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Recent ostracods from Admiralty Bay, King George Island, West Antarctica

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Abstract: Ostracods from Admiralty Bay on King George Island (South Shetland Islands) represent 29 podocopid species, belonging to 19 genera, one cladocopid and six myodocopid species. They were recovered from Recent marine and/or glacio-marine sediment samples from water depths of up to 520 m. These ostracods constitute a variable assemblage, which is overall typical for the Antarctic environment. Shallow-water assemblages tend to be more variable in terms of frequencies and species richness than deep-water assemblages. The later are low in numbers and remain relatively high diversities. Overall, no linear relation between ostracod assemblage-composition and environmental features analyzed was recognized.

Key words: Antarctica, King George Island, Ostracoda, Recent.

Introduction

Study of Recent ostracods began in Antarctica in the 19th century with such workers as G.S. Brady, and in the 20th century with T. Scott, F. Chapman, E. Dady, G.W. Müller, T. Skogsberg (see Neale 1967; Hartmann 1997), and continues today. The studies of Gerd Hartmann (Hartmann 1986, 1987, 1988, 1989a, b, 1990, 1991, 1992, 1993, 1994, 1997) on the ostracods from a number of localities in Antarctica were of special importance. Studies by Robin Whatley with co-authors (Whatley *et al.* 1987, 1988, 1995, 1996, 1997, 1998a,b), Richard Dingle (Dingle 2000, 2003), and many others, have greatly expanded our knowledge on ostracods from the Antarctic area.

Admiralty Bay (Fig. 1) is the largest fjord-like bay in the South Shetland Islands. Its total area is 120 km^2, and its total volume is over 20 km^3. This fjord is connected to the Bransfield Strait by a >500 m deep main channel, which splits into three major inlets with water depths down to 100–200 m (see Battke 1990). Less then half of the Admiralty Bay shore line is taken up by water-tide glaciers and ice falls. Winter freezing is extremely variable (Kruszewski 2002). The bay freezes for 2 out of every 3 years for up to 3 months.

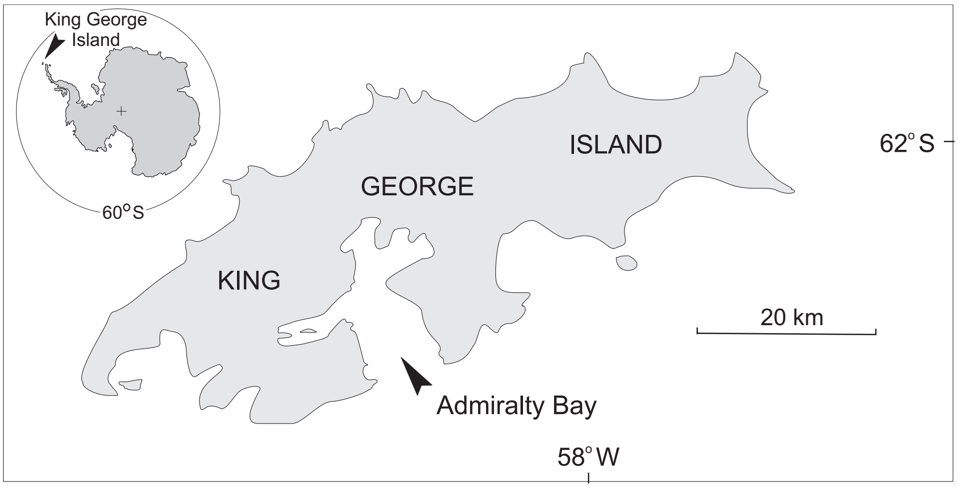

Fig. 1. Map showing location of the area of research (arrowed).

In general, water temperatures and salinities are quite uniform throughout Admiralty Bay (Lipski 1987; Szafrański and Lipski 1982). However, the bay is also characterized by estuarine circulation (Domack and Ishman 1993), and during the summer, the upper 15–35 m water-layer is a mixture of sea- and melt-waters (Sarukhanyan and Tokarczyk 1988). This layer is characterized by strong, local variations in temperature (–1.6–3°C) and salinity (16–34‰) (Szafrański and Lipski 1982). It is overloaded with a great deal of mineral material, which is rapidly deposited within the bay (Pęcherzewski 1980). WSW and NWN prevailing winds push surface waters out to the open sea. The water budget is balanced by inflow of deep waters from the Bransfield Strait, predominantly along its SW margin (Pruszak 1980; Robakiewicz and Rakusa-Suszczewski 1999).

Compared to other Antarctic embayments, chlorophyll contents in Admiralty Bay are ten- to two-fold lower, suggesting reduced phytoplankton levels probably due to intense vertical mixing and water exchange with the Bransfield Strait (Kopczyńska 1993; Lipski 1987). A significant structural upwelling, taking place over the submarine escarpment intersecting Ezcurra Inlet near Point Thomas (Rakusa-Suszczewski 1980), is an example of such processes.

Methods

During the 27th Polish Antarctic Expedition to *Arctowski* Station, between November 30th 2002 and April 18th 2003, 38 short (up to 15 cm) undisturbed sediment cores were collected by senior author using a tube-sampler with 7 cm in diameter. The sampling stations were distributed throughout Admiralty Bay (Fig. 2) and their water-depths ranged from 8 to 520 m (Table 1).

Table 1

List of station locations and their environmental parameters.

Station number	Station location		Water depth (m)	Distance to open sea (km)	Absorption per gram	Sediment mean size	Sediment sorting coefficient
1	Herve Cove		8	11.8	?	?	?
2	Lussish Cove		20	14.3	?	5.07	1.69
3	62°07.51'S	58°25.60'W	470	10.0	0.866	4.43	1.58
4	62°05.23'S	58°29.25'W	88	14.9	1.030	4.66	2.12
5	62°05.26'S	58°28.30'W	50	14.2	0.161	4.46	1.75
6	62°05.89'S	58°26.57'W	102	12.9	0.349	4.43	1.97
7	62°07.06'S	58°28.27'W	165	11.2	?	4.57	1.73
8	62°08.71'S	58°29.45'W	290	9.0	0.342	?	?
9	62°10.30'S	58°32.70'W	57	12.2	0.261	4.63	1.95
10	62°10.80'S	58°33.09'W	8	12.7	0.892	4.27	1.69
11	62°10.50'S	58°34.70'W	63	13.8	0.359	4.97	1.96
12	62°10.65'S	58°35.94'W	74	15.2	0.259	2.97	3.25
13	62°10.76'S	58°37.62'W	47	16.2	0.145	4.75	2.18
14	62°10.39'S	58°35.84'W	19	14.8	0.472	4.41	2.24
15	62°10.18'S	58°35.00'W	49	14.0	0.312	2.97	3.15
16	62°10.03'S	58°35.49'W	84	14.2	0.279	5.14	1.55
17	62°09.87'S	58°34.53'W	103	13.8	0.213	4.20	2.39
18	62°09.55'S	58°33.50'W	123	12.5	0.436	3.21	3.09
19	62°04.27'S	58°23.32'W	83	15.7	0.376	3.94	2.60
20	62°04.41'S	58°22.02'W	34	15.6	0.241	4.66	2.32
21	62°04.55'S	58°22.66'W	39	15.5	0.616	5.03	1.71
22	62°05.06'S	58°21.68'W	51	15.0	0.347	4.32	2.58
23	62°05.33'S	58°19.74'W	68	15.3	0.372	5.05	1.96
24	62°04.72'S	58°19.71'W	87	16.2	0.271	5.07	1.74
25	62°04.99'S	58°17.99'W	90	16.7	0.148	5.07	1.74
26	62°05.89'S	58°22.01'W	220	13.2	0.301	5.05	1.88
27	62°05.39'S	58°23.59'W	20	13.3	0.157	2.00	2.59
28	62°06.30'S	58°24.88'W	294	11.3	0.565	4.62	2.33
29	62°07.04'S	58°26.73'W	370	11.1	?	4.28	2.16
30	62°07.12'S	58°27.77'W	95	11.0	0.220	3.39	2.57
31	62°08.18'S	58°23.05'W	48	8.1	0.552	4.29	1.37
32	62°10.28'S	58°22.12'W	450	4.0	0.716	5.11	1.64
33	62°12.35'S	58°24.14'W	86	0.3	0.948	3.88	2.08
34	62°12.11'S	58°23.50'W	292	0.5	?	4.00	1.95
35	62°09.96'S	58°26.13'W	220	5.5	?	3.09	2.84
36	62°09.55'S	58°25.73'W	480	5.8	0.266	4.18	2.12
37	62°09.20'S	58°24.59'W	510	6.2	0.232	4.54	2.14
38	62°11.04'S	58°23.26'W	520	2.2	0.292	4.50	1.67

Shortly after sampling, sediment cores were sliced into 1 cm thick sections. Sediment was wet-washed over a 125 μm sieve. Ostracods were picked during treatment of the residues for foraminifera (see Majewski 2005). Foraminiferal-rich samples were divided using a dry microsplitter, and as a consequence, only a proportion of the residues was searched for ostracods (see "fraction of sample picked" in Table 2). Each separate valve was counted as one specimen. Fragmented valves were not counted. All specimens were arranged by taxa on micropaleontological slides. The investigated ostracod collection is housed at the Institute of Paleobiology of the Polish Academy of Sciences (Warszawa) under the catalogue number ZPAL O.55. All SEM micrographs were also taken at the Institute of Paleobiology PAS.

At 32 stations, surface-sediment sub-samples were taken for chlorophyll content (Table 1). These analyses were conducted in *Arctowski* Station Laboratory on SPEKOL 1100, Quantitative Analysis Version 3.2. Standard grain-size analysis of sediment was conducted at 36 stations on > 63 μm fraction. Mean grain size (M) and graphic standard deviation (σ), understood as sorting coefficient, were calculated according to the following equations:

$$M = (\Phi16 + \Phi50 + \Phi84)/3$$

$$\sigma = (\Phi84 + \Phi16)/4 + (\Phi95 + \Phi5)/6.6,$$

where Φn are grain sizes for different percentages taken from cumulative curves calculated for various stations.

Results

Table 2 presents counts of ostracod podocopid taxa. It also indicates total number of specimens counted at each station, fraction of sample picked, standing stock (number of ostracods per 10 cm^2 in the upper 15 cm of sediment), number of species, and species richness. Fig. 2 shows composition of ostracod assemblages collected at various locations, with the eight most-numerous taxa distinguished. Standing stocks of entire assemblages are indicated by circle surface.

