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Polychaetes of the shallow sublittoral of Admiralty Bay, King George Island, South Shetland Islands

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Abstract: Twenty five species of Polychaeta were recorded in soft bottom samples collected from 4–30 m. Total abundance of polychaetes ranged from 60 to 3300 m^{-2}. High abundance values were locally recorded for *Microspio moorei*, *Tharyx epitoca* and *Ophelina syringopyge*. These species, together with more regularly distributed *Capitella capitata* and *Scoloplos marginatus*, constituted over 70% of all specimens. Total biomass value of the polychaetes varied between 3.8 and 46.4 g m^{-2}. *Travisia kerguelenensis* and *Aglaophamus ornatus* constituted over 75% of total biomass. Species composition, richness and diversity of the polychaete assemblage varied with depth. Two parts of the investigated bottom section, differing in the polychaete assemblages structure, were distinguished; the first one in the depth range from 4–20 m and the second one at the depths of 25–30 m. On the basis of both new and previously published data two types of polychaete assemblages of the shallow soft bottom of the Antarctic sublittoral were distinguished. The type of sediment seems to be the main factor influencing the composition of polychaete assemblages.

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Key words: Polychaeta, benthos, soft bottom, Antarctica

Introduction

The polychaete fauna of the shallow Antarctic sublittoral has already been the subject of community analyses (Hardy 1972, Arnaud 1974, Lowry 1975, Chardy *et al.* 1976, Richardson & Hedgpeth 1977, Platt 1979, Averincev 1982, Duchêne 1984, Sicinski 1986). It seems, however, that further detailed data on the quantitative relationships between species would be useful. The aim of the present study is therefore to describe polychaete assemblages in the shallow sublittoral soft bottom of Admiralty Bay, King George Island, South Shetland Islands.

Zoobenthos of this area was already discussed in the papers by Jazdzewski *et al.* (1986), Presler (1986) and Jazdzewski *et al.* (1991). Sicinski (1986) described also the diversity of the polychaete fauna in Admiralty Bay. Recently Hartman-Schröder & Rosenfeldt (1988, 1989) have presented new informations on the polychaetes of that area.

Materials and methods

Sample sites

Material was collected in January 1988 in the Thomas Point area close to the Polish Antarctic Station "H. Arctowski". The samples were collected from soft bottom at depths from 4–30m (Fig. 1), (Jazdzewski *et al.* 1991). This was an area more or less corresponding to the section I studied by Jazdzewski *et al.* (1986), Presler (1986) and Sicinski (1986). A general description of the hydrography is also included in these papers. Hydrological and hydrochemical data on Admiralty Bay are included in the papers by Rakusa-Suszczewski (1980), Samp (1980), Lipski (1987), Sarukhanyan & Tokarczyk (1988). Pecherzewski (1980) reported on the distribution and quantity of suspended matter in the Admiralty Bay. The content of the smaller fraction of the sediment increased gradually with depth. In general the sediment changed from gravelly sand at 4m to muddy sand at 30 m.

The macroalgae assemblages of this area were described by Zielinski (1981) and by Furmanczyk & Zielinski (1982). The dominant algae were *Himantothallus grandifolius* (Gepp) Skottsberg, *Cystosphaera jacquinoti* (Montagne) Skottsberg and *Desmarestia* spp.

The zoobenthos was dominated by amphipods which constituted over 50% of the total number of animals (Jazdzewski *et al.* 1991). Polychaeta and Bivalvia, with *Mysella charcoti* (Lamy) and *Yoldia eightsi* (Couthouy) as dominant species, were also numerous. Isopods, mainly *Serolidae*, and *Echinoidea* (*Abatus* sp.) were locally of importance in community biomass. The mean abundance of the non-colonial animals amounted to 14400 m^{-2} with a range of 1900–25700 m^{-2}. The mean wet weight amounted to 165 g m^{-2} with a range of 77–263 g m^{-2}. Polychaetes constituted about 14% of the total biomass and about 26% of the total number of animals.

