POLISH POLAR RESEARCH	17	3–4	221-238	1996

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Zoobenthos and zooplankton of Herve Cove, King George Island, South Shetland Islands, Antarctic

ABSTRACT: Herve Cove, a small, shallow and partly isolated basin, is strongly influenced by glacial freshwater inlfow, bringing significant amount of mineral suspension. Its mean annual content amounted up to 46 mg dm^{-3}. Sea anemone (*Edwardsia* sp.), bivalves (*Yoldia eightsi*, *Laternula elliptica* and *Mysella* sp.), amphipods (mostly *Cheirimedon femoratus*) as well as some species of polychaetes constituted almost 95% of zoobenthos biomass and 90% of abundance. Four different assemblages of benthic invertebrates, with total biomass ranging from 0.002 kg m^{-2} up to 1.7 kg m^{-2}, were distinguished in this relatively small (about 12 ha) area. It seems that the freshwater impact influences the composition of an assemblage occurring close to the edge of a glacier. Relatively rich crustacean fauna was encountered in the shallow part of the cove near its entrance. Almost complete lack of echinoderms in Herve Cove, that are common in the shallow Antarctic sublittoral, should also be noted. Macrozooplankton of Herve Cove was dominated by Copepoda. The most frequent and abundant species were: *Oithona similis*, *Ctenocalanus citer* and *Metridia gerlachei*. Far less numerous Chaetognatha represented by three species, Ostracoda, Polychaeta, Pteropoda and Siphonophora constituted only 2.5% of all planktonic animals collected.

Key words: Antarctic, King George Island, zoobenthos, zooplankton, abundance and biomass.

Introduction

In the SCAR reports of September 1992 and November 1994 concerning the Antarctic Coastal and Shelf Zone much attention was devoted to the biological phenomena occurring at the land-ocean contact zone, acknowledging the import-

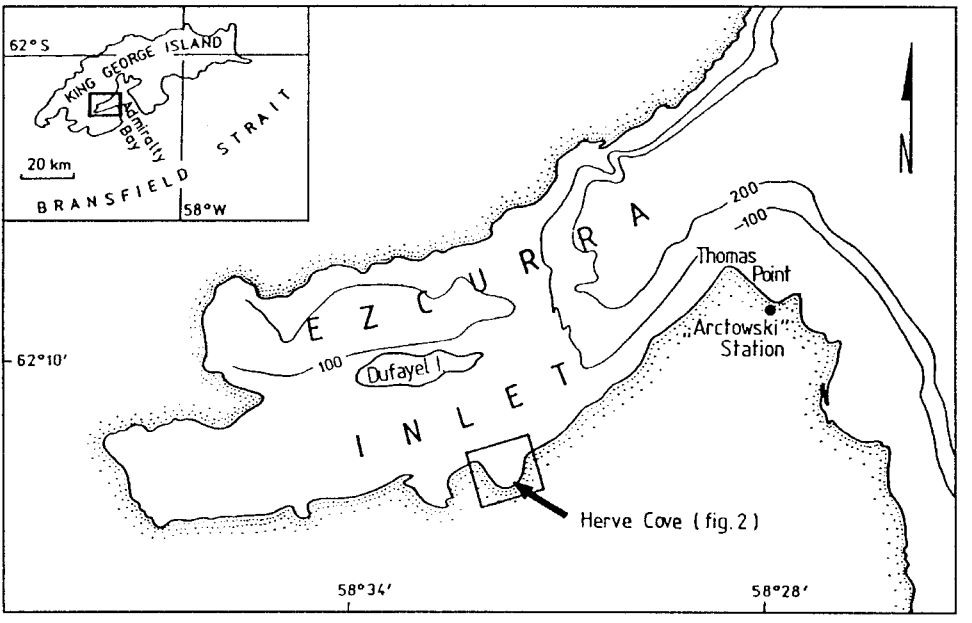

Fig. 1. Investigated area. Location of Herve Cove.

ance of the long lasting studies of this part of the Antarctic Ocean ecosystem. In concordance with this scientific trend in summer season 1992/93 we have undertaken studies on benthos and plankton of a small and shallow lagoon, Herve Cove, an embayment of Admiralty Bay. This lagoon is strongly influenced by phenomena occurring on the land, such as run-off of melt water and mineral suspension (terrestrial input) from subglacial and glacial streams. Such small and shallow lagoons are a characteristic feature of the South Shetlands shoreline (Rakusa-Suszczewski, 1994, 1995). These reservoirs are usually very young. They are formed or enlarging as a result of recent intensification of deglaciation processes in the described area (Marsz 1983, Rakusa-Suszczewski, Miętus and Piasecki 1993, Rakusa-Suszczewski 1994).

White (1984) and Gallardo (1987) have recently paid attention to our insufficient knowledge of shelf communities of the Southern Ocean, especially of the shallowest sublittoral. Soft bottom zoobenthos assemblages in such areas in West Antarctic region were studied by Hardy (1972), White and Robins (1972), Lowry (1975), Richardson and Hedgpeth (1977), Platt (1979), Zamorano (1983) and Wägele and Brito (1990). Biomass and abundance distribution of bottom fauna in Admiralty Bay (King George Island, South Shetlands) was a subject of studies of Jażdżewski *et al.* (1986). These data partly covered also areas of shallow sublittoral. Recently Jażdżewski and Siciński (1993) summarized the results of zoobenthos studies of this area. The polychaete assemblages of the soft bottom in the same area were described by Siciński (1986). More detailed studies on

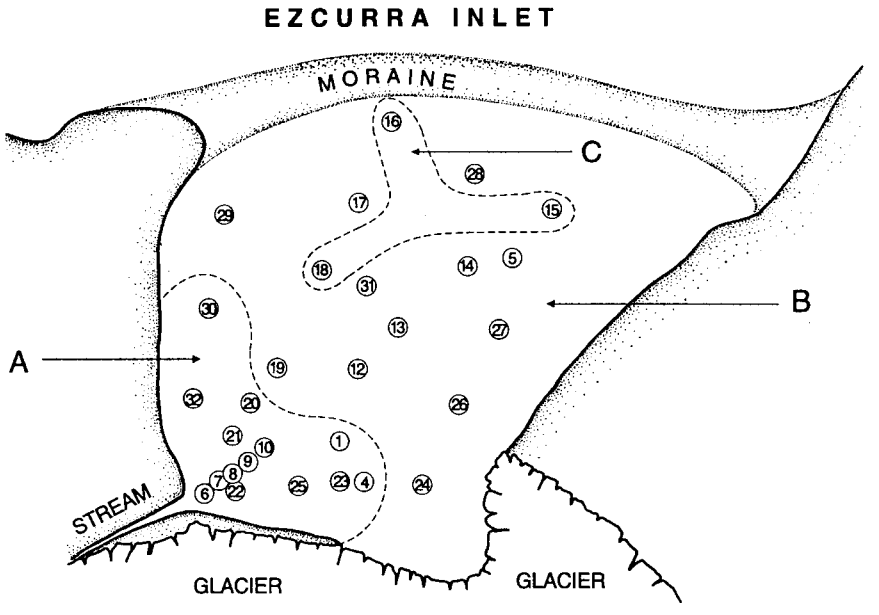

Fig. 2. Herve Cove. Location of sampling stations.