Ostracod faunas were found at all locations, except station 2. In all samples, 1668 specimens were identified. The numbers of specimens found at different stations varies greatly from just few up to 276. Up to 14 species were recognized in single samples. The podocopid fauna from the Admiralty Bay represent 29 species belonging to 19 genera, 10 families, and two superfamilies Cypridacea and Cytheracea. Of the 29 species, 7 are left in open nomenclature. The ostracod assemblage are dominated by the cytheracean taxa. Some species were represented by only a few specimens while others contained more numerous populations. Faunas are sparse and generally well preserved.

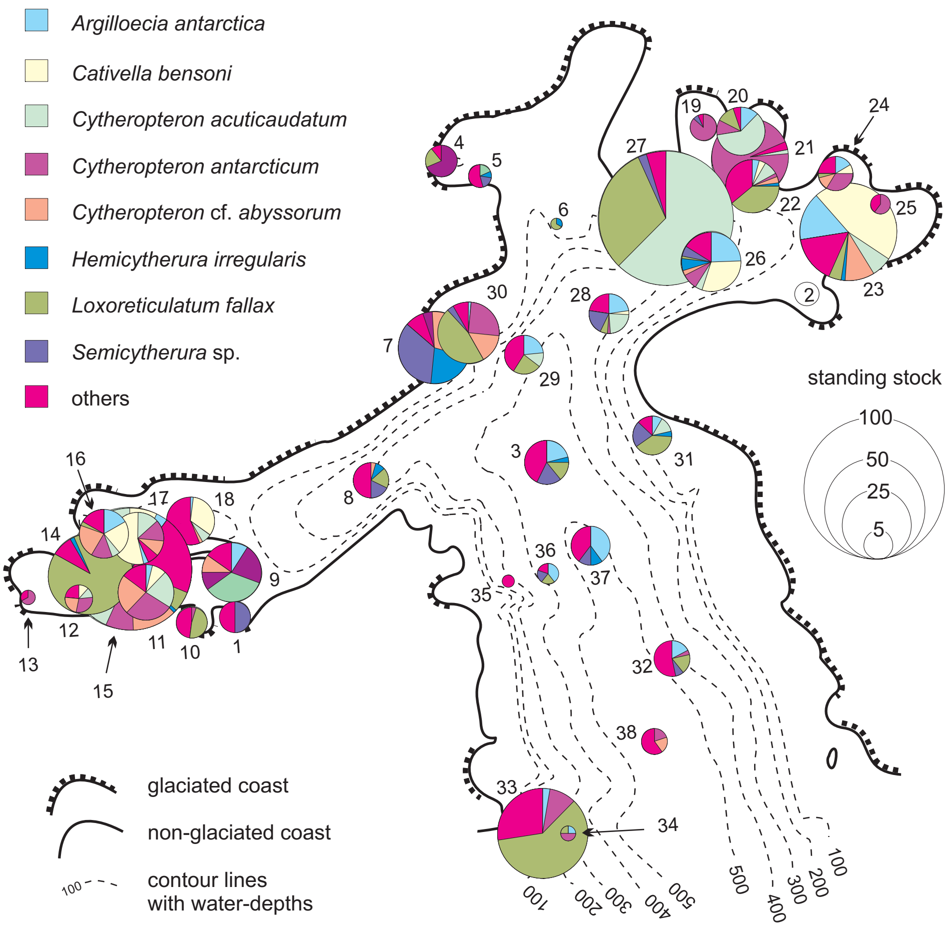

Fig. 2. Admiralty Bay: distribution map of 8 most prominent taxa. Station numbers, water depths, and coast types are indicated. Standing stock of entire assemblages is expressed by bubble surface.

The two most abundant ostracod species in Admiralty Bay are *Cytheropteron acuticaudatum* with 365 specimens, *Loxoreticulatum fallax* (331 specimens), *Cytheropteron antarcticum* (190 specimens), and *Cativella bensoni* (174 specimens). *Cytheropteron antarcticum* and *L. fallax* occurs in most of the samples. The other ornate species such as *Cytheropteron* cf. *abyssorum* (100 specimens), *Semicytherura* sp. (47 specimens), and *Antarctiloconcha frigida* (38 specimens) are much less abundant. Specimens of *Argilloecia antarctica* (113 specimens) are also comparatively numerous in almost all samples. Most species were not common in samples from depths greater than 300 m.

Cladocopid and myodocopid species are represented by few individuals only, living and dead. Therefore, the majority of the myodocopids was placed in open nomenclature (Fig. 12). *Philomedes* sp. A (Fig. 12.1), somewhat similar to *Philo-*

Table 2

Ostracod counts together with total number of specimens counted at each station, fraction of sample picked, standing stock, understood as number of ostracods per 10 cm^2 in the upper 15 cm of sediment, number of species and species richness.

Station	*Abyssocythere antarctica*	*Ambostracon (P.) longiductus*	*Antarctiloconcha frigida*	*Argilloecia antarctica*	*Austrocythere reticulotuberculata*	*Cativella bensoni*	*Copytus caligula*	*Cytheropteron acuticaudatum*	*Cytheropteron* sp. aff. *C. acuticaudatum*	*Cytheropteron antarcticum*	*Cytheropteron* cf. *abyssorum*	*Hemicythere robusta*	*Hemicytherura anomala*	*Hemicytherura irregularis*	*Hemicytherura* sp. aff. *H. branchae*	*Hemicytherura* sp.	*Loxoreticulatum fallax*	*Meridionalicythere megalodiscus*
1																		
2																		
3			3	6										1			4	4
4									2	13							4	
5			2							2				1				1
6														1			2	
7										1	7			5	1			
8	2		1		2						1	2		2			4	
9	2		5	6	1	14		22		7	6							
10			1							1							11	
11	1		4	2	2	4		10		13	11							
12						2		2		5	4							
13			1							2								
14		1												1			58	
15	11	13		7	4	16		94	2	15	27	2		1			13	3
16				6	2	8		2	1	5	8					1	1	
17	1			1	1	16		4		4	3							
18	5		2	1		14	11	3	2		1							
19										13								
20				5				24		4						1	5	
21								1		57								
22	2	6		2		2		4	1	1	2			1		1	21	2
23	8		12	25	1	73		11			15			2	1		7	
24			1	4	3	2			1	8	3					1	1	
25										3						1		
26			3	18		22		3		6	2			5			1	
27		7	1					172									86	5
28			2	8		1		8		1							2	
29	4			4				2									4	
30				1					3	15	9						28	
31				2				3						1			9	1
32				5						1							5	1
33		3		3						10		4	1				63	
34				1						2							1	
35	4																	
36	1			2													1	
37				4								1		1		1		
38										1	1							

Table 2 – continued.

Station	*Meridionalicythere mesodiscus*	*Paradoxostoma* cf. *gracilis*	*Paradoxostoma* cf. *kerguelense*	*Paradoxostoma* sp.	*Pontocypris arctowskiensis*	*Pseudocythere* cf. *caudata*	*Pseudocythereis spinifera*	?*Sclerochilus* sp.	*Semicytherura costellata*	*Semicytherura* sp.	*Xestoleberis* cf. *rigusa*	Total specimens counted	Fraction of sample picked	Standing stock	Number of species (S)	Species richness (d)
1	8							2		10		20	1	5.2	3	0.7
2												0	1	0	0	0
3	1		3							5	1	28	0.83	8.7	9	2.4
4												19	0.83	5.9	3	0.7
5	1							2		2		11	1	2.8	7	2.5
6												3	0.83	0.9	2	0.9
7	1									8		23	0.22	27	6	1.6
8			2						2	4		22	0.83	6.8	10	2.9
9		2										65	0.91	18	9	1.9
10	8						2					23	1	5.9	5	1.3
11												47	0.77	16	8	1.8
12	2	2										17	1	4.4	6	1.8
13												3	0.53	1.5	2	0.9
14								4				64	0.5	33	4	0.7
15							8	3				219	0.83	68	15	2.6
16		2										36	0.83	11	10	2.5
17												30	0.56	14	7	1.8
18		3					1					43	0.88	13	10	2.4
19								1		1		15	0.91	4.3	3	0.7
20											1	40	0.83	12	6	1.4
21	1	1										60	0.57	27	4	0.7
22									3			48	0.91	14	13	3.1
23							2	1				158	0.91	45	12	2.2
24												24	0.83	7.4	9	2.5
25		1										5	0.48	2.7	3	1.2
26	1	2			4			2		4		73	1	19	13	2.8
27										5		276	0.83	85	6	0.9
28	1	1						4		7		35	1	9	10	2.5
29								2	1			17	0.52	8.4	6	1.8
30		2								2		60	0.83	19	7	1.5
31								2		5		23	0.83	7.1	7	1.9
32	1	4			2	2		4		2	1	28	1	7.2	11	3
33									5		16	105	0.68	40	8	1.5
34												4	0.83	1.2	3	1.4
35												4	0.83	1.2	1	0
36										1		5	0.49	2.6	4	1.9
37		2								1		10	0.36	7.2	6	2.2
38				3								5	0.36	3.6	3	1.2

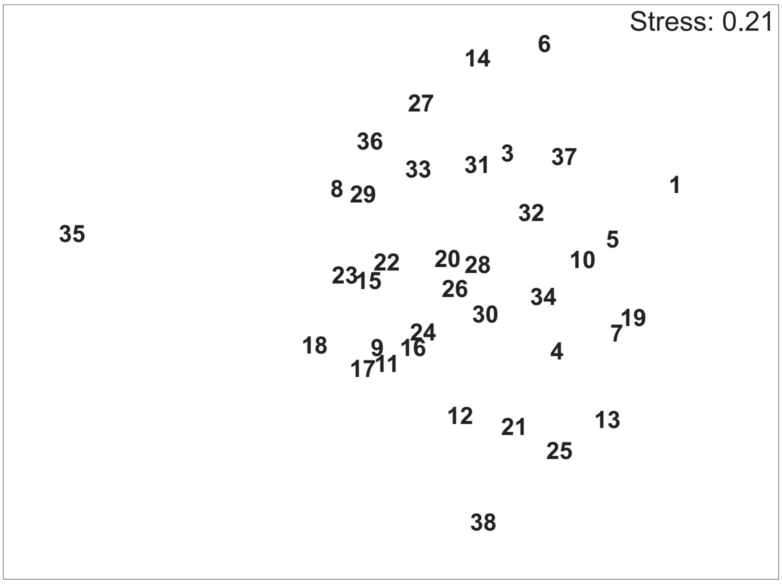

Fig. 3. Multidimensional Scaling (MDS) plot for data of species abundances. It was constructed for double-root transformed data. Numbers indicate particular stations.

medes rotunda Skogsberg, 1920, was found at station 6 from depth of 102 m (one specimen), at station 10 from depth of 8 m, (three specimens), at station 11 from depth of 63 m (one specimen), at station 12 from depth of 74 m (one specimen), and at station 16 from depth of 84 m (one specimen). *Philomedes* sp. B (Fig. 12.2) was found at station 10 from a depth of 8 m (two specimens). Two specimens of *Philomedes* sp. C. (Fig. 12.3), somewhat similar to *Philomedes orbicularis* Brady, 1907, were collected from station 3 (water depth 470 m), one specimen from station 11 (depth 63 m) and two specimens from station 12 (water depth 74 m), all were living specimens. One specimen of *Philomedes* sp. D (Fig. 12.4) was found at station 10 from a depth of 8 m.