In most of samples many Spirorbidae were recorded but as they live on hard substrata, not typical of the area studied, they were not included in a quantitative analysis. *Protolaeospira* (*Dextralia*) *stalagmia* Knight-Jones & Walker, 1972 and *Paralaeospira levinseni* Caullery & Mesnil, 1897 were recorded in great number at depths of 10 m and more. A

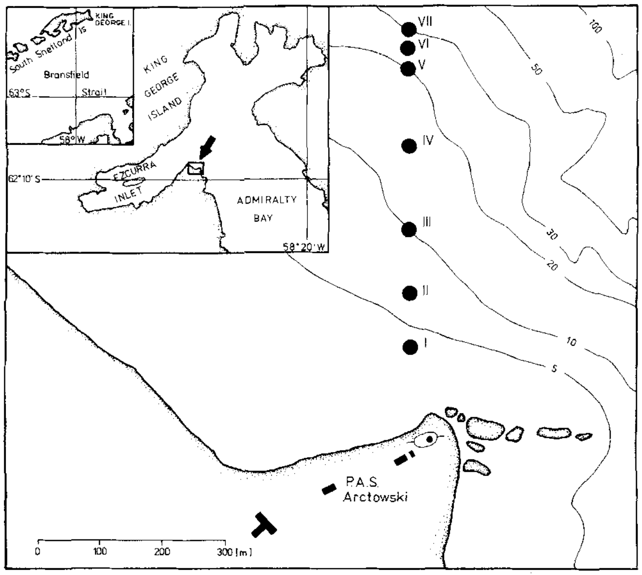

Fig. 1. Location of the sampling stations in Admiralty Bay.

dozen or so specimens of *Paralaeospira antarctica* Pixell, 1913 were found on *Himantothallus grandifolius* at a depth of 15m.

Sample collection

The upper (5cm thick) layer of sediment was collected by SCUBA divers using a Tvärminne-type bottom sampler (Kangas 1972) with a sampling area of 565 cm^2. At each station three replicates were taken except at the station VII, where two replicates were obtained (Jazdzewski *et al.* 1991). The abundance and biomass values were extrapolated to 1 m^2. The samples were collected from the soft bottom with the intentional omission of dense algal aggregations. Samples were sieved through a 500 μm screen. Animals were preserved in 4% formalin. Wet weight of each species was determined to 1 mg. Biomass values denote the wet weight of animals without their tubes.

Data analysis

Multivariate analysis was undertaken to assess various attributes of the seven stations in terms of the distribution of the 25 polychaete species. Canberra metric was used to calculate the distance values of stations (Q strategy) and of species (R strategy).

$$Cm = \sum_{k=1}^{n} \left(\frac{|x_i - x_j|}{x_i + x_j} \right)$$

where: Cm - Canberra metric,

x_i - number of individuals of given species at site i

x_j - number of individuals of given species at site j

$||$- absolute value

n - total number of characters

These calculations were made on the log transformed data. The complete link method was adapted in order to group stations as well as taxa (computer programme "Cluster" of Florczyk, 1989).

Species diversity indices were calculated for each station separately using first abundance and then biomass. The following formulas were applied (Magurran 1988):,Shannon index of diversity

$$H^{I} = - \sum \frac{n_i}{N} \ln \frac{n_i}{N}$$

Evenness

$$E = \frac{H^{I}}{H_{max}} = \frac{H^{I}}{\ln S}$$

Simpson index (expressed as 1 - D)

$$D = \sum \left(\frac{n_i (n_i - 1)}{N (N - 1)} \right)$$

Berger - Parker index (expressed as 1 -d)

$$d = \frac{N_{max}}{N}$$

where: n_i - number of individuals or biomass in the i^{th} species

N - total number of individuals or total biomass

S - number of species recorded

N_{max} - number of individuals of the most abundant species or the greatest biomass

Results

Twenty five species of Polychaeta belonging to 17 families were recorded from the area investigated (Tables I & II). Some of these species are designated by their family or generic name only since more precise identification was not possible. However, each name denotes a single taxon only. Species number increased with increasing depth. Only four species were found at the shallowest stations. Three of them, namely *Capitella capitata*, *Scoloplos marginatus* and *Travisia kerguelenensis*, were also the most common in the area investigated.

Polychaeta abundance ranged from 60–3293 m^{-2}, with the greatest abundances at the two deepest stations. High density values were recorded locally for *Microspio moorei* at the shallowest station, for *Tharyx epitoca* and *Ophelina syringopyge* at the deepest stations and for *Scoloplos marginatus* at 10 m. These species, together with the more regularly distributed *Capitella capitata*, constituted the group of eudominants and dominants, i.e. the species with a frequency

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Table I. Abundance (ind. m^{-2}) of 25 polychaete species in Admiralty Bay.

