00.87	00.73-01.52	0.93±0.40	00.02
Bryozoa	**	**	-	156.3-790.4	459.79±288.83	09.39
Polyplacophora	1-2	01.30±0.50	00.87	22.00-38.00	26.00±8.0	00.53
Brachiopoda	2-3	02.30±0.50	01.54	60.72-92.20	68.59 ±15.74	01.40
Bivalvia	20-30	24.0±4.89	16.14	62.77-93.50	74.80±14.92	01.53
Gastropoda	05-15	10.30±4.27	06.94	06.80-16.72	11.53±4.25	00.23
Scaphopoda	1-2	01.30±0.50	00.87	10.70-21.20	13.33±05.25	00.27
Polychaeta	26-35	29.80±3.86	20.04	315.15-418.5	361.56±42.73	07.39
Acarina	2-4	03.00±0.82	02.02	00.22-00.66	00.50±00.19	00.01
Amphipoda	9-18	12.00±4.08	08.07	18.30-38.30	26.18±09.01	00.53
Cumacea	3-8	05.30±2.22	03.56	01.80-05.60	03.34±01.62	00.07
Harpacticoida	5-6	05.30±0.50	03.56	01.59-02.60	01.99±00.44	00.04
Isopoda	8-15	11.30±2.99	07.60	17.56-32:60	23.82±06.37	00.48
Taniadacea	3-6	04.00±0141	02.69	00.94-01.88	01.25±00.44	00.02
Ostracoda	19-28	23.50±3.87	15.80	13.04-19.22	16.13±02.66	00.33
Holothuroidea	1-3	01.75±0.96	01.17	34.46-103.3	60.27±32.95	01.23
Asteroidea	1-3	01.75±0.96	01.17	43.02-129.06	75.29±41.19	01.54
Ophiuroidea	4-7	05.00±1.41	03.36	292.87-512.23	366.1±103.4	07.48
Crinoidea	1-2	01.50±0.58	01.01	479.0-958.6	792.8±226.3	16.20
Tunicate	1-3	01.50±1.00	01.01	673.2-2019.6	1009.8±673.2	20.64
Hemichordata	**	**	-	1298-1188.8	1225.8±54.18	25.05
Turbellaria	1-6	02.50±2.30	01.68	00.17-01.03	00.43±00.41	00.01

**: Quantitative evaluation was difficult due to fragments

bryozoans, spines of echinoids and large spicules of sponges. Crustaceans, specially amphipods, isopods and tanaids occurred prominently in all the samples. Among the amphipods, *Epimeria robusta, Granthipimedia* sp., *Orchomenella franklini, Shackletonia* sp., and among the isopods, *Serolis polita* and *S. cornuta* were common. Ophiuroids are one of the commonest macrofaunal groups recorded in Antarctic benthic fauna. Ophiuroide, *Ophiurolepsis gelida* and *Ophisparte gigas* were found almost at all the sampling stations. The asteroid, *Labidiaster annulatus*, was found at greater depth (Fig. 5), whereas, *Odontaster validus*, a common starfish having circumpolar distribution, was collected from shallow waters in the Lazarev Sea, East Antarctica.

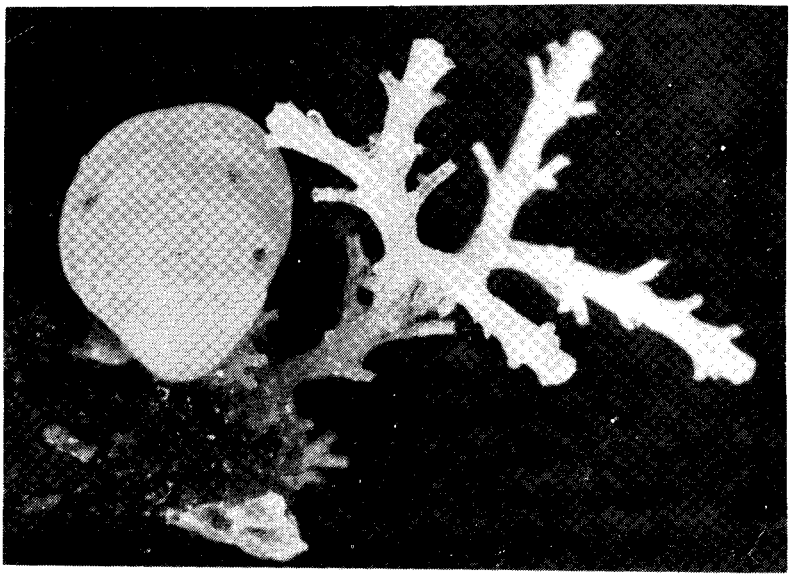

Fig. 4. Attachment of Brachiopod to hydroids and sponge

Fig. 5. A common Antarctic Starfish

Biomass

Values for benthic biomass (wet weight) varied between 2807.09 and 3187.23 mg/0.017m^2 with a mean of 3057.65±209.70 SE at station A. The standing crop was dominated by Tunicates (23.81%), followed by Hemichordata (23.30%), Crinoida (15.65%), Bryozoa (10.97%), Polychaeta (07.73%), Porifera (7.48%), Echinodermata (7.20%) and Mollusca (2.50%). Other miscellaneous taxa accounted for rest of the macrobenthic biomass (*i.e.*, 01.36%, Table 3).