Amphipoda (Jażdżewski *et al.* 1991) and Polychaeta (Siciński and Janowska 1993) in the uppermost sublittoral zone (5–30 m depth) of Admiralty Bay were also carried out.

Zooplankton of small lagoons, such as Herve Cove, was not yet studied. In Ezcurra Inlet, part of which is Herve Cove, the studies on zooplankton were carried out by Chojnacki and Węgleńska (1984). Seasonal changes in the abundance of the dominant species were the subject of studies by Mienshenina and Rakusa-Suszczewski (1992). Life cycles of some Copepoda species of this reservoir were described by Żmijewska (1994).

Study area

The study area was a small lagoon situated on the southern shore of Ezcurra Inlet, a fiord forming the western branch of Admiralty Bay (Fig. 1). Extensive characteristics of the waters in Admiralty Bay can be found in the papers by Rakusa-Suszczewski (1980), Samp (1980) and Lipski (1987). The morphology of the shore and bottom of this part of the Bay, which encloses Ezcurra Inlet and adjoining areas was described by Marsz (1983).

Herve Cove (Fig. 2) is a shallow bay with an area of about 12 ha, with a maximum depth of 20 m. It is strongly affected by glacial freshwater inflow bringing large amounts of mineral suspension. Underwater ridge isolates the

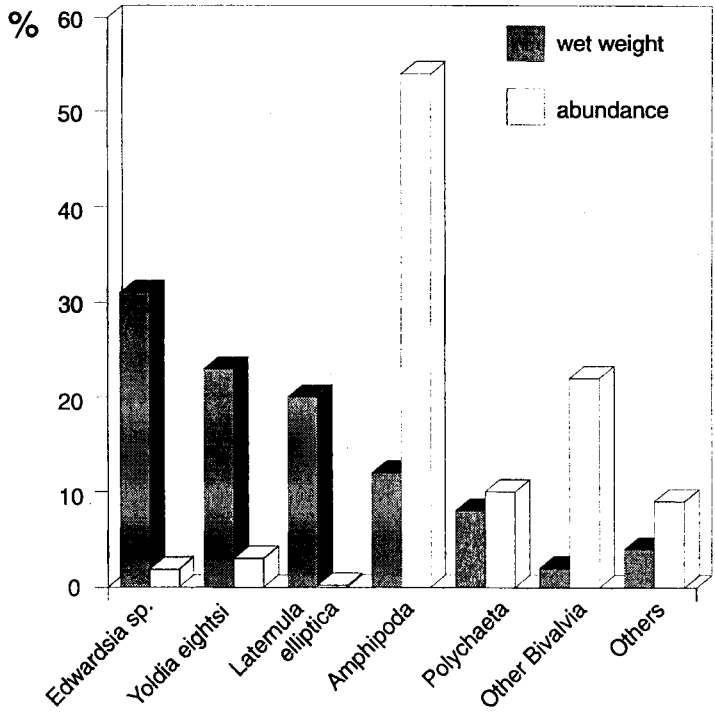

Fig. 3. Dominant invertebrate taxa from Herve Cove and their share in abundance and biomass.

cove from deeper basin of Ezcurra Inlet, that favors accumulation of small grain bottom deposits. The stream, emptying to the cove in its south-western part (Fig. 2), is the main source of freshwater and mineral suspension. Mean annual content of mineral suspension in the lagoon equals 46 mg dm^{-3}. The highest amounts of the suspension were observed in the southern part, near estuaries of subglacial streams, where it reached over 100 mg dm^{-3}. The maximum value, almost 270 mg dm^{-3}, was noted near the estuary of largest stream in the south-western part of the lagoon (Fig. 2). The lagoon is characterised by a complex bottom configuration. Macroscopic algae, common in many other coastal regions of the Admiralty Bay, were not found here. Underwater ridge in the northern part of the lagoon forms a barrier isolating to a certain degree the waters of Herve Cove from the main basin of Ezcurra Inlet.

Materials and methods

Bottom samples were collected in the area of the whole lagoon in 29 stations (Fig. 2) from 10th February to 21st April 1993. At each station one replicate was taken using the Van Veen grab with a sampling area of 0.1 m^2.

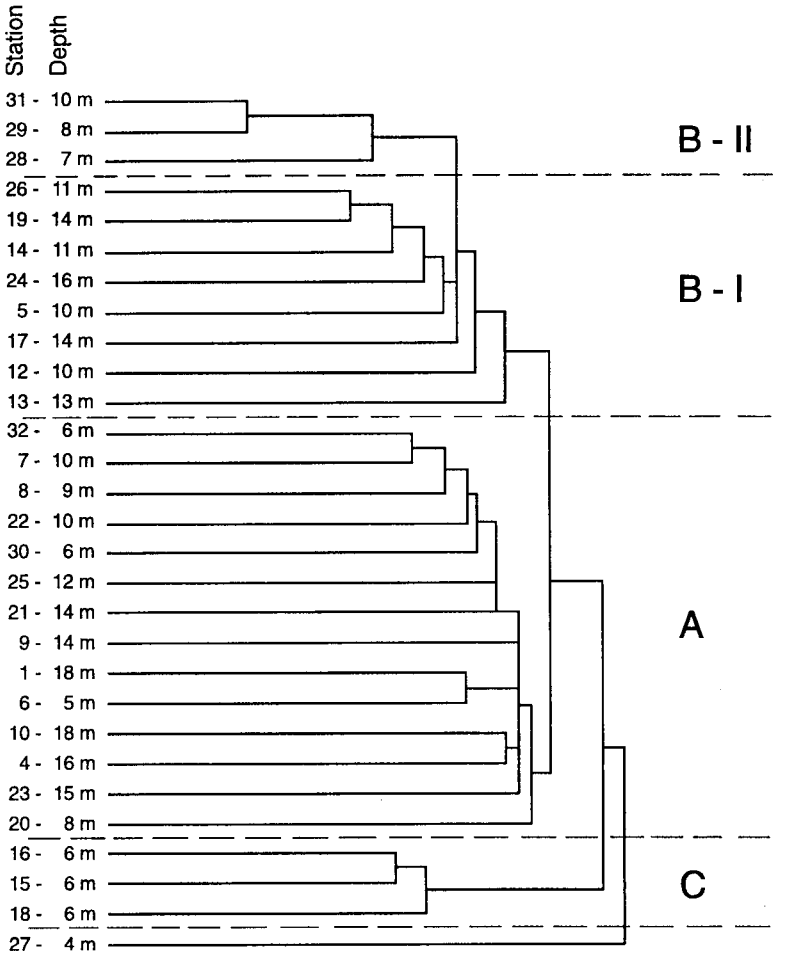

Fig. 4. Dendrogram of stations and its division into four clusters.

Sediments were sieved in the laboratory using 0.5 mm mesh sieves. Animals were sorted into major taxa and their wet weight was then measured.