Station Depth (m)	I 4	II 6.5	III 10	IV 15	V 20	VI 25	VII 30
Microspio moorei (Gravier, 1911)	996					210	
Cirrophorus brevicirratus Strelzov, 1973				12		72	258
Sphiophanes tcherniai Fauvel, 1951					54	36	150
Leitoscoloplos kerguelenensis (McIntosh, 1885)					24	144	42
Ophelina syringopyge (Ehlers, 1901)					18	150	641
Ophryotrocha sp.						6	
Syllidae gen. sp.						12	
Eteone sculpta Ehlers, 1897						30	6
Sphaerodoropsis sp.						12	42
Apistobranchus gudrunae Hartman-Schröder & Rosenfeldt, 1988						6	54
Cirratulidae gen. sp.							18
Terebellidae gen. sp.							6
Oriopsis limbata (Ehlers, 1897)							6
Polycirrus kerguelenensis (McIntosh, 1885)			6		12		
Lumbrineris magalhaensis (Kinberg, 1865)					12		
Aglaophamus ornatus Hartmann, 1967			6	6	24	30	
Orbinia sp.			36	6	48	84	6
Brania rhopalophora (Ehlers, 1897)			12	18	66	30	18
Rhodine intermedia Arwidsson, 1911			12	18	120	108	42
Neanthes kerguelenensis (McIntosh, 1885)				6	60		6
Tharyx epitoca Monro, 1930				6	54	2130	126
Exogone heterosetosa McIntosh, 1885				6	6	12	24
Capitella capitata (Fabricius, 1780)	18	6	102	78	60	101	60
Scoloplos (Leodamas) marginatus (Ehlers, 1897)		6	378	150	30	96	18
Travisia kerguelenensis (McIntosh, 1885)		48	72	30	42	24	24
Total abundance	1014	60	624	336	630	3293	1547

Table II. Biomass (mg m^{-2}) of 25 polychaete species in Admiralty Bay.

Station Depth (m)	I 4	II 6.5	III 10	IV 15	V 20	VI 25	VII 30
Microspio moorei	9934					248	
Ophryotrocha sp.						6	
Syllidae gen. sp.						71	
Eteone sculpta						65	18
Apistobranchus gudrunae						35	88
Sphaerodoropsis sp.						6	6
Cirratulidae gen. sp.							94
Terebellidae gen. sp.							24
Oriopsis limbata							6
Polycirrus kerguelenensis			30		142		
Lumbrineris magalhaensis					224		
Capitella capitata	59	6	53	47	47	153	18
Scoloplos (Leodamas) marginatus		6	501	448	71	808	6
Orbinia sp.			35	6	171	1522	53
Brania rhopalophora			18	6	29	12	18
Travisia kerguelenensis		46350	10880	10526	7499	7511	77
Aglaophamus ornatus			3900	11269	11918	11346	
Rhodine intermedia			35	1038	2820	1687	926
Neanthus kerguelenensis				112	4508		
Cirrophorus brevicirratus				6		53	195
Tharyx epitoca				6	112	4325	124
Exogone heterosetosa				6	6	6	6
Spiophanes tcherniai					177	174	743
Ophelina syringopyge					47	307	1333
Leitoscoloplos kerguelenensis					248	2572	88
Total biomass	9993	46362	15452	23470	28019	30907	3823

value greater than 5%. *Cirrophorus brevicirratus, Rhodine intermedia, Spiophanes tcherniai, Leitoscoloplos kerguelenensis* and *Orbinia* sp. were subdominants, providing 2–5% of all recorded specimens. *Travisia kerguelenensis* and *Aglaophamus ornatus* constituted over 75% of the biomass of the whole polychaete material. These two species, together with *Microspio moorei, Rhodine intermedia, Neanthes kerguelenensis* and *Tharyx epitoca*, constituted *c.* 93% of biomass. Polychaete biomass in particular stations varied from 3.8–46.4 g m^{-2}.

Data analysis shows that seven stations form two groups (Fig. 2 a & b) with the two deepest stations —VI and VII clearly distinguishable from the rest. The five shallower stations can be considered as two subgroups (I & II, III–V). The structure of these two dendrograms and grouping of stations are identical for both abundance and biomass data.