One living specimen of cylindroleberidid ?*Empoulsenia* sp. (Fig. 12.5) has been collected at station 3 from a water depth of 470 m. One carapace of *Scleroconcha* sp. (Fig. 12.6), similar to *S. gallardoi* Kornicker, 1971, was found at station 26 from a water depth 220 m. One living specimen of *Polycope kinggeorgensis* (Fig. 12.7) was found at station 3 from a depth of 470 m.

Environmental control on ostracod assemblages

Keeping in mind rather limited number of collected specimens (Table 2), we took the opportunity to analyze ostracod distribution throughout Admiralty Bay in therms of environmental data available (Table 1). First, multivariate analysis was

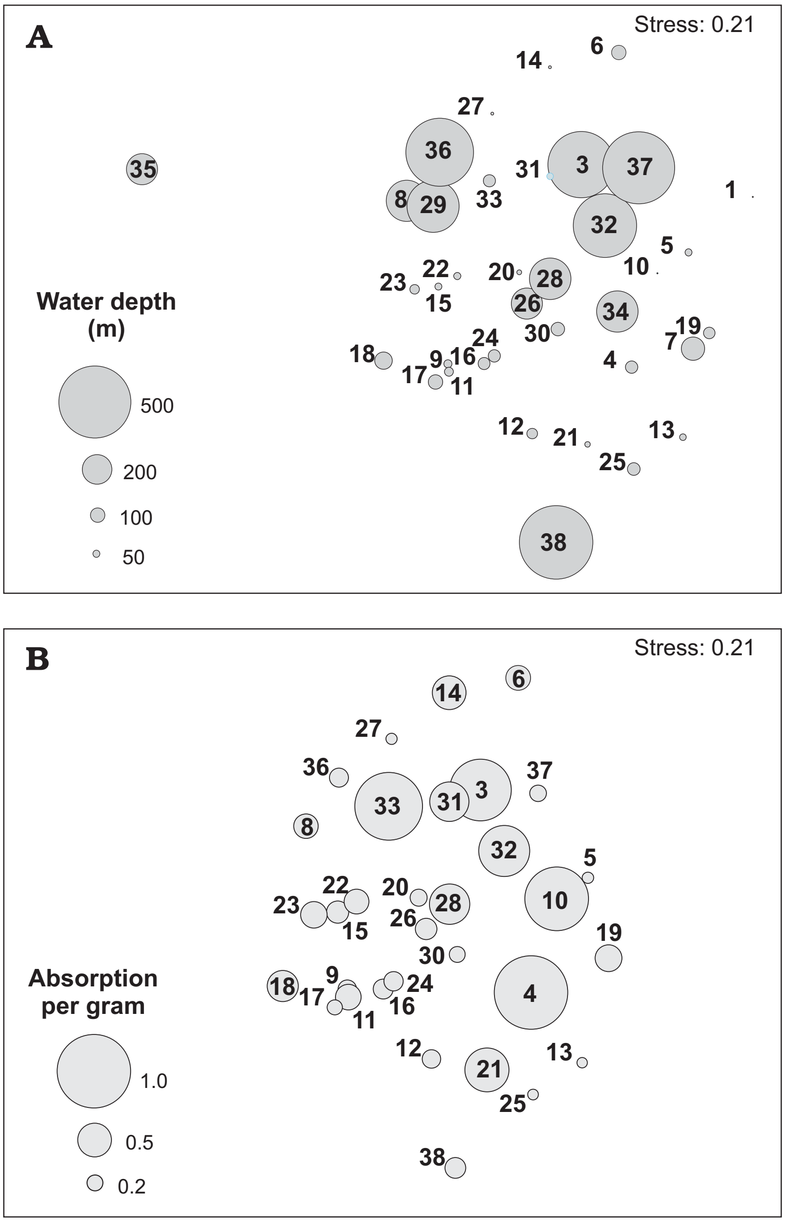

Fig. 4. Multidimensional Scaling (MDS) plots from Fig. 3 with superimposed water depths (A) and chlorophyll content, expressed by absorption per gram (B). Note bubble scale expressed by circle radius not surface area.

performed on a data matrix of species abundances using *PRIMER 5 for Windows* software (Wlodarska-Kowalczuk and Pearson 2004). The data were double-root transformed to downplay the dominants and retain the basic quantitative information. Multidimensional Scaling (MDS) of the transformed data was carried out to reduce the complexity of the multidimensional picture of the ostracod populations in all samples to a two-dimensional plot.

The resulting MDS plot (Fig. 3) shows position of the ostracod populations, numbered after their stations, along the hypothetical two axes best-approximating the data-matrix variability. It was used to distinguish clusters of populations with similar species composition. As seen on Fig. 3 no such clusters can be clearly identified. Moreover, water depths and chlorophyll content, superimposed over the MDS plot (Fig. 4), do not show any trends either. Although further MDS plots are not presented here, they indicate that other environmental data follow this patchy mode. We concluded that the MDS reviled no statistically significant pattern in the species composition of ostracode populations studied, or the relation between faunal composition and the environmental data analyzed.

Similarly, correlation coefficients (*r*) calculated for all taxa percentages against environmental data from Table 1 gave all *r* values between –0.4 and 0.4. The calculation results are not presented in this paper; nevertheless, the low correlation values *r* indicate no linear relationship (Hald and Korsun 1997) between the fauna and water depth, distance to open sea, chlorophyll content, nor sediment properties analyzed.

Also according to Fig. 2, no clear spatial trend in assemblage composition is observed. The same major species occupy shallow- and deep-water regions of Admiralty Bay. Among deep-water faunas, minor increase in “other” ostracod taxa is observed. However, all of these taxa, except *Paradoxostoma* sp. and *Pseudocythere* cf. *caudata,* occur also in shallower settings.

On the other hand, shallow-water habitats, above 100 m, appear to support much more size-variable populations than in deeper waters. Shallow-water assemblages are the most but also the least numerous. All communities inhabiting greater depths of the main channel, have low standing stock numbers (Fig. 5A), but their species richness is comparable if not slightly larger, than among shallow water communities (Fig. 5B).

Comparison with other Antarctic ostracod faunas

Recently, the existing information on the taxonomy and distribution of podocopid species in Antarctic Peninsula area was summarized by Hartmann (1997), in the Antarctic Peninsula and the Scotia Sea by Whatley *et al.* (1998b), from the Marion and Prince Edward Islands by Dingle (2002, 2003). Moreover, Błaszyk (1987), Wood *et al.* (1999) discussed the taxonomy and palaeozoogeography of Oligocene to Recent ostracods from Antarctica.

The assemblage from Admiralty Bay is composed predominantly of species previously described from various Antarctic locations. Recently studied podocopid fauna shows close relationship with faunas from Antarctic Peninsula.

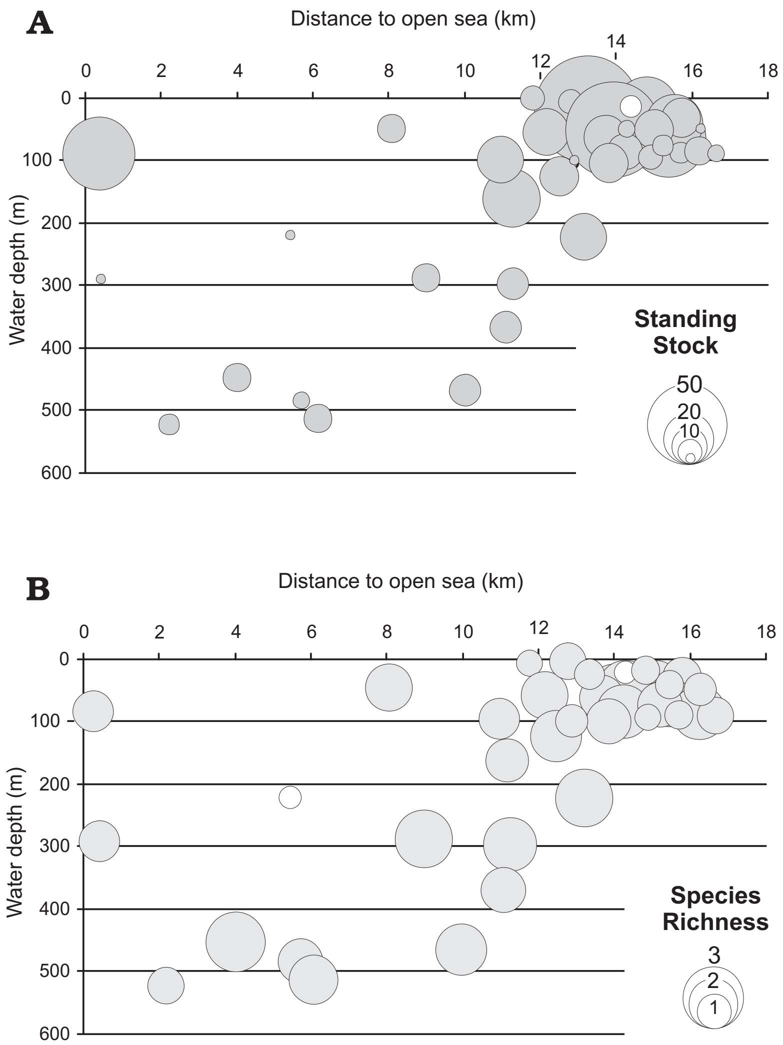

Fig. 5. Standing stock (A) and species richness (B) plots *versus* water depth and distance to open sea. Bubble scale is in circle surface.