The basis for the analysis were 16678 individuals of benthic animals encountered in 29 Van Veen grab samples.

Multivariate analysis was carried out in order to classify stations as well as taxa according to the abundance distribution of particular animal groups and to detect clusters. The data matrix comprises the abundance (ind. 0.1 m^{-2}) of 24 taxa at 29 stations. Bray-Curtis measure was used to calculate the distance values of stations and taxa. These calculations were made on the logarithmically transformed data. The single link method was adapted for stations and taxa grouping (Figs 4–5). Stations as well as taxa were then arranged in Tables 1–2 according to their sequence in dendrograms (Figs 4–5).

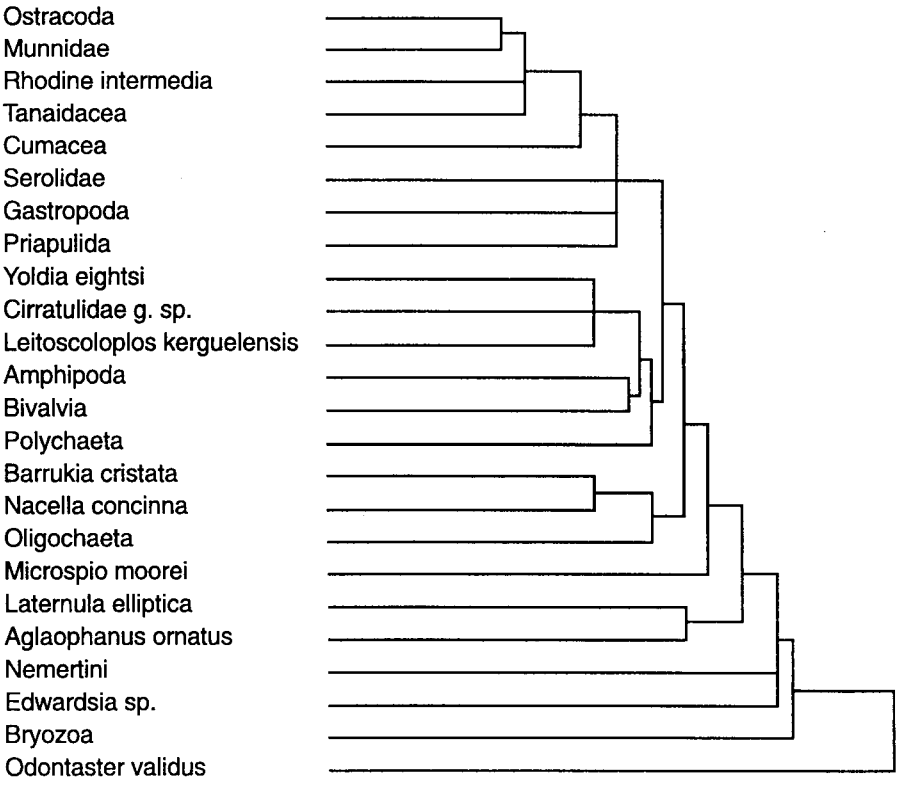

Fig. 5. Dendrogram of taxa.

The index of taxa associations mentioned in the text means the percentage share of individuals from each taxon caught in the particular group of stations in the total number of individuals from this taxon collected in the whole study area.

In the period from February 1993 to December 1993 the series of zooplankton samples was collected in the deepest place of the lagoon using WP-2 net with inlet surface of 0.196 m^2 and mesh size of 200 μm; the water layer 0–15 m was sampled.

Results

The abundance of zoobenthos in Herve Cove varied from 350 to 21760 ind. m^{-2}, mean 5800 ind. m^{-2} (95% CL: 3500–8000 ind. m^{-2}). Amphipoda and small Bivalvia were the most common and abundant invertebrates in the bottom of the lagoon (Figs 3, 6). Wet weight of the Herve Cove zoobenthos ranged from 2 g m^{-2} to 1700 g m^{-2}, mean 300 g m^{-2} (95% CL: 120–470 g m^{-2}). The bulk of biomass consisted of sea anemones (*Edwardsia* sp.) and bivalve *Yoldia eightsi*

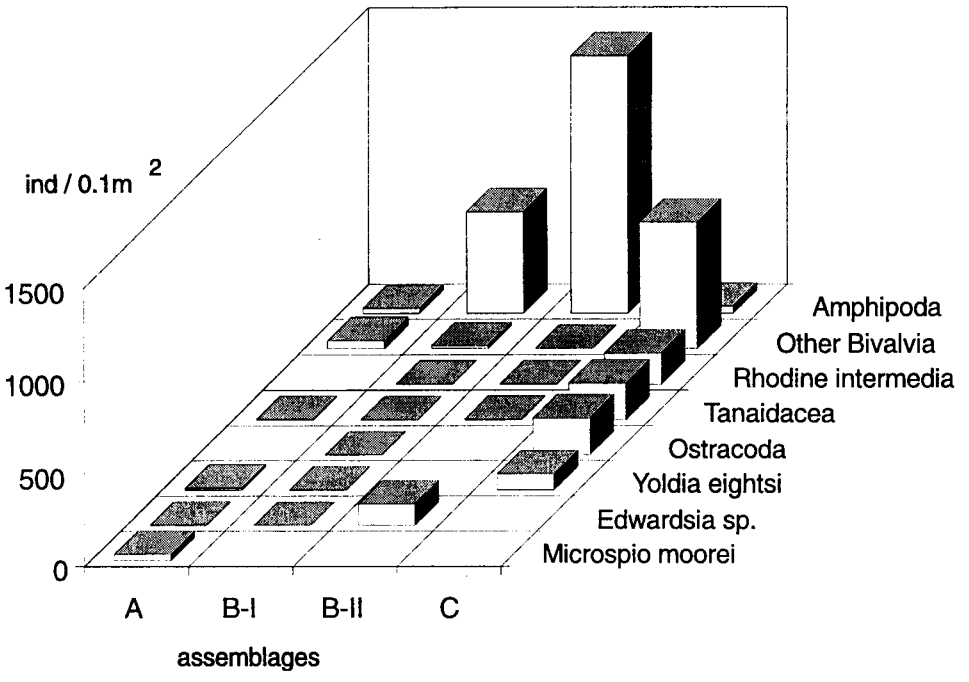

Fig. 6. Abundance of dominant taxa in four invertebrate assemblages from Herve Cove.

and *Laternula elliptica* (Figs 3, 7), scattered irregularly and numerous only in some regions of the lagoon. A significant role in benthos biomass was played also by Amphipoda and Polychaeta (Fig. 3). Abundance and biomass of particular taxa are presented in Tables 1–2.

Rather accidental taxa found in Herve Cove were a starfish *Odotaster validus* and a snail *Nacella concinna*, both represented by single specimens in the material. Only one small piece of bryozoan colony was encountered.