Table 3: Macro benthic standing stock (wet weight) at two different locations in Antarctica

Faunal groups	Biomass (mg/0.017 m^2)			
	#.A	(%)	#.B	(%)
Porifera	201.10	07.48	272.02	05.56
Anthozoa	001.08	00.04	00.93	00.02
Bryozoa	308.05	10.97	459.79	09.39
Polychaeta	271.07	07.73	361.56	07.39
Mollusca	070.18	02.50	194.22	03.97
Crustacea	035.01	01.25	057.08	01.47
Echinodermata	202.24	07.20	501.58	10.25
Tunicate	668.43	23.81	1009.8	20.45
Hemichordata	654.18	23.30	1225.8	25.06
Crinoids	439.49	15.65	792.07	16.20
Others	01.38	00.05	016.56	00.24

Macrofaunal biomass varied between 2229.14 and 5400.87 mg/0.017 m^2 with a mean biomass of 4467.09±750.09 SE at station B (Atca Ice Port). It was dominated by Hemichordata (25.06%), followed by Tunicates (20.45%), Crinoida (16.20%), Echinodermata (10.25%), Bryozoa (09.39%), Polychaeta (7.39%) and Porifera (5.56%). All other taxa combined accounted for rest of the biomass value.

Sediment Organic Carbon

The bottom substrate at both the sampling sites was composed of pebbles and cobbles with relatively coarse sediment. The most common epifaunal species were particle feeding sponges, bryozoans and hydroids, suggesting that the major food source was plankton and detritus. Organic carbon content of Antarctic shelf sediments range from 0.96 to 6.90 mg/g ($\bar{x}$: 3.46±2.13 SE) and 1.29 to 5.60 mg/g ($\bar{x}$ = 3.95 ± 1.90 SE), respectively at station A and station B (Table 4). In general, the siliceous sediments are rich in organic carbon content.

Table 4: Comparison of the macrofaunal data from two sampling sites, in continental Antarctica

	Stations	
	# A	# B
No. of stations	07	03
No. of samples	14	06
Taxon groups	25	24
Faunal density (range Nos./0.017m^2)	30-140	128-170
Faunal density (Mean Nos./0.017 m^2)	64.86±38.7	140.00±15.68
Mean Biomass (Mean mg/0.017 m^2)	3057.65±209.70	4467.09±750.69
Sediment Type	Siliceous with pebbles & cobbles	Siliceous with pebbles & cobbles
Sediment organic (carbon mg/g)	3.46±2.13	3.95±1.90

Discussion

The earlier studies reported very high abundance of benthic fauna in the Queen Maud Land, area in East Antarctica (Parulekar *et. al.*, 1983; Ingole *et. al.*, 1988). However, the present investigation shows that the abundance of benthic macro organisms was much higher in West Antarctica (*i.e.*, in Atca Ice Port), than that of the East Antarctica (Queen Maud Land). The data for faunal abundance showed significant variation between the two sampling sites ($P>0.05$). In general, the faunal abundance was low at station close to the ice-shelf as compared to the stations away from the ice-shelf. Discussing the abundance of benthic fish and shrimp fauna of Lazarev Sea, Gutt *et al.* (1994) suggested higher patchiness in benthic assemblage within the Lazarev Sea than in the other areas, *viz.* Weddell Sea and Halley Bay. The principal reason for this may be the sediment texture, variation in the sampling depths and available food resource (Richardson and Hedgpeth, 1977).

According to Tietjen (1971) and Tietjen *et al.* (1989), detritus and bacteria forms the major food for deep sea benthos of tropical oceans. Detritus is produced mainly in the euphotic zone and reaches benthos after passing through the benthopelagic zone. The absolute amount of organic matter reaching seafloor therefore, depends on the level of primary production in the surface water (Parulekar *et al.*, 1992; Ingole *et al.*, 1992). Phytoplankton is considered as a major food source for Antarctic benthos (reviewed by Knox, 1994), however, the primary production in Antarctic coastal water is highly fluctuating (El-Sayed and Taguchi, 1981; Pant, 1986; Verlencer and Dhargalkar, 1992).

Hence the high fluctuation in the benthic faunal abundance within the study sites may be due to the differences in the amount of food available to them.

Peracarid crustaceans (isopods), polychaetes and bivalves are more abundant in Queen Maud Land, whereas sponges, brachiopods and echinoderms (asteroids) made the bulk of biomass in Atca Ice Port area. A benthic shrimp, *Chorismus* sp. was very common at stations dominated by sponge communities. According to White (1984) the shallow-water areas with soft-bottom sediments, support rich infaunal communities dominated by lamellibranch molluscs, polychaetes and peracarid crustaceans. Where as the present study shows that deeper waters of East Antarctic coast (Lazarev Sea) support high epifaunal communities.

Although the present investigation covers a very small portion of both the study sites, the sampling, however, was conducted in the same season (*i.e.*, in austral summer) at comparable water depths. It is interesting to note that many "typical Antarctic species" reported by Dell (1972) were collected from both the sites. Although the site B is relatively rich in benthic biomass, many benthic species (*e.g.* Amphipods, Isopods, bivalves and shrimps) were common at both the sites and therefore the data presented here could be useful for comparative study of the antarctic benthos.

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