Cytheropteron acuticaudatum, the most abundant species of Admiralty Bay assemblage (almost 22% of total fauna), is known from King George Island, northern part of Antarctic Peninsula (Hope Bay), Joinville and D'Urville Islands, Bransfield Strait, and South Georgia (Harmann 1997). *Loxoreticulatum fallax* (almost 20% of total fauna) is widespread in the Antarctic (Elephant Island, Livingston Island, King George Island, Joinville Island, D'Urville Island, Lavoisier Island, Adelaide Island) in relatively shallow water (Hartmann, 1997; Whatley *et al.* 1998b). Hartmann (1997) recorded *Cytheropteron antarcticum* from Halley Bay, Elephant Island, Livingston Island, King George Island, and Ross Island.

Cativella bensoni is a common element of Admiralty Bay faunas, represented by numerous adult and juvenile specimens. It is widely reported from Antarctic, Subantarctic, and the coasts of southern Argentina (see Hartmann 1997; Dingle 2000, 2003; Whatley *et al.* 1998b). According to Dingle (2003), *C. bensoni* occurs at 37–448 m; however, it is most abundant between 208 and 286 m. In the Admiralty Bay it has depth-range of 19–480 m. *Argilloecia antarctica* has been reported by Hartmann (1997) from many localities (South Georgia, South Orkney Islands, Elephant Island, King George Island, Livingston Island, and Lavoisier Island). *Cytheropteron abyssorum* is known from Antarctic Peninsula (Hartmann 1997), Marion Island (Dingle 2003), Halley Bay (Whatley *et al.* 1988), and Brady (1880; not seen, as cited in Dingle 2003) recorded it also south off Australia. *Semicytherura* sp., a common taxon in Admiralty Bay, is most similar to *Semicytherura* sp. 4010 *sensu* Dingle (2003), described from Marion Island with water-depth range 45–179 m. In the Admiralty Bay, it occurs practically throughout, between 8 and 510 m water-depth.

Comments can be made on a number of less frequently occurring Admiralty Bay species. *Semicytherura costellata* is recorded by Hartmann (1997) from a few localities at the northern tip of the Antarctic Peninsula with the depth range 112–358 m. It is also known from Ross Sea and Marion Island (see Dingle 2003). *Xestoleberis rigusa* has been recorded by Whatley *et al*. (1998b) from the west coast of the Antarctic Peninsula (Paradise Bay) from a water depth of 2 m and from the Halley Bay from the depth of 206 m. Hartmann (1997) recorded it off Elephant Island, Bransfield Strait, and the Antarctic Peninsula (Joinville, d'Urville, Lavoisier and Adelaide Islands) with the depth range 130–385 m. In the present study, *Xestoleberis* cf. *rigusa* occurs at stations 3, 20, 32, and 33 with the water-depth range 34–450 m. *Ambostracon* (*P.*) *longiductus* is widespread in shallow waters in the Antarctic and Subantarctic (Whatley *et al.* 1998b). All records of *Paradoxostoma* cf. *gracilis* have been from the High Antarctic (Dingle 2003). *Pseudocythere* cf. *caudata*, rare in Admiralty Bay, is an Antarctic cosmopolitan species (Dingle 2003).

Hemicytherura irregularis and *Hemicytherura anomala,* rare components of the Admiralty Bay assemblage, are widely distributed throughout the Antarctic continental shelf (Hartmann 1997), but not Sub-Antarctic Marion Island (Dingle 2003). Whatley *et al.* (1998b) recorded *Hemicythere robusta* from littoral of Paradise Bay (west coast of the Antarctic Peninsula). Other records are from the High Antarctic (Whatley *et al.* 1998b). *Pontocypris arctowskiensis* is a rare component in all samples from the Admiralty Bay. This species, according to Hartmann (1997), is known from South Georgia, South Orkney Island, South Shetland Islands (Elephant Island, King George Island, Livingston Island), Bransfield Strait, and Lavoisier Island, with water-depth range 93–303 m. *Austrocythere reticulotuberculata* is restricted to the Antarctic Peninsula today, but in the Oligocene occurred in the Ross Sea area (Dingle and Majoran 2001), and has closest relations in New Zealand.

The podocopid assemblage from the Admiralty Bay, belong to the Antarctic ostracod subprovince (*sensu* Whatley *et al.* 1998c and Dingle 2002). In summary, ostracod fauna inhabiting Admiralty Bay is typical of the near-shore Antarctic setting. It appears devoid of endemic components.

Conclusions

1. Recent Ostracoda collected at 38 locations in Admiralty Bay belong to 29 podocopid species and 19 genera, 10 families, and two superfamilies Cypridacea and Cytheracea. The ostracod assemblages are dominated by cytheracean taxa.
2. No clear distribution pattern of various ostracod assemblages, nor relation between faunal composition and any elements of surrounding environmental were recognized.
3. Shallow-water assemblages are much more variable in terms of frequencies and species richness than deep-water assemblages, which are low in numbers but remain relatively high diversities.
4. Analysed faunas are typical for Antarctic-shelf waters. No significant degree of endemism was discovered.

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Taxonomic appendix

Class Ostracoda Latreille, 1806
Order Podocopida Müller, 1894
Suborder Podocopina Müller, 1894
Superfamily Cytheracea Müller, 1894
Family Cytheridae Baird, 1850
Genus *Austrocythere* Hartmann, 1989
    Austrocythere reticulotuberculata Hartmann, 1989; Fig. 6.1–2.
Family Neocytherideidae Puri, 1957
Genus *Copytus* Skogsberg, 1939
    Copytus caligula Skogsberg, 1939; Fig. 6.3–4.
Family Trachyleberididae Sylvester-Bradley, 1948
Genus *Pseudocythereis* Skogsberg, 1928
    Pseudocythereis spinifera Skogsberg, 1928; Fig. 6.5–6.
Genus *Abyssocythere* Benson, 1971
    Abyssocythere antarctica (Neale, 1967); Fig. 6.7–8.

Genus *Cativella* Coryell and Fields, 1937
Cativella bensoni Neale, 1967; Fig. 7.1–5.
Family Hemicytheridae Puri, 1953
Genus *Ambostracon* Hazel, 1962
Subgenus *Patagonacythere* Hartmann, 1962
Ambostracon (*Patagonacythere) longiductus* (Skogsberg, 1928); Fig. 6.9–10.
Genus *Hemicythere* Sars, 1925
Hemicythere robusta (Skogsberg, 1928); Fig. 7.6–8.
Genus *Meridionalicythere* Whatley, Chadwick, Coxill and Toy, 1987
Meridionalicythere megalodiscus (Skogsberg, 1928); Fig. 7.10–11.
Meridionalicythere mesodiscus (Skogsberg, 1928); Fig. 10.6.
Family Loxoconchidae Sars, 1925
Genus *Antarctiloxoconcha* Hartmann, 1986
Antarctiloxoconcha frigida (Neale, 1967); Fig. 8.1.
Family Cytheruridae Müller, 1894
Genus *Semicytherura* Wagner, 1957
Semicytherura costellata (Brady, 1880); Fig. 8.2.
Semicytherura sp. *sensu S*. sp. 4010 Dingle (2003); Fig. 8.3–5.
Genus *Hemicytherura* Elofson, 1941
Hemicytherura anomala (Müller, 1908); Fig. 8.9.
Hemicytherura irregularis (Müller, 1908); Fig. 8.6–7.
Hemicytherura sp.; Fig. 8.8.
Hemicytherura sp. aff. *H. branchae* Dingle, 2003; Fig. 7.9.
Genus *Cytheropteron* Sars, 1866
Cytheropteron acuticaudatum Hartmann, 1986; Fig. 9.8–10.
Cytheropteron sp. aff. *C. acuticaudatum* Hartmann, 1986; Fig. 10.1–2.
Cytheropteron antarcticum Chapman, 1916; Fig. 9.1–4.
Cytheropteron cf. *abyssorum* Brady, 1880; Fig. 9.5–7.
Genus *Loxoreticulatum* Benson, 1964
Loxoreticulatum fallax (Müller, 1908); Fig. 10.3–5.
Family Xestoleberididae Sars, 1866
Genus *Xestoleberis* Sars, 1866
Xestoleberis cf. *rigusa* Müller, 1908; Fig. 10.7–8.
Family Bythocytheridae Sars, 1866
Genus *Pseudocythere* Sars, 1866
Pseudocythere cf. *caudata* Sars, 1866; Fig. 10.9–10.
Family Paradoxostomatidae Brady and Norman, 1889
Genus *Paradoxostoma* Fischer, 1855
Paradoxostoma cf. *gracilis* (Chapman, 1915) 103; Fig. 11.5.
Paradoxostoma cf. *kerguelense* Müller, 1908; Fig. 11.7.
Paradoxostoma sp.; Fig. 11.8–9.