Cluster analysis allowed to distinguish four groups of stations inhabited by markedly different assemblages of bottom fauna (Fig. 4). It was a group of stations from the south-western part of the lagoon influenced by the stream supplying the Cove with fresh water and mineral suspension (Fig. 4, "A"). The second group consisted of stations of medium depth in the central and eastern part of the examined basin (Fig. 4, "B"). Further division of this group of stations results from the fact that stations 28, 29 and 31 form a clear subgroup within its limits (Fig. 4, "B-II"). The last group (Fig. 4, "C") consists of stations 15, 16 and 18 of the shallow regions situated at the entrance to Herve Cove.

It appears that the bottom fauna of Herve Cove is significantly heterogenic and differentiated in relation to the habitat. In the relatively small area four zoobenthos assemblages were observed (Figs 2, 4, 6–7). Their character and structure are related to the type of sediments, oxygen supply and topography of the bottom.

Assemblage "A" was found in the vicinity of the stream estuary, where 17 taxa of invertebrates were distinguished. Their total abundance ranged from 350 up to 3900 (mean 1430 ind. m^{-2}); dominant animals were here bivalves (*Mysella* sp., *Yoldia eightsi*), three polychaete species (*Microspio moorei*, *Aphelochaeta* sp. and *Leitoscoloplos kerguelenensis*) and amphipods. These taxa constituted about 90% of all animals collected. Strongly associated with this group of stations was *Microspio moorei*; almost 100% of all individuals from this species were found in the area "A". A rather high association degree was observed also for *Aphelochaeta* sp. and *Laternula elliptica*. On the contrary, amphipods and sea-anemones, usually very common in the lagoon had a low association index to this assemblage.

Zoobenthos biomass in this part of the lagoon was the lowest (mean 95 g m^{-2}). Over the half (54%) of wet weight of the benthos fell to *Yoldia eightsi*, however significant share had also *Laternula elliptica* (14%), *Aglaophamus ornatus* (13%), small bivalves (5%) and sea-anemone *Edwardsia* sp. (5%). The taxa listed above constituted 90% of the assemblage biomass.

Diversity of macrozoobenthos in this part of the lagoon was relatively high, but at the same time the biomass and abundance of macrozoobenthos was extremely low. It seems that the structure of this assemblage depends greatly on the impact of the stream.

The second assemblage, "B-I", occurred in middle dephts of water in the eastern part of the lagoon. Abundance of zoobenthos in this area ranged from 1340 up to about 10000 ind. m^{-2} (mean: 5700 ind. m^{-2}). The bottom fauna was strongly dominated by amphipods (mainly *Cheirimedon femoratus*), which constituted 80% of all bottom invertebrates found in this part of the lagoon. Small bivalves, mostly *Mysella* sp., were the second important component, with a dominance of 18%. In this region of the lagoon a low diversity is an apparent feature. Average biomass was low (84 g m^{-2}). Amphipods, mainly *Cheirimedon femoratus*, which constituted almost 80% of the fauna, were also the dominant group in terms of biomass. Together with less important small Bivalvia, sea anemone *Edwardsia* sp. and *Yoldia eightsi* they constituted 97% of the total zoobenthos biomass. Characteristic taxa in terms of abundance and/or biomass, with high association index to this part of the bottom, were not found here. Diversity of zoobenthos was extremely low.

Assemblege "B-II", a peculiar variety of assemblege "B-I", consisted almost exclusively of two components, namely sea anemone — *Edwardsia* sp. and amphipods occurring in great masses. In some stations up to 1500 individuals of anemones and over 20000 individuals of amphipods per squ. meter were found. Mean values of abundance were 1140 ind. m^{-2} and 14000 ind. m^{-2}, respectively and mean values of biomass — 1040 g m^{-2} and 210 g m^{-2}. Therefore extremely high values of biomass (maximally over 1.7 kg m^{-2}) were observed in some samples from this area.

The biomass [g wet weight m^{-2}] of 24 macrozoobenthos taxa in 29 stations of Herve Cove.

Table 2

No	STATIONS / SPECIES	31-10m	29-8m	28-7m	26-11m	19-14m	14-11m	24-16m	5-10m	17-14m	12-10m	13-13m	32-6m	7-10m	8-9m	22-10m	30-6m	25-12m	21-14m	9-14m	1-18m	6-5m	10-18m	4-16m	23-15m	20-8m	16-6m	15-6m	18-6m	27-4m
1.	Ostracoda									0.1																	1.5	7.4	*	*
2.	Munnidae									0.1																	1.3	*	*	
3.	*Rhodine intermedia*			2.4			0.5			0.2	0.1																87.0	64.3	102.0	3.1
4.	Tanaidacea			0.1	*					*						*			*							0.6	0.4	0.1	9.4	
5.	Cumacea								*								0.1									*	1.5	1.9		
6.	Serolidae						0.5		0.2	0.2	6.6						1.3	0.5			0.1					0.5	26.0	26.2	0.4	0.8
7.	Gastropoda				*			*									*	*								*	2.7	4.1	3.8	4.6
8.	Priapulida				0.2	0.7		*								*	*	0.1		0.2						0.5	*		0.3	
9.	*Yoldia eighsti*								0.1				45.6	5.4	0.6	*	634.5			5.8	5.6		0.1	0.9			496.5	471.8	698.5	34.7
10.	Cirratulidae gen.sp.														2.6		0.2	0.4		5.7	0.1	0.2	0.5	0.3			0.1	0.7	0.5	
11.	*Leitoscoloplos kerguelenensis*				0.2						1.1	*	0.9	0.5	0.2	0.2	2.6	0.3	2.5	1.4	*		0.5	0.2	0.1			5.7	1.0	0.2
12.	Amphipoda	167.9	231.1	231.1	135.8	94.5	186.2	39.7	86.5	34.2	36.2	35.0	9.2	2.0	3.6	3.0	4.1	1.6	0.8	0.2	0.9	1.6	0.6	0.1	3.6	14.0	2.5	2.2	0.6	2.8
13.	Bivalvia			0.1	0.2	0.1	0.1	2.8		0.5	0.9		1.4	13.7	3.2	42.6	5.0	2.1	*	0.4			0.3		1.0	0.4	20.5	63.3	35.3	58.6
14.	Polychaeta	0.2				0.3		0.1	3.3		1.0		0.3	0.1		0.2	0.1	0.1	0.4	0.2		0.1	*			0.1	1.0	2.8	0.9	
15.	*Barrukia cristata*																										60.4		102.1	
16.	*Nacella concinna*																										54.6			
17.	Oligochaeta			*																										*
18.	*Microspio moorei*							*					0.6	0.2	0.2	2.1	0.2	0.1	0.8	0.1	0.8	9.1			7.7	0.1				
19.	*Laternula elliptica*												52.9			8.2	0.3		1.2		115.9						1.6	0.1	46.5	
20.	*Aglaophamus ornatus*												62.4	8.0			66.3	7.8					23.3				27.3	81.1	8.4	
21.	Nemertini					0.1							3.9				49.9		0.5											
22.	*Edwardsia* sp.	298.2	1366.6	1459.3	10.5		0.6		42.8				0.5	8.3	13.6			4.7		10.9	11.6		11.4	0.3		0.1	*			
23.	Bryozoa		0.1																										0.1	
24.	*Odontaster validus*																													
		Assemblage "B-II"			Assemblage "B-I"								**Assemblage "A"**														**Assemblage "C"**			

* biomass (wet weight) below 0.1 g m^{-2}

The abundance [ind. 0.1 m^2] of 24 macrozoobenthos taxa in Herve Cove.