Abundance and biomass distribution for the 25 polychaete

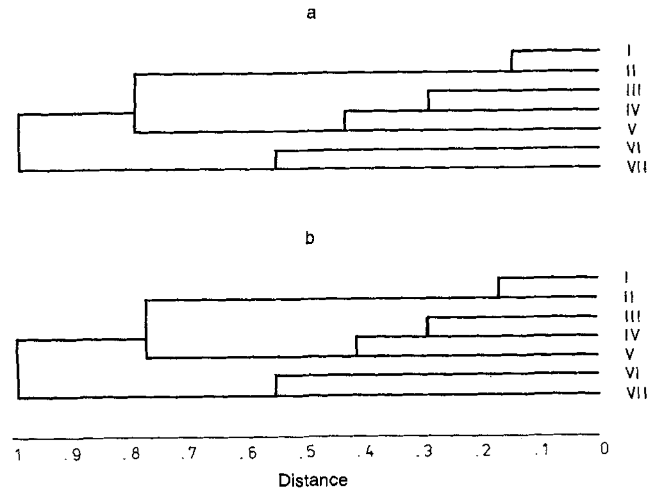

Fig. 2. Dendrograms of stations, **a.** derived from abundances of 25 polychaete species, **b.** derived from their biomass values.

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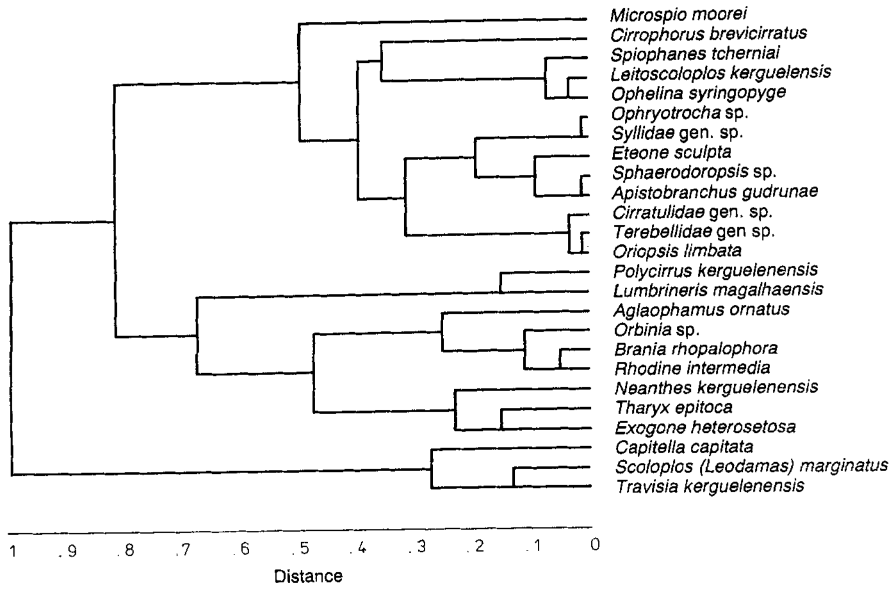

Fig. 3. Dendrogram of 25 polychaete species derived from their abundance distribution at seven stations.

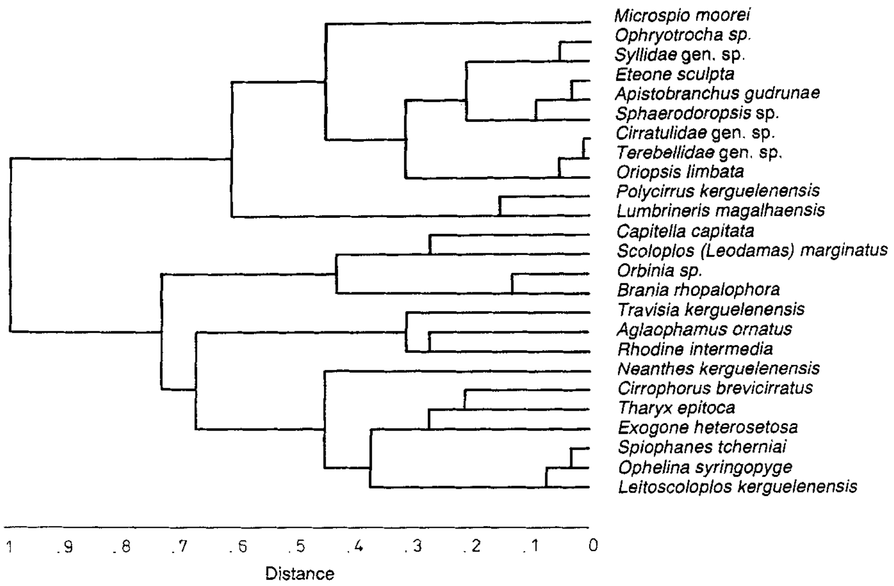

Fig. 4. Dendrogram of 25 polychaete species derived from their biomass distribution at seven stations.

species are presented in Tables I & II, where the species and sites are arranged according to dendrogram sequencies, as in Figs 2, 3 and 4.