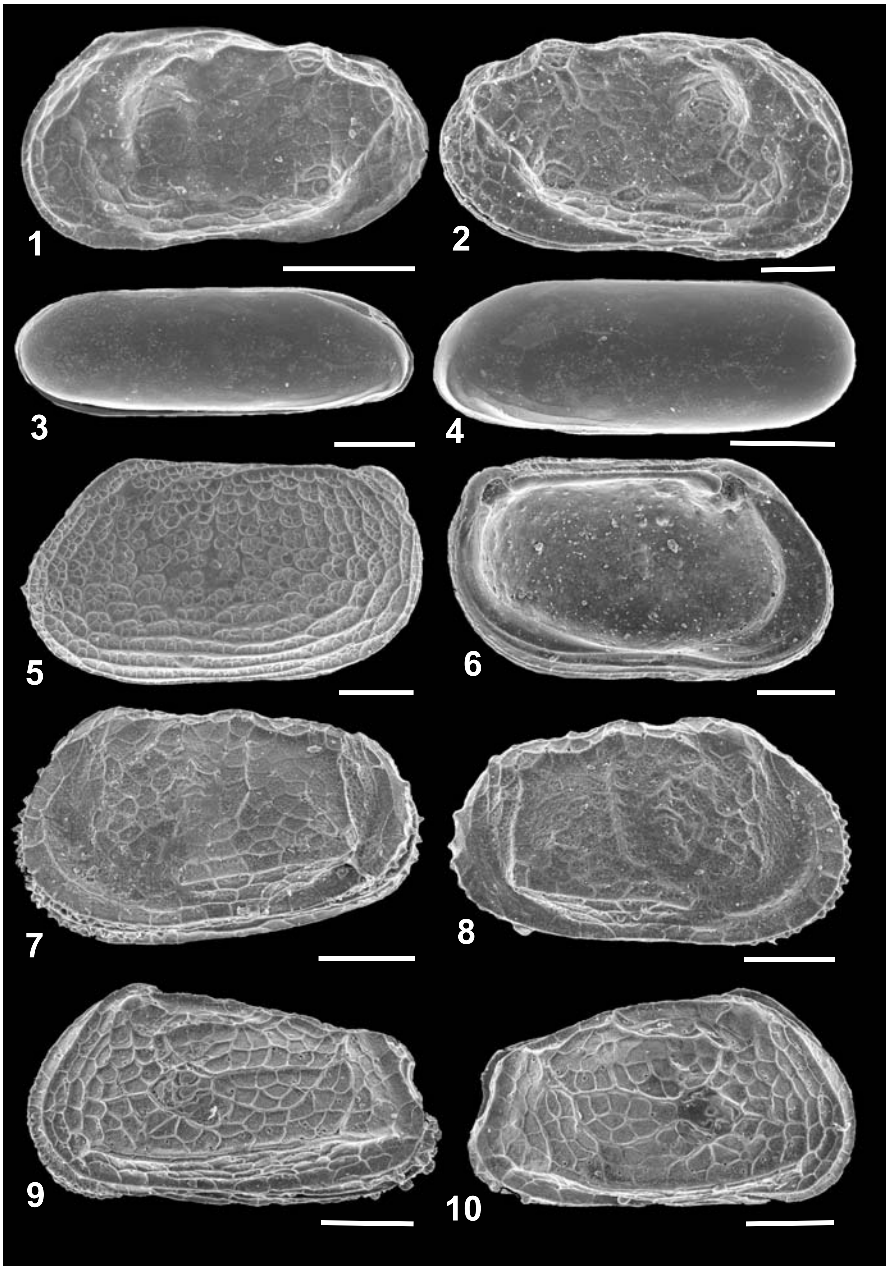

Fig. 6. **1**–**2**. *Austrocythere reticulotuberculata* Hartmann, 1989. 1. LV, ZPAL O.55/82, st. 17; 2. RV, ZPAL O.55/121, st. 23. **3**–**4**. *Copytus caligula* Skogsberg, 1939. 3. Carapace in right lateral view, ZPAL O.55/100, st. 18; 4. LV, ZPAL O.55/101, st. 18. **5**–**6**. *Pseudocythereis spinifera* Skogsberg, 1928. 5. LV, ZPAL O.55/12, st. 15; 6. LV internal view, ZPAL O.55/36, st. 23. **7**–**8**. *Abyssocythere antarctica* (Neale, 1967). 7. Carapace in left lateral view, ZPAL. O.55/32, st. 22; 8. RV, ZPAL O.55/37, st. 23. **9**–**10**. *Ambostracon (Patagonacythere) longiductus* (Skogsberg, 1928). 9. Carapace in left lateral view, ZPAL O.55/33, st. 22; 10. Carapace in right lateral view, ZPAL O.55/99, st. 15. Scale bar 200 μm.

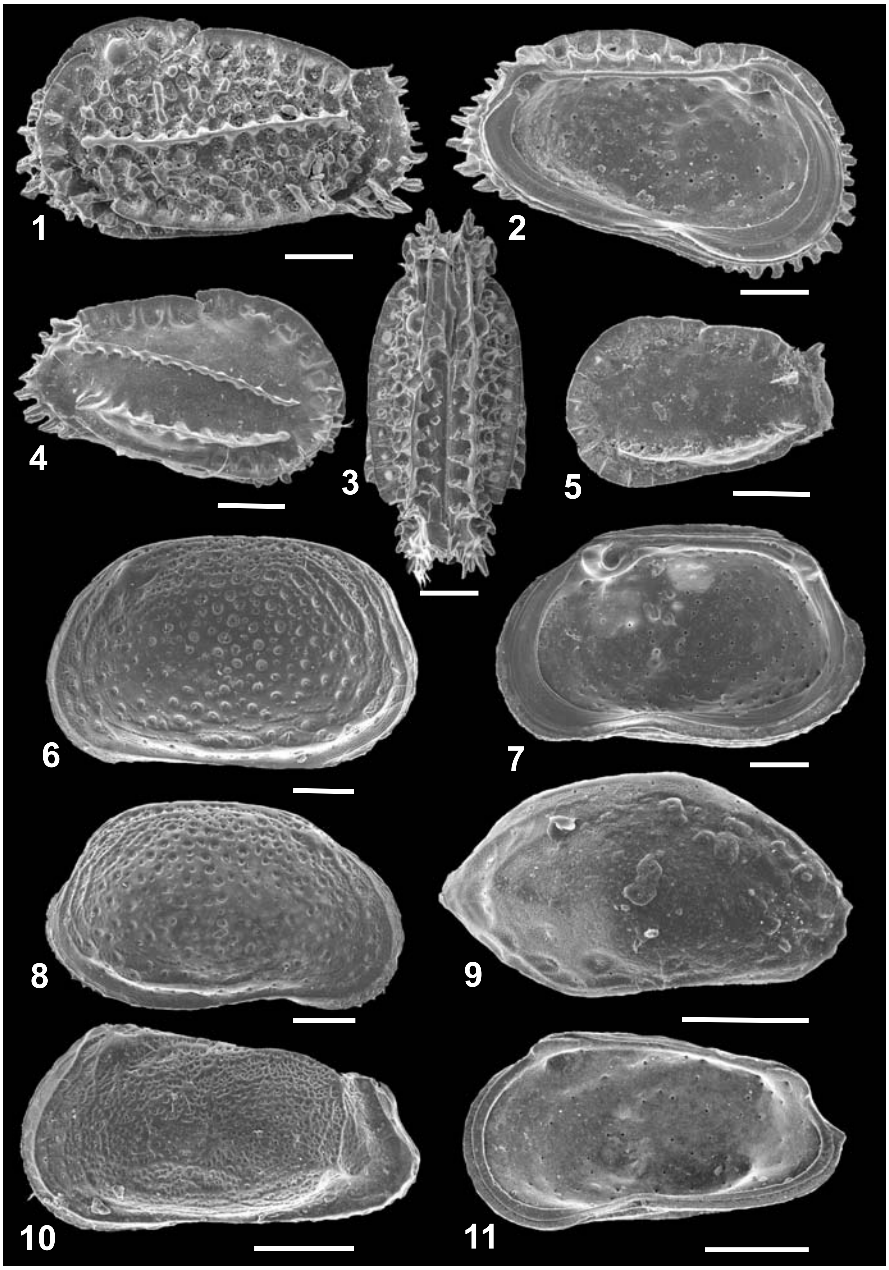

Fig. 7. **1–5**. *Cativella bensoni* Neale, 1967. 1. LV, ZPAL O.55/122, st. 23; 2. LV in internal view, ZPAL O.55/74, st. 23; 3. Carapace in dorsal view, ZPAL O.55/08, st. 15; 4. Carapace in right lateral view, juv., ZPAL O.55/41, st. 23; 5. LV, juv., ZPAL O.55/43, st. 23. **6–8**. *Hemicythere robusta* (Skogsberg, 1928). 6–7. LV and RV in internal view of carapace ZPAL O.55/56, st. 33; 8. RV, ZPAL O.55/31, st. 33. **9**. *Hemicytherura* sp. aff. *H. branchae* Dingle, 2003. RV, ZPAL O.55/45, st. 23. **10–11**. *Meridionalicythere megalodiscus* (Skogsberg, 1928). LV and RV in internal view of carapace ZPAL O.55/63, st. 27. Scale bar 200 μm.