Table 1

No	STATIONS / SPECIES	31-10m	29-8m	28-7m	26-11m	19-14m	14-11m	24-16m	5-10m	17-14m	12-10m	13-13m	32-6m	7-10m	8-9m	22-10m	30-6m	25-12m	21-14m	9-14m	1-18m	6-5m	10-18m	4-16m	23-15m	20-8m	16-6m	15-6m	18-6m	27-4m
1.	Ostracoda									3																	116	477	2	1
2.	Munnidae									5																	84	6	4	
3.	*Rhodine intermedia* Arwidsson, 1911			3			1			2	1								1								210	115	170	2
4.	Tanaidacea			8	1					1						4			2							42	175	12	395	
5.	Cumacea								1								3									1	37	50		
6.	Serolidae						1		3	1	8						5	3			1					3	9	22	3	1
7.	Gastropoda				1			1									1	2								2	6	9	12	19
8.	Priapulida				1	3		1								1	1	1		1						1	2		7	
9.	*Yoldia eighsti* (Couthouy, 1839)								2				3	19	7	1	92			16	1		2	13			59	63	138	4
10.	Cirratulidae gen.sp.														9		5	13		55	7	13	9	12			3	64	16	
11.	*Leitoscoloplos kerguelenensis* (McIntosh, 1885)				2	9					8	1	4	10	1	4	54	3	5	6	1		5	3	1		1	66		2
12.	Amphipoda	754	1418	2014	554	527	921	873	828	313	158	216	111	15	25	25	64	24	5	1	18	4	9	4	15	71	77	18	19	46
13.	Bivalvia			2	4	4	3	82		15	13		13	124	64	285	77	9	1	8			5		6	10	530	951	559	926
14.	Polychaeta	1							4		2		8	2		7	1	4	8	5		2	1			2		18	12	
15.	*Barrukia cristata* (Willey, 1902)																										3		4	
16.	*Nacella concinna* (Strebel, 1908)																										4			
17.	Oligochaeta			3																									5	
18.	*Microspio moorei* (Gravier, 1911)							1					16	19	5	52	5	10	30	3	67	96			179	1				
19.	*Laternula elliptica* (King et Broderip, 1831)												1			9	1		2		1						1	1	1	
20.	*Aglaophamus ornatus* Hartman, 1967												2	1			1	1					3				2	1	1	
21.	Nemertini					1							1				1		1											
22.	*Edwardsia* sp.	61	136	146	2		1		2				1	1	3			1		5	2		1	3		1	1			
23.	Bryozoa		1																										1	
24.	*Odontaster validus* (Koehler, 1906)																											1		
		Assemblage "B-II"			**Assemblage "B-I"**								**Assemblage "A"**														**Assemblage "C"**			

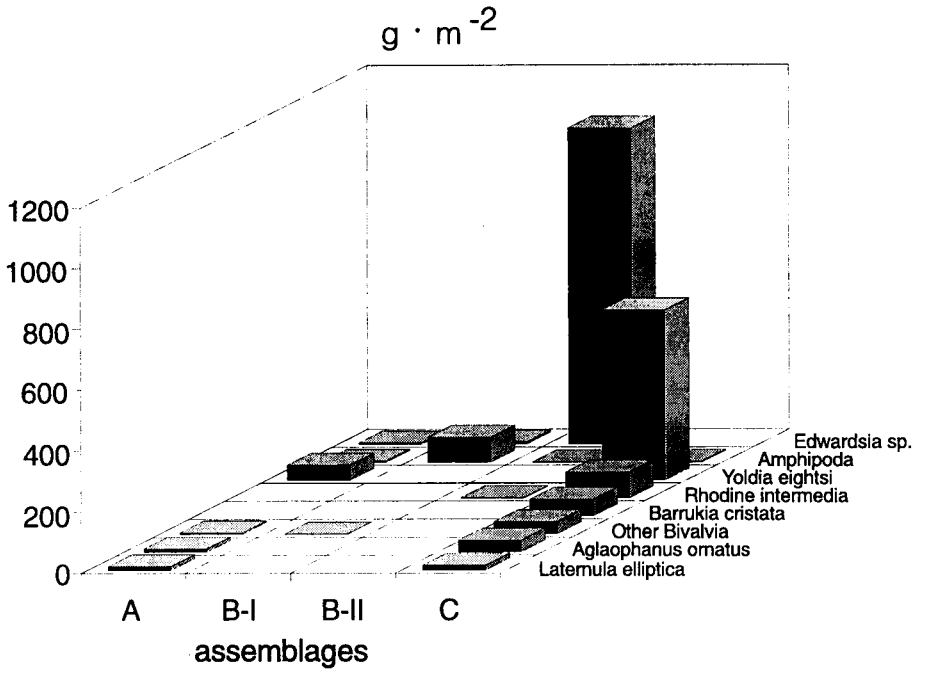

Fig. 7. Wet weight of dominant taxa in four invertebrate assemblages from Herve Cove.

Assemblage "C", from shallow, outer parts of the cove near its entrance was the richest in terms of abundance, biomass and diversity. It was clearly different from the former ones. On the average 15140 individuals per squ. meter were found here. High abundance of zoobenthos was due to many taxa, mainly small Bivalvia, Ostracoda, Tanaidacea and polychaete *Rhodine intermedia*, which constituted 45%, 13%, 13% and 11% of whole assemblage, respectively. Significant share belonged here also to *Yoldia eightsi* (5.7%), Amphipoda (2.5%), Munnidae (Isopoda) (2.1%), Cumacea (1.9%) and polychaetes *Aphelochaeta* sp. (1.8%) and *Leitoscoloplos kerguelenensis* (1.5%). Mean wet weight reached 880 g m^{-2}. The dominant species in terms of biomass was *Yoldia eightsi* which constituted 63% of the whole assemblage biomass; the rest fell to polychaetes, mainly to *Rhodine intermedia* (almost 10%), *Aglaophamus ornatus* (4.4%) and *Barrukia cristata* (6.2%), as well as to small Bivalvia (4.5%), *Odontaster validus* (4.2%), *Nacella concinna* (2.1%), Serolidae (Isopoda) (2.0%) and *Laternula elliptica* (1.8%). High number of taxa of high association index, usually above or equal 95%, was a striking feature of this group of stations. Such taxa were mainly Ostracoda, *Rhodine intermedia*, Munnidae, Cumacea and Tanaidacea. Three species, i.e. *Barrukia cristata*, *Nacella concinna* and *Odonaster validus* were found exclusively in this group of stations. Crustaceans were the most diversified group in this part of the cove.

Table 3

The abundance [ind./1000 m^3] of Herve Cove zooplankton in annual cycle.