The features which distinguish stations VI and VII as a separate group are the presence of species which are absent in the shallower areas (*Ophryotrocha* sp. *Syllidae* gen. sp. *Eteone sculpta*, *Sphaerodoropsis* sp., *Apistobranchus gudrunae*, *Cirratulidae* gen. sp. *Terebellidae* gen. sp. and *Oriopsis limbata*) and the presence of *Cirrophorus brevicirratus*, *Spiophanes tcherniai*, *Leitoscoloplos kerguelenensis*, *Ophelina syringopyge* and *Tharyx epitoca* in a greater abundance and biomass than elsewhere (Tables I & II). Some of them make a group of co-ocurring species (Figs 3 & 4).

Within the second group (stations I–V) the polychaete fauna of the shallowest stations (I &II) is represented by such a very poor assemblage, consisting mostly of species common in the whole area, that these two stations can be considered as a distinct subgroup.

Species diversity indices, calculated from abundance data, (Fig. 5) increase from station I to station V and then decrease. The reason for this is the occurrence of such numerous species as *Tharyx epitoca*, *Ophelina syringopyge* and *Cirrophorus brevicirratus* at the stations VI and VII. We suggest that at a depth of *c.* 20 m a change of character occurs in the polychaete fauna.

The pattern of species diversity calculated on the basis of species biomasses (Fig. 5) is different with a gradual increase from the shallowest to the deepest stations. The species biomass diversity was lower than species abundance diversity

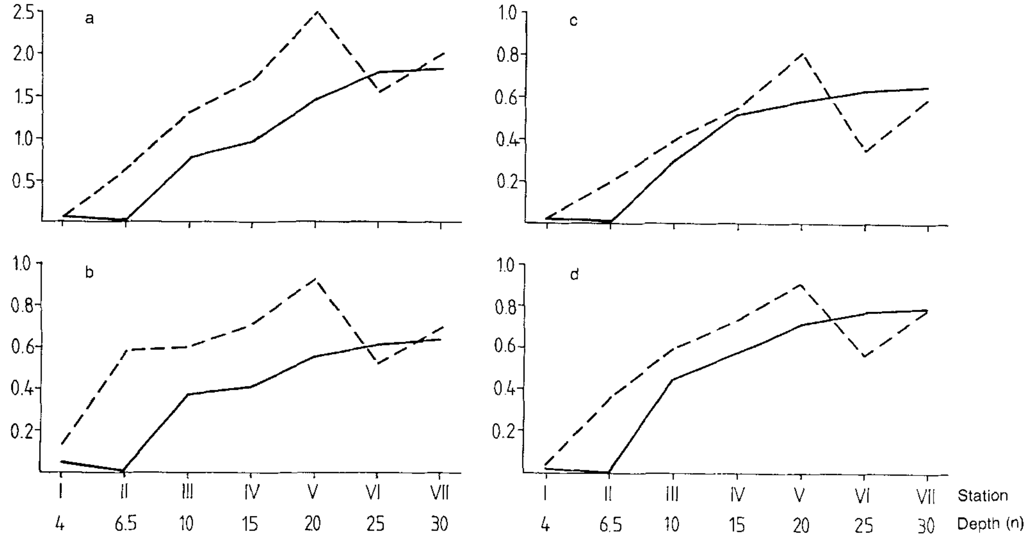

Fig. 5. Changes of the polychaete species diversity in the investigated section, **a.** Shannon index (H), **b.** evenness (E), **c.** Berger-Parker index (1-d), **d.** Simpson index (1-D). (- - - - species diversity calculated from abundances, ——— species diversity calculated from biomass values).

at stations I, II, III, IV and V. This results from the overwhelming biomass of *Travisia kerguelenensis*, and *Aglaophamus ornatus*. This tendency did not affect the stations VI and VII, where species diversity values calculated from both abundance and biomass are more or less similar.