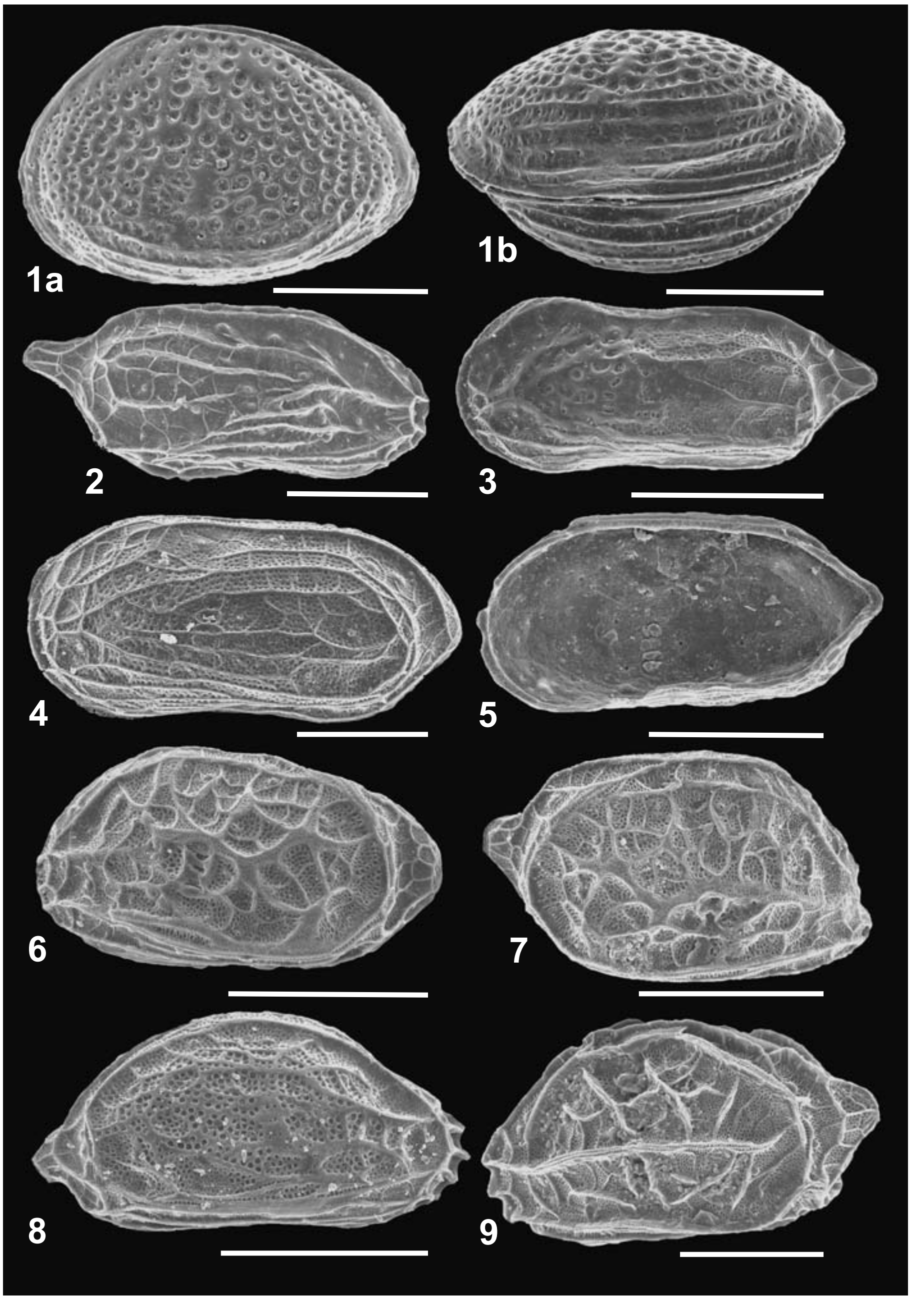

Fig. 8. **1**. *Antarctiloxoconcha frigida* (Neale, 1967). Carapace in left lateral and oblique ventral views, ZPAL O.55/94, st. 9. **2**. *Semicytherura costellata* (Brady, 1880), RV, ZPAL O.55/19, st. 29. **3–5**. *Semicytherura* sp. *sensu S.* sp. 4010 Dingle (2003); 3. LV, ZPAL O.55/34, st. 22; 4. LV, ZPAL O.55/66, st. 7; 5. RV in internal view, ZPAL O.55/62, st. 28. **6–7**. *Hemicytherura irregularis* (Müller, 1908). 6. LV, ZPAL O.55/50, st. 26; 7. RV, ZPAL O.55/78, st. 26. **8**. *Hemicytherura* sp. RV, ZPAL O.55/80, st. 20. **9**. *Hemicytherura anomala* (Müller, 1908), LV, ZPAL O.55/55, st. 33. Scale bar 200 μm.

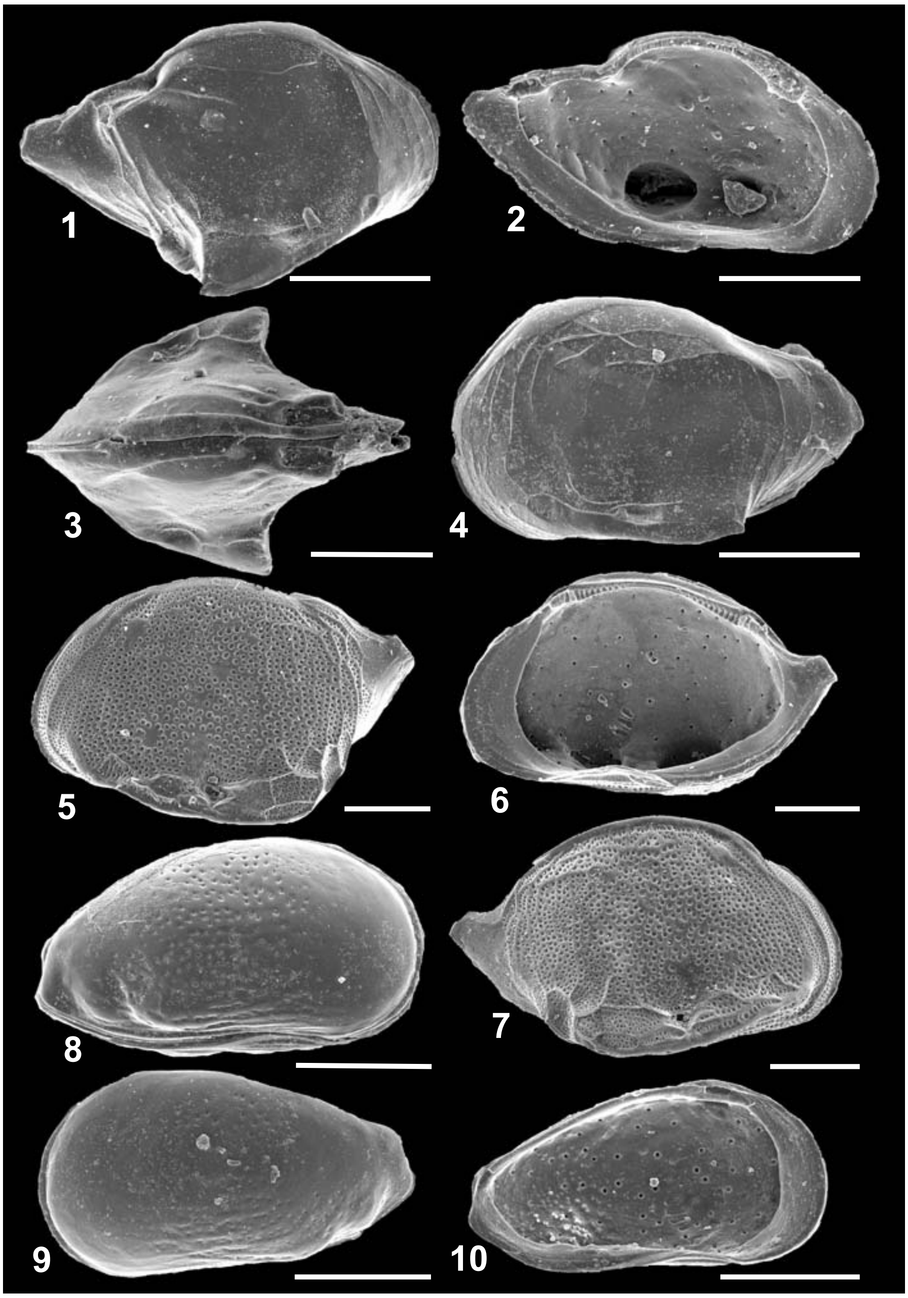

Fig. 9. **1**–**4**. *Cytheropteron antarcticum* Chapman, 1916. 1–2. RV and LV in internal view of carapace ZPAL O.55/58, st. 33; 3. Carapace in dorsal view, ZPAL O.55/07, st. 15; 4. LV, ZPAL O.55/76, st. 25. **5–7**. *Cytheropteron* cf. *abyssorum* Brady, 1880. 5–6. LV and RV in internal view of carapace ZPAL O.55/60, st. 30; 7. RV, ZPAL O.55/42, st. 23. **8**–**10**. *Cytheropteron acuticaudatum* Hartmann, 1986. 8. Carapace in right view, ZPAL O.55/03, st. 20; 9. LV, ZPAL O.55/65, st. 27; 10. LV in internal view, ZPAL O.55/123, st. 27. Scale bar 200 μm.

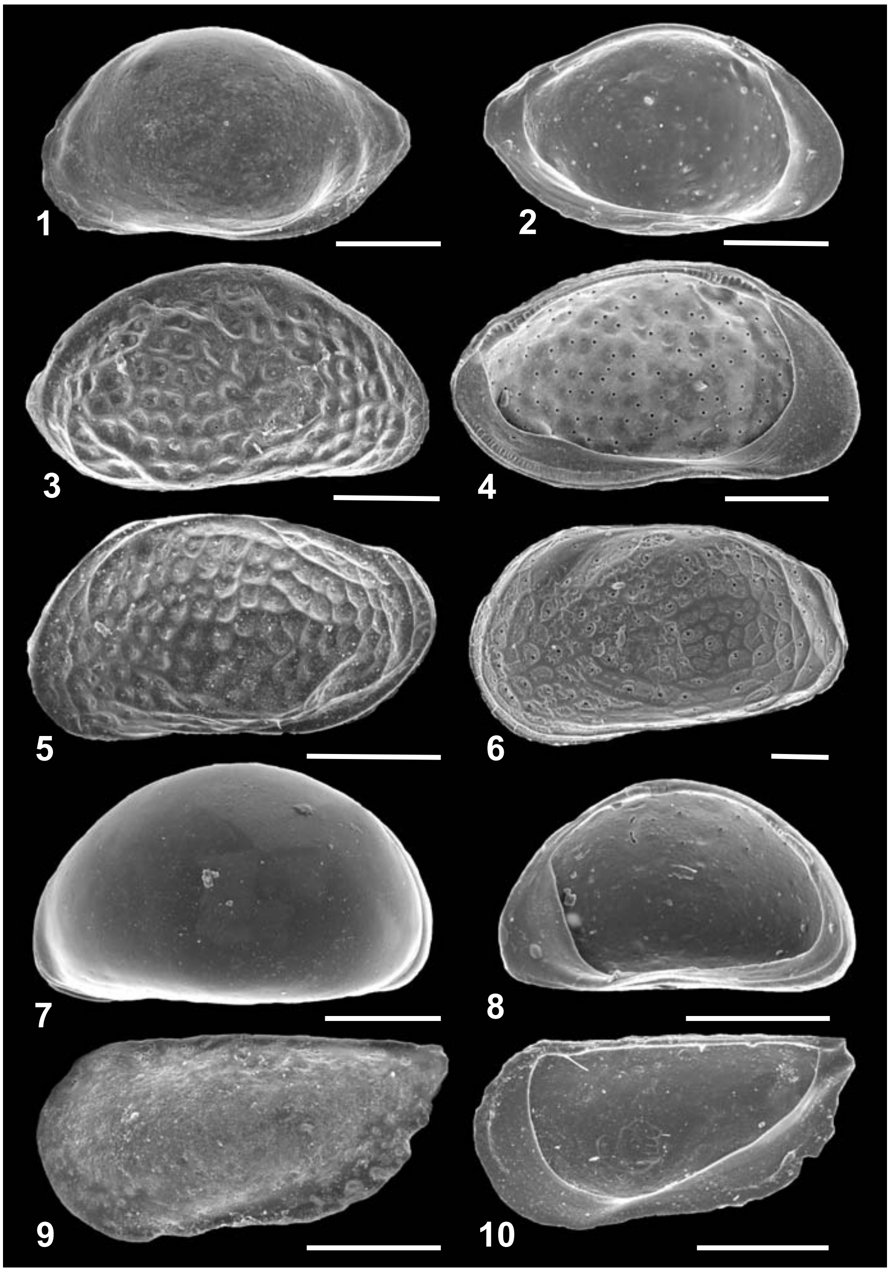

Fig. 10. **1**–**2**. *Cytheropteron* sp. aff. *C. acuticaudatum* Hartmann, 1986. 1. LV, ZPAL O.55/104, st. 30; 2. LV in internal view, ZPAL O.55/118, st. 30. **3**–**5**. *Loxoreticulatum fallax* (Müller, 1908). 3–4. RV and LV in internal view of carapace ZPAL O.55/64, st. 27; 5. LV, st. 14. **6**. *Meridionalicythere mesodiscus* (Skogsberg, 1928), LV, ZPAL O.55/89, st. 10. **7**–**8**. *Xestoleberis* cf. *rigusa* Müller, 1908. 7. Carapace in left view, ZPAL O.55/54, st. 33; 8. RV in internal view, ZPAL O.55/106, st. 33. **9**–**10**. *Pseudocythere* cf. *caudata* Sars, 1866. 9. LV, ZPAL O.55/29, st. 32; 10. RV in internal view, ZPAL O.55/59, st. 32. Scale bar 200 μm.