DATE / TAXON	10 II	6 III	8 IV	28 IV	28 V	18 VI	4 VIII	19 VIII	3 X	21 X	22 XI	2 XII	15 XII	TOTAL	Mean	[%]	SD
Siphonophora	0	0	0	0	0	0	0	0	0	0	25	0	0	25.0	2.1	0.03	
Nematoda	0	0	0	0	0	0	25	0	0	0	0	0	0	25.0	2.1	0.03	
Pelagobia longicirrata Greeff	0	0	350	0	26.7	0	0	0	0	0	0	0	0	376.7	31.4	0.44	100.6
Chaetosphaera - larvae (Polychaeta)	0	0	850	0	0	0	0	0	0	0	0	0	0	850.0	70.6	1.00	
Limacina helicina f. *antarctica* (Phipps)	0	0	0	0	0	0	0	0	0	0	0	62.5	0	62.5	5.2	0.07	
Alacia belgicae (MĆller)	0	31.2	0	0	0	75	25	50	25	0	0	0	0	206.2	15.9	0.24	24.3
Alacia hettacra (MĆller)	0	0	0	0	0	50	0	0	0	0	0	0	0	50.0	4.2	0.06	
Calanus propinquus Brady	0	0	0	62	0	100	25	25	0	50	75	0	0	337.0	28.1	0.40	35.4
Calanoides acutus Giesbrecht	0	31.2	200	31.2	26.7	0	0	0	0	0	50	0	0	339.1	28.3	0.43	56.9
Rhincalanus gigas Brady	0	0	75	0	0	1100	0	0	0	0	0	0		1175.0	97.9	1.38	316.3
Microcalanus pygmaeus Sars	0	0	0	0	26.7	300	250	0	0	0	350	62.5	25	1014.2	78.0	1.19	129.5
Ctenocalanus citer Heron *et* Bowman	22.2	62.5	3200	5125	160	300	700	1650	75	100	1275	406.2	0	13075.9	1005.8	15.38	1540.9
Stephus longipes Giesbrecht	0	0	0	0	0	0	0	0	0	0	25	0	0	25.0	2.1	0.03	
Euchaeta antarctica Giesbrecht	0	0	25	0	0	0	0	0	0	0	0	0	0	25.0	2.1	0.03	
Scolecithricella glacialis (Giesbrecht)	0	0	0	0	0	25	0	50	0	0	0	0	0	75.0	6.3	0.09	15.5
Racovitzanus antarcticus Giesbrecht	0	0	0	0	0	8000	25	0	0	0	25	0	0	8050.0	670.8	9.48	2308.1
Scaphocalanus spp.	0	0	0	31.2	26.7	0	25	0	0	0	0	0	0	82.9	6.9	0.10	12.6
Metridia gerlachei Giesbrecht	22.2	0	725	1625	133	0	3225	1925	125	75	75	93.7	25	8048.9	619.1	9.47	1014.2
Oithona frigida Giesbrecht	0	0	0	0	0	200	0	25	0	0	50	0	0	275.0	21.2	0.32	55.8
Oithona similis Claus	0	406.2	5000	12500	160	2000	2650	2300	675	550	5750	1687	125	33803.2	2600.2	39.77	3494.5
Oncaea antarctica Heron	0	31.2	0	1000	0	100	0	0	0	0	0	0	0	1131.2	94.3	1.33	286.7
Oncaea curvata Giesbrecht	0	0	1400	1375	0	100	250	125	0	0	100	25	0	3375.0	259.6	3.97	506.1
Harpacticoida	0	62.5	4000	3375	240	400	1800	100	50	1875	75	0	25	12002.5	923.3	14.12	1393.6
Eukrohnia hamata (Mobius)	22.2	31.2	75	31.2	0	25	0	0	0	25	100	0	0	309.6	25.8	0.36	32.1
Sagitta gazellae (Ritter-Zahony)	44.4	0	25	0	0	0	50	25	25	0	0	0	0	169.4	14.1	0.20	19.0
Sagitta marri David	0	0	0	0	26.7	0	0	0	0	0	0	0	0	26.7	2.2	0.03	
Ascidiacea - larvae	0	0	0	0	0	0	0	25	0	0	0	0	0	25.0	1.9	0.03	
Total abundance [ind./1000 m^3]	88.8	531.1	11225	19937	586.4	10825	8025	4500	875	2525	6175	1806	200			100.0	

Table 4

The biomass [g/1000 m^3] of Herve Cove zooplankton.

	10 II	6 III	8 IV	28 IV	28 V	18 VI	4 VIII	19 VIII	3 X	21 X	22 XI	2 XII	15 XII	Mean
Copepoda	15.5	6.2	36.8	42.8	7.5	35.0	32.8	10.0	3.0	7.0	11.8	11.5	3.3	17.2
Chaetognatha	0.2	0.1	0.8		1.5	1.3	4.2	0.3	0.1	0.3	0.8			0.7
Siphonophora											0.5			
L. helicina f. *antarctica*												11.8		
Polychaeta			0.3											0.05
Ostracoda		0.1				1.3	0.1	0.1	0.1					
Ascidiacea - larvae								0.1						
Nematoda							0.1							
TOTAL	15.7	6.4	37.9	42.8	9.3	37.6	37.2	10.5	3.2	7.3	13.1	23.3	3.3	18.9

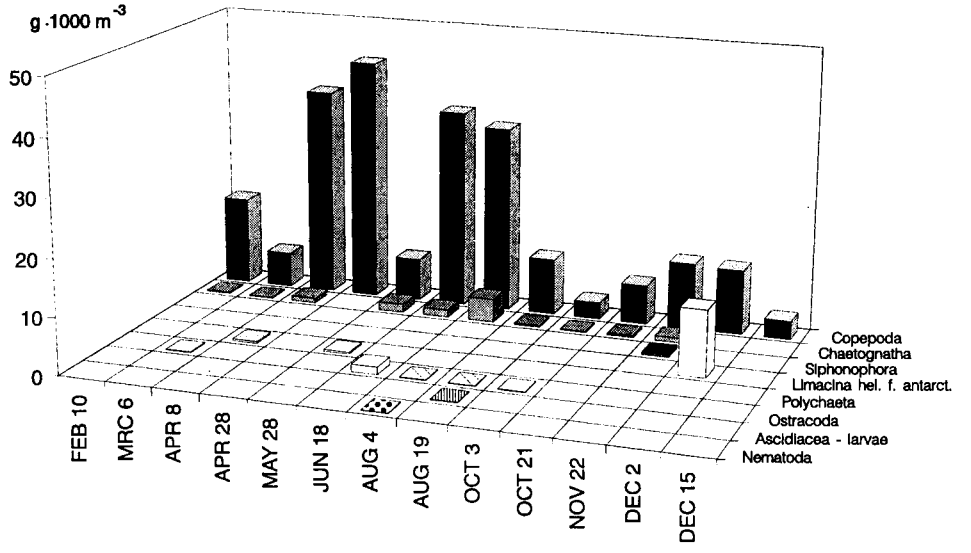

Fig. 8. Wet weight of dominant zooplankton taxa from Herve Cove in annual cycle.