Discussion

The polychaete assemblages presented in this paper resemble those from Morbihan Bay (Iles Kerguelen) in composition and species richness. There, on a sandy bottom at the depth of 10 m, Duchêne (1984) found 25 species of Polychaeta nearly half of which were also present in Admiralty Bay. The earlier results of Chardy *et al.* (1976), also from Morbihan Bay, were similar. On the sandy bottom in the depth range of 0-20 m they recorded an assemblage dominated by *Microspio moorei, Travisia kerguelenensis, Scoloplos marginatus* and *Flabelligera pennigera* (Ensemble I). The first three species constituted the group of dominant species in Admiralty Bay, especially at shallower stations. It is worth noting that in these two areas *Microspio moorei* was the most abundant species.

The polychaete fauna of Borge Bay, Signy Island, South Orkney Islands (Hardy 1972), was very similar, at stations II and V, to the assemblage presented here in terms of species composition, but with lower species richness. Among 11 species mentioned by Hardy (1972) for soft bottom in the depth range 3–35 m six were also present in Admiralty Bay and belonged to the group of dominants, both in abundance and in biomass.

In King Edward Cove, South Georgia (Platt 1979) *Scoloplos* sp. was the most common species, but *Aglaophamus ornatus* was also common, dominating the polychaete biomass, as in Admiralty Bay. On sandy and silty-sandy bottom of the Davis Sea at depths down to 40 m *Haploscoloplos kerguelenensis* (= *Leitoscoloplos kerguelenensis*) and *Spiophanes tcherniai* dominated the zoobenthos in terms of biomass (Gruzov *et al.* 1967). *Spiophanes luleevi, Aglaophamus macrura, Travisia kerguelensis, Barrukia cristata* and *Haploscoloplos kerguelensis* comprised the dominant group of species in the silty sandy bottom of shallow sublittoral of the Davis Sea (Averincev 1982), indicating a similarity with Admiralty Bay whilst other taxocens of the rocky bottom differed completely.

The comparison of our results with previous data on Polychaeta from Admiralty Bay reveals the importance of sampling techniques. At depths between 15 and 30 m of Section I Sicinski (1986) recorded nine species excluding Spirorbidae. In the present study 25 species were found using the different sampling method. Furthermore, the general abundance of polychaetes at 15–30 m differed by an order of magnitude - 30 and 174 m^{-2} respectively, (Sicinski 1986), in contrast with 336 and 1547 m^{-2} for the same depths in the present data. This can be attributed to the use of the Van Veen grab in the previous work, which probably penetrates with difficulty into compact sandy bottom, in contrast to our instrument used by experienced divers.

Various sampling methods and different ways of presenting data make accurate comparisons difficult. It seems, however, that polychaete assemblages from soft bottoms in Morbihan Bay, Borge Bay, King Edward Cove, Davis Sea as well as Admiralty Bay, show similarities in terms of species composition, frequency and dominance. The following group of species can be regarded as typical for assemblages of these regions: *Cirratulus cirratus, Aglaophamus ornatus, Scoloplos marginatus, Microspio moorei, Travisia kerguelenensis, Spiophanes tcherniai, Capitella capitata* and *Leitoscoloplos kerguelenensis*.

Lowry (1975) and Richardson & Hedgpeth (1977) also discussed the polychaete fauna of shallow Antarctic sublittoral localities based on a comprehensive analysis of macrozoobenthos from soft bottom at Arthur Harbour, Anvers Island. Sicinski (1986) noticed a high similarity between the polychaete fauna of Arthur Harbour and Ezcurra Inlet (Section

Table III. Summary distribution of dominant polychaete species found on soft bottoms in shallow Antarctic sublittoral together with sediment characteristics.