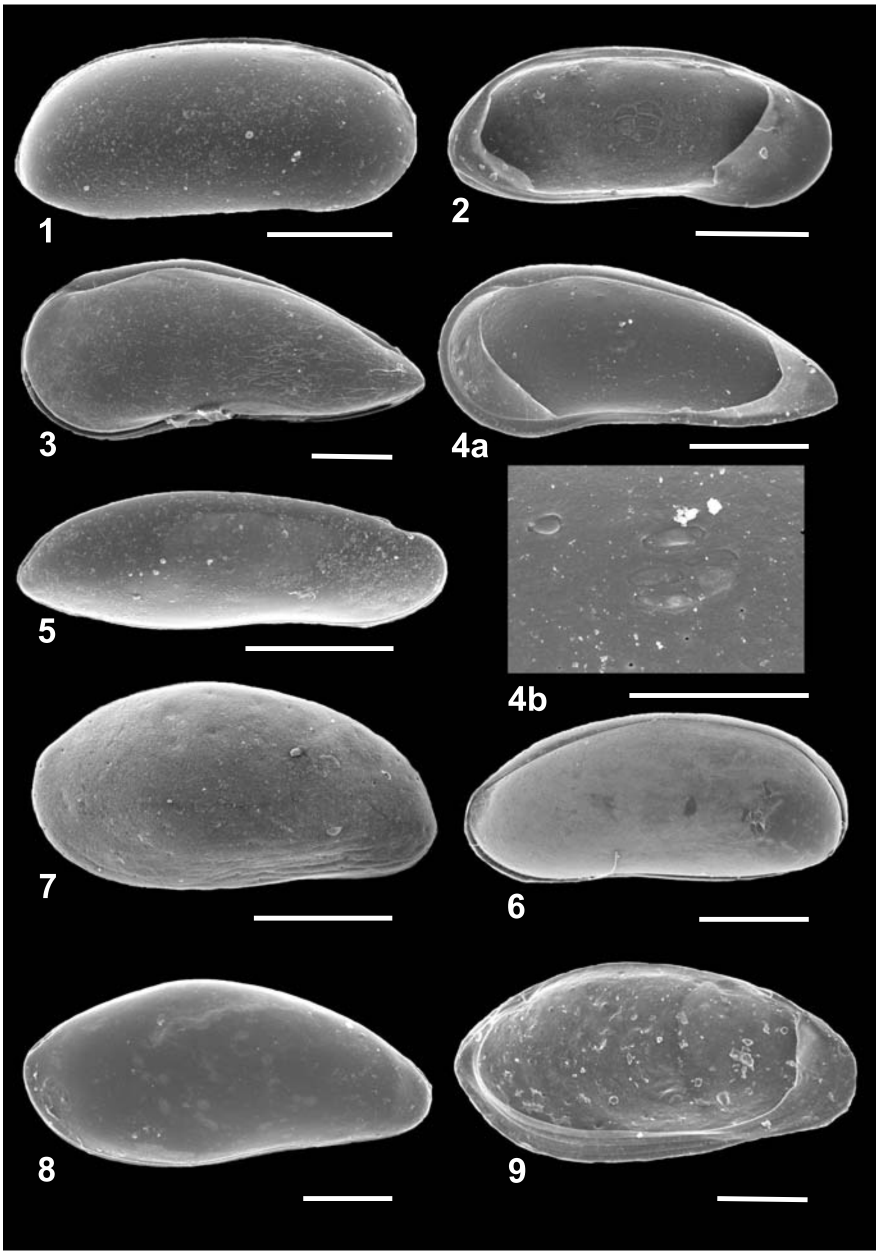

Fig. 11. **1**–**2**. *Argilloecia antarctica* Hartmann, 1986. 1. Carapace in right view, ZPAL O.55/47, st. 26; 2. LV in internal view, ZPAL O.55/109, st. 37. **3**–**4**. *Pontocypris arctowskiensis* Hartmann, 1986. 3. Carapace in left view, ZPAL O.55/49, st. 26; 4a, b. RV in internal view and details of adductorial muscle field, ZPAL O.55/77, st. 26. **5**. *Paradoxostoma* cf. *gracilis* (Chapman, 1915), carapace in right view, ZPAL O.55/103, st. 26. **6**. ?*Sclerochilus* sp., carapace in right view, ZPAL O.55/20, st. 28. **7**. *Paradoxostoma* cf. *kerguelense* Müller, 1908, RV, ZPAL O.55/93, st. 7. **8**–**9**. *Paradoxostoma* sp.; 8. Carapace in right view, ZPAL O.55/116, st. 38; 9. LV in internal view, ZPAL O.55/117, st. 38. Scale bar 200 μm, except for 4b which is 100 μm.

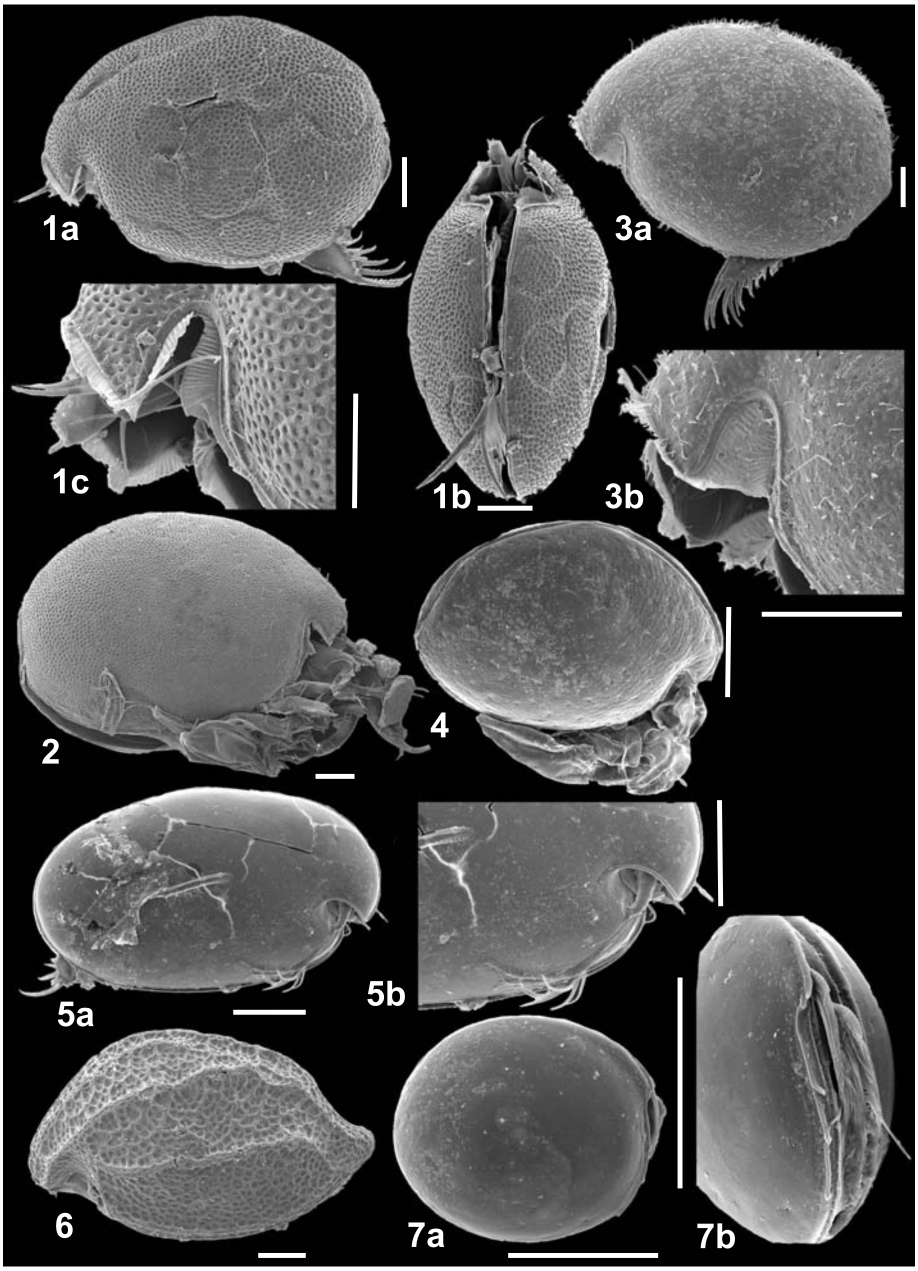

Fig. 12. **1**. *Philomedes* sp. A, carapace in left view, and details of anterior incisor and rostrum, ZPAL O.55/17, st. 6. **2**. *Philomedes* sp. B, carapace in right view, ZPAL O.55/26, st. 10. **3**. *Philomedes* sp. C, carapace in left view, and details of anterior incisor and rostrum, ZPAL O.55/16, st. 3. **4**. *Philomedes* sp. D, carapace in right view, ZPAL O.55/88, st. 10. **5**. ?*Empoulsenia* sp., carapace in right view and details of anterior incisor and rostrum, ZPAL O.55/91, st. 3. **6**. *Scleroconcha* sp. aff. *S. gallardoi* Kornicker, 1971, carapace in left view, ZPAL O.55/48, st. 26. **7**. *Polycope kinggeorgensis* Hartmann, 1987, carapace in right view and details of anterior part, ZPAL O.55/71, st. 3. Scale bar 200 μm.