Some remarks of a more general nature can be added to the presented characteristics of the assemblages. The character and structure of the assemblage "A" are in some way created by the influence of a stream. Relatively poor assemblage "B-I", strongly dominated by amphipods, with its low faunistic diversity, is the result of oxygen deficiency in bottom sediments of this part of the lagoon. It is difficult to understand the cause of a very specific structure of assemblage "B-II", very rich in terms of biomass and number of animals and extremely poor in relation to biodiversity. These are actually "meadows" of sea-anemones *Edwardsia* sp., anchored in the bottom, together with a crowd of amphipods. And finally, the most diverse and rich assemblage "C" was clearly under the influence of open waters of Ezcurra Inlet. The infauna was especially rich here and mass occurrence of a burrowing małdanid *Rhodine intermedia* was its another interesting feature.

Zooplankton of Herve Cove in the period of study consisted of Siphonophora, Nematoda, Polychaeta, Copepoda, Ostracoda, Chaetognatha and larvae of Ascidiacea (Tables 3–4). The most abundant were, as expected, Copepoda (Table 3), represented in the collected meterial by 15 species; the most abundant were *Oithona similis*, *Ctenocalanus citer* and *Metridia gerlachei*. Their mean numbers were: 2600, 1000 and 620 ind. 1000 m^{-3} respectively. These three species occurred during the whole year. They constituted about 65% of total zooplankton in respect to the number of individuals. Numerous Harpacticoida constituted further 14%. Other abundant taxa caught irregularly throughout the year, were other species of Copepoda, such as *Racovitzanus antarcticus*, *Oncaea curvata*, *Rhincalanus gigas*, *Oncaea antarctica* and *Microcalanus pygmeaus*. They made

up about 8% of all animals. Still less abundant were Chaetognatha (mainly *Eukrohnia hamata* and *Sagitta gazellae*), Ostracoda (mainly *Alacia belgicae*) and some other species of Copepoda. Quite accidental, found only once in the waters of Herve Cove, were Siphonophora, pteropod *Limacina helicina* f. *antarctica*, larvae of Ascidiacea, Nematoda and polychaete larvae — chaetosphaera. Mean biomass of macrozooplankton of Herve Cove was 19 g of wet weight of animals in 1000 m^3 of water. The main part of biomass (91% of all animals) was constituted by Copepoda (Table 4, Fig. 8).

Discussion

Bottom fauna of Herve Cove appeared to be significantly different from zoobenthos assemblages of shallow sublittoral of open waters in Admiralty Bay, not directly influenced by the glaciers. Such conclusion is derived from the comparison with zoobenthos assemblages presented by Jażdżewski *et al.* (1986). In general one can observe that the bottom fauna of Herve Cove is characterised by low biodiversity (the only one exception was the shallow part of the lagoon, close to its entrance). This is especially true for assemblages "B-I" and "B-II". Another striking feature is a lack of some groups of animals, *e.g.* echinoderms, ascidians and some peracarid crustacean groups common and numerous in the shallow sublittoral of central part of Admiralty Bay. In the zoobenthos of Herve Cove strong dominance of mono-specific populations (*e.g. Edwardsia* sp. or *Cheirimedon femoratus*) is worth noticing. The comparison of Herve Cove fauna with the fauna of shallow sublittoral of open waters in Admiralty Bay in the comparable dephts (Jażdżewski *et al.*, 1986) can lead to the following observations. A significant share in biomass of zoobenthos of the shallowest sublittoral in Admiralty Bay, contrary to Herve Cove, fell to echinoderms, especially sea-urchins (Echinoidea) and starfishes (Asteroidea). Quite similarly at the depth of 15 m, on the northern slope of the moraine isolating Herve Cove from the waters of Ezcurra Inlet Echinodermata constituted almost 55% of zoobenthos biomass whereas echinoderms were nearly absent inside the lagoon. A similarity of fauna of the neighbouring part of Ezcurra Inlet studied by Jażdżewski *et al.* (1986) (station A of the Section III) with the distinguished here assemblage "C" from the southern inner slope of the moraine separating Herve Cove from Ezcurra Inlet can be observed. This similarity consists, among others, in the significant share of Cumacea, Tanaidacea and Isopoda in both compared areas. Further affinities of our assemblage "C" with bottom fauna of station A, section III of Jażdżewski *et al.* (1986) consisted in similar abundance and biomass of zoobenthos. Our assemblage "C", rich and diverse, was the least typical assemblage of the lagoon studied.

There are few data on the zoobenthos assemblages similar to those found in Herve Cove. One exception is Assemblage E distinguished by Richardson and Hedgpeth (1977) in Hero Inlet (Anvers Island) at the depth of 5–7 m. The dominants in this assemblage were, among others, Tanaidacea (*Nototanais antarcticus*), *Edwardsia* sp., *Rhodine loveni*, Cumacea (*Eudorella gracilior*), *Yoldia eightsi* and Amphipoda (*Heterophoxus videns*). Such a composition considerably resembles that of our assemblages "B-II" and "C" of Herve Cove. It is worth noticing that according to Hartmann-Schröder and Rosenfeldt (1989) *Rhodine loveni* can be mistaken with *Rhodine intermedia* and among Cumacea in our material we have found *Eudorella splendida*.

Abundant occurrence of such species like *Yoldia eightsi*, *Eudorella gracilior* and *Rhodine loveni* in the assemblage D at the depths of 15–18 m in Hero Inlet as found by Richardson and Hedgpeth (1977) indicates also to the affinity of the bottom fauna of Hero Inlet (Anvers Island) to the assemblage "C" of Herve Cove.

Information about Antarctic sea-anemones are quite scarce (Sieg and Wägele, 1990). Richardson and Hedgpeth (1977) in Arthur Harbor have found the only large population of sea-anemones in inner part of Hero Inlet. Similarly in Admiralty Bay Herve Cove is so far the only known place of their occurence.

The range of Herve Cove zoobenthos biomass values is very wide. Low values, about 90–95 g m^{-2}, were observed in assemblages "A" and "B-I". They were significantly lower than mean values of wet weight of bottom fauna in shallow sublittoral in Admiralty Bay, which were 200 g m^{-2} in the shallowest sublittoral (0–10 m) and 400 g m^{-2} for depths of 10–50 m (Jażdżewski and Siciński, 1993). On the other hand similar values of biomass (80–90 g m^{-2}) were noted on sandy bottom of shallow sublittoral in Admiralty Bay (Jażdżewski *et al.*, 1986, sections I and II, depth 15 m). Zoobenthos biomass of assemblages "A" and "B-I" can be placed among the lowest values found for soft bottoms of shallow sublittoral in the Antarctic Ocean (Platt 1979, Zamorano 1983, Jażdżewski *et al.* 1986, 1991). It concerns also low values of population densities of the discussed assemblages (compare for example data of Lowry 1975, Dayton and Oliver 1977, Richardson and Hedgpeth 1977, Platt 1979, White 1984 and Jażdżewski *et al.* 1986, 1991). High values of biomass (mean 1250 g m^{-2}) as well as of abundance (mean about 15000 ind. m^{-2}) were characteristic of bottom areas of Herve Cove populated by the assemblage "B-II" dominated by amphipods and sea-anemones. It can be concluded from the literature data that standing crop of zoobenthos from the soft bottom of the most shallow Antarctic sublittoral rarely exceeds the value of 1000 g m^{-2} (Propp 1970, Hardy 1972, Mills and Hessler 1974, Nakajima, Watanabe and Naiyo 1982, Jażdżewski *et al.* 1986, 1991, Jażdżewski and Siciński 1993). The underestimation of biomass of large clam *Laternula elliptica* should be however taken into account. This problem has been already suggested by Hardy (1972), Wägele and Brito (1990) as well as by Jażdżewski and Siciński (1993).