	Borge Bay	Moribhan Gulf	Davis Sea	King Edward Cove	Admiralty Bay		Ezcurra Inlet	Arthur Harbour	Arthur Harbour	Arthur Harbour	Arthur Harbour
	Hardy 1972	Chardy *et al.* 1976	Averincev 1982	Platt 1979	this study and Sicinski 1986		Sicinski 1986	Richarson Hedgpeth 1977	Richardson Hedgpeth 1977	Richardson Hedgpeth 1977	Lowry 1975
	Stations II & V	Ensemble I			Section I		Section III	Assemblage E	Assemblage D	Assemblage C	Stations I & II
Depth (m)	6–35	0–20	0–45	4–12	4–20	25–30	15–30	5–7	15–18	18–43	
Average grain size or grain size range (µm)	>63	100–120		39–1000	<63		4–16				15 & 43
Md φ coefficient	<4.0	3.0		<5.0	<4.0		8.0–6.0	5.4	5.2–5.1	6.6–4.0	6.0 & 4.0
Sediment	silty sand	sand	silty sand	sand and mud	sand and silty sand		silt	sandy silt	sandy silt	silty sand, sandy silt, clayey silt	medium to fine silt coarse silt
Barrukia cristata			36								
Polydora sp.				9900							
Cirratulus cirratus[1]	x			1890							
Aglaophamus ornatus[2]	x		28	170	72						
Travisia kerguelenensis		x	36		48						
Orbinia sp.					60						
Neanthes kerguelenensis					66						
Brania rhopalophora					378	96					
Scoloplos marginatus[3]	x	x		5170	996	210					
Microspio moorei	x	5000			102	101					
Capitella capitata	x										
Flabelligera penningera		x				150					
Spiophanes tcherniai[4]			400		54	2130					
Tharyx epitoca	x										
Notoproctus oculatus ant.	x										
Pionosyllis comosa	x										
Cirrophorus brevicirratus					258						
Leitoscoloplos kerguelenensis	x		36			144	659			370	328
Rhodone loveini[5]	x				120	108		2148	1164	896	260
Ophelina syringopyge						641	1073	1674	4549	1378	x
Paraonis gracilis[6]							1232			670	x
Apistobranchus sp.[7]							226		427	6073	1110
Maladanidae gen. sp[7]									853	799	
Axiothella sp.											170
Tharyx cincinnatus							300				
		Sandy bottom						Silty bottom			

[1]*Cirratulus* sp. by Platt (1979)
[2]*Aglaophamus virginis* by Hardy (1972), *A. macrura* by Averincev (1982),
[3]*Scoloplos marginatus mcleani* by Hardy (1972), *Scoloplos* sp. by Platt (1972),
[4]*Spiophanes luleevi* by Averincev (1982),
[5]*Rhodine intermedia* in this paper,
[6]*Paraonis* sp. by Lowry (1975),
[7]*Apistobranchus typicus* by Richardson & Hedgpeth (1977).

III), especially evident in the composition of dominants. These were *Apistobranchus* sp. (*Apistobranchus typicus* of the paper by Richardson & Hedgpeth, 1977), *Ammotrypane* sp.(*Ammotrypane syringopyge* by Richardson & Hedgpeth), *Haploscoloplos kerguelenensis* and *Paraonis gracilis*. These assemblages differ very clearly from those discussed earlier in this paper.

Table III lists those species with an abundance higher than 2% given in the papers by Lowry (1975), Platt (1979), Averincev (1982), Sicinski (1986) and the present one, relating the data to specific substrate types. In the case of data by Gruzov *et al.* (1967), Chardy *et al.* (1976) and Richardson & Hedgpeth (1977) the species indicated as dominants are included. Hardy (1972) contained a list of species but without their density values. Where it was possible, maximal densities of species are given. This table shows the two different assemblages: the polychaetes from Morbihan Bay, King Edward Cove, Borge Bay, Davis Sea and part of the Admiralty

Bay on one hand, and the assemblage from Arthur Harbour and Ezcurra Inlet on the other. Parallel patterns have also been noticed for Amphipoda (Jazdzewski *et al.* 1991), which show similarities between Admiralty Bay and Signy Island and differences from Arthur Harbour. Using the granulometric data for sediments (Table III) in most of the cited papers correlation can be seen between these two types of assemblages and the kinds of sediments. At Arthur Harbour (Richardson & Hedgpeth 1977) as well as at Ezcurra Inlet (Tatur, Sicinski unpublished data) silty sediments prevail with a median grain size from *c.*4–63 μm. Sandy sediments with a distinctly larger median grain size, mostly >63 μm, were recorded in Morbihan Bay, King Edward Cove, Borge Bay and central parts of Admiralty Bay.

In summary it appears that the soft bottom fauna of the shallow Antarctic sublittoral is dependent on the quality of sediments. This is related to local geology and geomorphic processes which control the inflow of suspended matter into the sea. Rapid sedimentation in the areas neighbouring the glaciers produces sediments of considerable thickness, mainly of silt and clay carried by subglacial streams. This is clearly visible in Ezcurra Inlet and it seems that a similar situation occurs in Arthur Harbour. The other areas discussed lie along shores free of glaciers where the habitats differ in sedimentation type with the domination of sandy deposits.

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