Genus Sclerochilus Sars, 1866
?*Sclerochilus* sp.; Fig. 11.6.
Superfamily Cypridacea Baird, 1845
Family Pontocyprididae Müller, 1894
Genus *Argilloecia* Sars, 1866
Argilloecia antarctica Hartmann, 1986; Fig. 11.1–2.
Genus *Pontocypris* Sars, 1866
Pontocypris arctowskiensis Hartmann, 1986; Fig. 11.3–4.
Order Cladocopida Sars, 1866
Superfamily Polycopacea Sars, 1866
Family Polycopidae Sars, 1866
Genus *Polycope* Sars, 1866
Polycope kinggeorgensis Hartmann, 1987; Fig. 12.7.
Order Myodocopida Sars, 1866
Suborder Myodocopina Sars, 1866
Superfamily Sarsiellacea Brady and Norman, 1896
Family Philomedidae Müller, 1912
Genus *Philomedes* Liljeborg, 1853
Philomedes sp. A; Fig. 12.1.
Philomedes sp. B; Fig. 12.2.
Philomedes sp. C; Fig. 12.3.
Philomedes sp. D; Fig. 12.4.
Genus *Scleroconcha* Skogsberg, 1920
Scleroconcha sp. aff. *S. gallardoi* Kornicker, 1971; Fig. 12.6.
Superfamily Cylindroleberidacea Müller, 1906
Family Cylindroleberididae Müller, 1906
Genus *Empoulsenia* Kornicker, 1975
?*Empoulsenia* sp.; Fig. 12.5.

References

BATTKE Z. 1990. Admiralty Bay, King George Island. Map 1: 50 000. Institute of Ecology, Polish Academy of Sciences.

BŁASZYK J. 1987. Ostracods from the Oligocene Polonez Cove Formation of King George Island, West Antarctica. *Palaeontologia Polonica* 49: 63–81.

BRADY G.S. 1880. Report on the Ostracoda dredged by the H.M.S. *Challenger* during the years 1873–1876. *Report of the Voyage of H.M.S. Challenger, Zoology* 1: 1–184 (not seen; as cited in Dingle 2003).

DINGLE R.V. 2000. Ostracoda from CRP-1 and CRP-2/2A Victoria Land Basin, Antarctica. *Terra Antartica* 7 (4): 479–492.

DINGLE R.V. 2002. Insular endemism in Recent Southern Ocean benthic Ostracoda from Marion Island: paleozoogeographical and evolutionary implications. *Revista Española de Micropaleontologia* 34 (2): 215–233.

DINGLE R.V. 2003. Recent Subantarctic benthic ostracod faunas from the Marion and Prince Edward Islands Archipelago, Southern Ocean. *Revista Española de Micropaleontologia* 35 (1): 119–155.

DINGLE R.V. and MAJORAN S. 2001. Palaeo-climatic and -biogeographical implications of Oligocene Ostracoda from CRP-2/2A and CRP-3 drillholes, Victoria Land Basin, Antarctica. *Terra Antartica* 8 (4): 369–382.

DOMACK E.W. and ISHMAN S. 1994. Oceanographic and physiographic controls on modern sedimentation within Antarctic fjords. *Geological Society of America Bulletin* 105: 1175–1189.

HALD M. and KORSUN S. 1997. Distribution of modern benthic foraminifera from fjords of Svalbard, European Arctic. *Journal of Foraminiferal Research* 27 (2): 101–122.

HARTMANN G. 1986. Antarktische benthische Ostracoden I (Mit einer Tabelle der bislang aus der Antarktis bekannten Ostracoden). Auswertung der Fahrten der "Polarstern" Ant III/2 (Sibex-Schnitte) und der Reise 68/1 der "Walther Herwig" (1. Teil: Elephant Island) in die Antarktis. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 83: 147–221.

HARTMANN G. 1987. Antarktische benthische Ostracoden II. Auswertung der Fahrten der "Polarstern" Ant. III/2 und der Reisen der "Walther Herwig" 68/1 und 2. 2. Teil: Elephant Island und Bransfield Strasse. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 84: 115–156.

HARTMANN G. 1988. Antarktische benthische Ostracoden III. Auswertung der Reise des FFS "Walther Herwig" 68/1. 3. Teil: Süd-Orkney-Inseln. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 85: 141–162.

HARTMANN G. 1989a. Antarktische benthische Ostracoden IV. Auswertung der während der Reise von FFS "Walther Herwig" (68/1) bei Süd-Georgien gesammelten Ostracoden. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 86: 209–230.

HARTMANN G. 1989b. Antarktische benthische Ostracoden V. Auswertung der Südwinterreise von FS "Polarstern" (Ps 9/V-1) im Bereich Elephant Island und der Antarktischen Halbinsel. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 86: 231–288.

HARTMANN G. 1990. Antarktische benthische Ostracoden VI. Auswertung der Reise der "Polarstern" Ant. VI-2 (1.Teil, Meiofauna und Zehnerserien) sowie Versuch einer vorläufigen Auswertung aller bislang vorliegenden Daten). *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 87: 191–245.

HARTMANN G. 1991. Antarktische benthische Ostracoden VII. Ostracoden aus dem Oberen Litoral von King George Island. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 88: 211–220.

HARTMANN G. 1992. Antarktische benthische Ostracoden. VIII. Auswertung der Reise der "Meteor" (Ant. 11/4) in die Gewässer um Elephant Island und der Antarktischen Halbinsel. *Helgoländer Meeresuntersuchungen* 46: 405–424.

HARTMANN G. 1993. Antarktische benthische Ostracoden IX. Ostracoden von der Antarktischen Halbinsel und von der Isla de los Estados (Feuerland/Argentinien). Auswertung der "Polarstern" Reise PS ANT/X/1b. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 90: 227–237.

HARTMANN G. 1994. Antarktische benthische Ostracoden X. Bemerkungen zur Gattung *Krithe* mit Beschreibung einer neuen Untergattung *Austrokrithe. Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 91: 77–79.

HARTMANN G. 1997. Antarktische und Subantarktische Podocopa (Ostracoda). *In:* J.W. Wagele and J. Sieg (eds) *Synopses of the Antarctic Benthos*, vol. 7. Koeltz Scientific Books, Koenigstein: 355 pp.

KOPCZYŃSKA E.E. 1993. Net phytoplankton annual cycle (February 1990 – January 1991) in Admiralty Bay, King George Island, West Antarctic. *Polish Polar Research* 14 (4): 383–392.

KORNICKER L.S. 1975. Antarctic Ostracoda (Myodocopina). Part 1. *Smithsonian Contributions to Zoology* 163: 1–374.

KRUSZEWSKI G. 2002. *Zlodzenie Zatoki Admiralicji – przebieg i uwarunkowania*. Wydawnictwo Uczelniane Akademii Morskiej, Gdynia: 123 pp. (in Polish).

LIPSKI M. 1987. Variations of physical conditions, nutrient and chlorophyll *a* contents in Admiralty Bay (King George Island, South Shetland Islands, 1979). *Polish Polar Research* 8 (4): 307–332.

MAJEWSKI W. 2005. Benthic foraminiferal assemblages from Admiralty Bay, King George Island, West Antarctica. *Polish Polar Research* 26 (2).

NEALE J.W. 1967. An ostracod fauna from Halley Bay, Coats Land, British Antarctic Territory. *British Antarctic Survey, Scientific Reports* 58: 1–50.

PĘCHERZEWSKI K. 1980. Distribution and quantity of suspended matter in Admiralty Bay (King George Island, South Shetland Islands). *Polish Polar Research* 1 (1): 75–82.

PRUSZAK Z. 1980. Currents circulation in the waters of Admiralty Bay (region of *Arctowski* Station of King George Island). *Polish Polar Research* 1 (1): 55–74.

RAKUSA-SUSZCZEWSKI S. 1980. Environmental conditions and the functioning of Admiralty Bay (South Shetland Islands) as part of the near shore Antarctic ecosystem. *Polish Polar Research* 1 (1): 11–27.

ROBAKIEWICZ M. and RAKUSA-SUSZCZEWSKI S. 1999. Application of 3D circulation model to Admirality Bay, King George Island, Antarctica. *Polish Polar Research* 20 (1): 43–58.

SARUKHANYAN E.J. and TOKARCZYK R. 1988. Coarse-scale hydrological conditions in Admiralty Bay, King George Island, West Antarctica, summer 1982. *Polish Polar Research* 9 (1): 121–132.

SZAFRAŃSKI Z. and LIPSKI M. 1982. Characteristics of water temperature and salinity at Admiralty Bay (King George Island, South Shetland Islands, Antarctic) during the austral summer 1978/1979. *Polish Polar Research* 3 (1–2): 7–24.

WHATLEY R.C., CHADWICK J., COXILL D. and TOY N. 1987. New genera and species of cytheracean Ostracoda from the S. W. Atlantic. *Journal of Micropalaeontology* 6 (2): 1–12.

WHATLEY R. and COLES G. 1987. The Late Miocene to Quaternary Ostracoda of Leg 94, deep sea drilling project. *Revista Española de Micropaleontologia* 19 (1): 33–97.

WHATLEY R., CHADWICK J., COXILL D. and TOY N. 1988. The ostracod family Cytheruridae from the Antarctic and South-West Atlantic. *Revista Española de Micropaleontologia* 20 (2): 171–203.

WHATLEY R., TOY N., MOGUILEVSKY A. and COXILL D. 1995. Ostracoda from the South West Atlantic Part I. The Falkland Islands. *Revista Española de Micropaleontologia* 27 (1): 17–38.

WHATLEY R., MOGUILEVSKY A., TOY N., CHADWICK J. and RAMOS M.I.F. 1997. Ostracoda from the south west Atlantic. Part II. The littoral fauna from between Tierra del Fuego and the Rio de La Plata. *Revista Española de Micropaleontologia* 29 (2): 5–83.

WHATLEY R., MOGUILEVSKY A., CHADWICK J., TOY N. and RAMOS M.I.F. 1998a. Ostracoda from the South West Atlantic. Part III. The Argentinian, Uruguayan and Southern Brazilian continental shelf. *Revista Española de Micropaleontologia* 30 (2): 89–116.

WHATLEY R.C., MOGUILEVSKY A., RAMOS M.I.F. and COXILL D.J. 1998b. Recent deep and shallow water Ostracoda from the Antarctic Peninsula and the Scotia Sea. *Revista Española de Micropaleontologia* 30 (3): 111–135.

WHATLEY R.C., RAMOS M.I.F., MOGUILEVSKY A. and CHADWICK J. 1998c. The provincial distribution of Recent littoral and shelf Ostracoda in the SW Atlantic. *Bulletin Centre de Recherche Elf Exploration Production, Mémoire* 20: 317–327.

WLODARSKA-KOWALCZUK M. and PEARSON T.H. 2004. Soft-bottom macrobenthic faunal associations and factors affecting species distribution in an Arctic glacial fjord (Kongsfjord, Spitsbergen). *Polar Biology* 27: 155–167.

WOOD A.M., RAMOS M.I. and WHATLEY R.C. 1999. The palaeozoogeography of Oligocene to Recent marine Ostracoda from the Neotropics (mid- and South America) and Antarctica. *Marine Micropaleontology* 37: 345–364.

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