One more interesting feature of benthic fauna of the studied lagoon should be noticed. This fauna is dominated by few eurytopic species. Among Polychaeta they are *Leitoscoloplos kerguelenensis*, *Aglaophamus ornatus* and *Rhodine intermedia*, among Bivalvia — *Yoldia eightsi*. The dominant cumacean in the lagoon was *Eudorella splendida* (det. M. Błażewicz), and among Amphipoda — *Cheirimedon femoratus* (det. K. Jażdżewski). On the other hand some species were significant in terms of abundance and biomass, which are otherwise known to be rare. These are mainly *Microspio moorei*, one of the dominants in assemblage "A", and sea-anemones from the genus *Edwardsia*.

Zooplankton of Herve Cove, similarly to zoobenthos, is characterised by a rather low biodiversity. The number of observed taxa recorded was low and high domination values of few species were observed. Low abundance values of particular taxa and zooplankton as a whole is the next feature of the pelagic fauna of Herve Cove. Fifteen species of Copepoda from the suborders Calanoida and Cyclopoida were here encountered. Chojnacki and Węgleńska (1984) have found over 20 taxa of Copepoda in the directly neighbouring Ezcurra Inlet, whereas Mienshenina and Rakusa-Suszczewski (1992) and Żmijewska (1992) have recorded about 40 taxa of Copepoda in the central part of Admiralty Bay. All copepods from Herve Cove are typically Antarctic species, often found both in Admiralty Bay and in the adjoining waters (Hopkins 1985, Boysen-Ennen 1987, Żmijewska 1994). Ostracoda in Herve Cove were represented by two species: *Alacia belgicae* and *Alacia hettacra*; both common in the waters of Bransfield Strait and Drake Passage (Kock 1992, Błachowiak-Samołyk and Żmijewska 1995). *Eukrohnia hamata*, *Sagitta gazellae* and *Sagitta mari* found in Herve Cove are the most common species of Chaetognatha of the Southern Ocean (David 1958, O'Sullivan 1982, Kittel 1996). Mean biomass of macrozooplankton in Herve Cove (19 g 1000 m^{-3}) was two times lower than mean values given as 40–50 g 1000 m^{-3} (Foxton 1956, Voronina 1984) for the Antarctic waters.

Acknowledgements. — Thanks are due to Dr. M.I. Żmijewska for the identification of Copepoda, to Mr. Edmund Dibowski, skipper of the motor-boat, for his kind help during collection of the material, and to A. Piechura M.Sc. for the information about the amount of the suspended matter. This paper is the result of the collaboration with Department of Antarctic Biology, Polish Academy of Sciences; research was realized during the XVII Polish Antarctic Expedition to the *H. Arctowski* Station.

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Received September 1, 1996
Accepted November 14, 1996

Streszczenie

Herve Cove (Wyspa Króla Jerzego, Szetlandy Południowe, Antarktyka) jest niewielką zatoką o powierzchni ok. 12 ha i maksymalnej głębokości nie przekraczającej 20 m (fig. 1–2). Istotnym rysem sytuacji środowiskowej jest intensywny spływ zawiesiny mineralnej wnoszonej tu przez polodowcowe strumienie oraz wysłodzenie wód zatoki. Średnia roczna zawartość zawiesiny mineralnej w wodach laguny wynosi 46 mg dm^{-3}. Niskie zasolenie wód laguny, zwykle nie przekracza-

jące 26%, stanowi jeszcze jeden charakterystyczny rys panującej tu sytuacji środowiskowej. Częściowa izolacja wód laguny od Ezcurra Inlet stanowi sprzyjający czynnik dla kumulacji drobnoziarnistych osadów. Szczególnie wyraźnie zaznacza się to w zagłębieniach urozmaiconego dna laguny. Na stosunkowo niewielkim obszarze zatoki wyróżniono cztery zgrupowania zoobentosu (fig. 2, 4, 6 i 7). Ich charakter i struktura uwarunkowane są przede wszystkim typem osadów, warunkami tlenowymi i topografią dna. Zgrupowanie „A" stwierdzone w bezpośredniej bliskości strumienia odznacza się skrajnie niską wartością biomasy zoobentosu jako całości, która wynosi 95 g/m^2. Intensywny spływ wody słodkiej oraz zawiesiny mineralnej jest chyba zasadniczym czynnikiem warunkującym charakter tego zgrupowania. Średnia mokra masa zoobentosu zgrupowania „B" jest również niewielka i wynosi ok. 90 g/m^2. Około 90% biomasy stanowią Amphipoda. Zgrupowanie odznacza się bardzo małą różnorodnością i skrajnym ubóstwem infauny. Wysoce swoiste zgrupowanie „BIJ" składa się niemal wyłącznie z dwu, masowo tu występujących komponentów: ukwiałów (*Edwardsia* sp.) i obunogów (głównie *Cheirimedon femoratus*). Mokra masa bezkręgowców osiąga tu wysokie wartości, przekraczające niekiedy 1.5 kg/m^2. Najbogatszym pod względem biomasy, liczebności oraz faunistycznej różnorodności jest zgrupowanie „C" stwierdzone w płytkich, przyujściowych obszarach laguny. Średnia mokra masa wynosi tu 850 g/m^2. Trzon biomasy tworzą *Yoldia eghtsi* oraz wieloszczety, przede wszystkim ryjące *Rhodine intermedia*. Zarówno infauna, jak i epifauna stanowią tu pod względem biomasy i liczebności znaczące elementy zgrupowania. W tej części Herve Cove stwierdzono najbogatszą faunę skorupiaków. Jest to jedyne zgrupowanie (spośród czterech wyróżnionych) wykazujące podobieństwa do fauny dennej bezkręgowców dna piaszczystego otwartych wód Zatoki Admiralicji.

W zooplanktonie Herve Cove stwierdzono przedstawicieli ośmiu grup zoologicznych. Najliczniej reprezentowane były Copepoda — 16 taksonów, łącznie z Harpacticoida. Zdecydowanymi dominantami były: *Oithona similis*, *Ctenocalanus citer*, *Metridia gerlachei*. Są to gatunki, które stwierdzano najliczniej i w ciągu całego sezonu. Chaetognatha reprezentowane były przez 3, a Ostracoda przez 2 gatunki (tab. 3).

Średnia mokra masa zooplanktonu wynosiła 18.9 g/1000 m^3 wody (tab. 4, fig. 8).