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Spitsbergen glacial bays macrobenthos – a comparative study

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Abstract Macrobenthos was studied in seven glacial bays situated along the Spitsbergen coast between 77 and 79°N. The fauna was dominated by deposit-feeding or carnivorous polychaetes and bivalves. Only 4 of 118 species identified in the collected material occurred in all the west Spitsbergen localities examined (the polychaetes *Chaetozone/Tharyx* sp., *Cossura longocirrata*, *Lumbrinereis fragilis* s.l. (sensu lato), and the bivalve *Thyasira flexuosa*). Clustering of samples showed a difference between the faunas of east and west Spitsbergen; the latter formed two subgroups, localities open to Atlantic waters and those from inner fjord basins. The fauna in open basins was dominated by cosmopolitan species, whereas arctic elements shares were higher in inner basins and predominated in the fauna in Bettybukta (east Spitsbergen). This indicates arctic, relict character of the inner fjords sites. The biomass ranged from 6 to 310 g/m^2 and Shannon diversities from 0.49 to 2.54.

Introduction

Spitsbergen, the largest island in the Svalbard archipelago, is known as a place of intensive glacial retreat, a phenomenon that has been considered as a possible sign of regional climate change (Lefauconnier et al. 1994; Jania and Hagen 1996). Most of the fjordic tidal glaciers in the area are regressing at a maximal rate of 0.5 km per year, thus continuously exposing new areas of sea bed. Such places are areas of high environmental disturbance – namely massive freshwater outflow, iceberg scouring and heavy mineral sedimentation (Węsawski et al. 1995), which have all been recognised as strongly affecting benthic fauna distribution and diversity (Pearson 1980; Görlich et al. 1987; Syvitski et al. 1989; Kendall 1994; Holte et al. 1996; Włodarska et al. 1996). The benthic fauna inhabiting such turbid areas has been described from a number of North American (Farrow et al. 1983; Syvitski et al. 1989) and European localities (Gromisz 1983; Gulliksen et al. 1984; Holte et al. 1996; Włodarska et al. 1996). However, there is still a lack of comparative studies and comparisons of existing and published data are difficult due to the inconsistencies in sampling methodology as noted by Kendall (1994). To allow comparability of data from different geographical sites, similar sampling and sample-processing techniques should be used and comparable habitats sampled; this has been especially stressed for comparative studies concerning faunal diversity (Warwick and Ruswahyuni 1987). Differences in sampling devices and in sieving screen size result in differences in taxonomic and quantitative composition of samples (Gage 1975; Huberdeau and Brunel 1982; Bachelet 1985). The present study encompasses a geographically wide range of Svalbard sites representing the same type of habitat and sampled with regard to sampling procedures standardisation. We have focused on the muddy, 30 to 80-m-deep bottom of the Spitsbergen glacial bays and compared the macrobenthic communities for taxonomic and zoogeographical composition, biomass and diversity. It is assumed that such turbid environments within the same geographical region would host the same simple, pioneer, physically controlled macrofaunal assemblage. We were interested in whether the similarities in environmental characteristics of these distinct habitats were accompanied by similarities in macrobenthos content.

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Materials and methods

Study area

A glacial bay, as defined in the present work, is an embayment originating at the face of an active tidal glacier. Glacial bays occur on Spitsbergen both on the exposed open ocean coast and in inland fjord basins. The present study was carried out in seven basins: Bettybukta, Skoddebukta, Yoldiabukta, Ekmanfjord, Tempelfjord, Kongsfjord (at Kongsvegen) and Julibukta, all of which experience the presence of a tidal glacier. They are U-shaped coastal basins ranging in depth from 20 to 180 m. The Spitsbergen glacier bays studied range in size from 0.5 to 10 km in width and from 1 to 10 km in length. The tidal glaciers are of the actively retreating subpolar "warm" type (Baranowski 1968; Jania and Hagen 1996). Following glacial retreat due to melting and calving, glacial bays grow in some cases up to 0.5 km per year (Lefauconnier et al. 1994). The areas of sea bed examined have been uncovered by glaciers for the last few decades (in Kongsfjord, 25 years, Hagen et al. 1993). Hence they are young habitats in terms of faunal succession.

The sediments were composed mostly of fine sediments. The pelite fraction composed over 90% in all bays excluding Skoddebukta (82%) (Table 2). Fine-grained deposits originate from the settlement of sediment from the surface meltwater plume. The fine sediment covering the sea bed in the bays investigated is of varied mineral origin – coloured light grey from siliciclastic minerals (Bettybukta) through brownish (Skoddebukta) to reddish-brown from carbonate-feldspar minerals (Kongsfjord).

The near-bottom water salinity on stations ranged from 33.2 to 34.5 PSU; the temperature of this layer varied from −1.43 to 0.74°C (Table 2). A negative temperature and salinity over 34 PSU indicate the presence of "old winter water" formed during the freezing of surface waters in the previous autumn (Swerpel 1985; Sagan and Moskal 1986). This water layer is well aerated (Swerpel 1985). Sometimes the cold winter water may persist the year round in semi-isolated basins; in other cases it gets mixed and warms up during late summer (Węsławski et al. 1991).

Waters in the bays investigated contain large amounts of inorganic suspensions from glacial discharge. Elverhoi et al. (1983) reported 300–500 mg/l of sediment in the surface plume decreasing to 25–50 mg/l in the bottom layers and 1–5 mg/l in the central and outer parts of Kongsfjorden. In the localities studied, the surface suspension concentrations ranged from 9 to 101 mg/dm^3 (Table 2). The mineral sedimentation was estimated at up to 9 g/m^2 per day in Sassenfjorden in spring by Węsławski et al. (1993); in Kongsfjorden up to 250 g/m^2 per day was observed at the peak of summer discharge (M. Zajączkowski, personal communication).

Macrofauna

Samples were collected from R/V "Oceania" in Bettybukta in July 1992 and in six glacial bays off west Spitsbergen in July 1994. In each basin sampling sites were selected at varying distances from the glacier cliffs (from 0.5 to 4 nm) and at various depths (from 30 to 80 m) (Table 1).

Macrofauna was sampled using a van Veen grab sampler of 40 × 40 cm catching area, sieved on 0.5-mm mesh screen (with the exception of Bettybukta – 1 mm) and preserved with a 4% formaldehyde solution. In the laboratory all the animals found in a sample were weighed (wet formaline mass). Organisms were identified and counted. The polychaetes *Chaetozone* sp., *Tharyx* sp. and *Cauleriella* sp. were grouped into *Chaetozone*/*Tharyx* sp. The species were classified according to Gajewska (1948) and Klekowski and Węsławski (1991, 1992) into four zoogeographical groups: arctic, arctic-boreal, boreal and cosmopolitan. Percentages of animals of different zoogeographical status in the total faunal abundances were calculated for the basins examined. The multivariate analysis was applied to species abundance data using the PRIMER package. The data were double root transformed and Bray-Curtis similaritites were calculated. Ordination (non-metric multidimentional scaling – MDS) and classification (using group average linking) of samples were performed. Groups of samples were distinguished based on the resultant dendrogram and MDS plot. Species with the highest frequency (> 75%) and significant dominance (> 1%) within a group were identified as characteristic of that group. The Shannon-Wiener index of diversity (log e) was calculated for each sample. The expected number of species in a sample of 100 individuals [E(S100)] was calculated by Hurlbert's (1971) rarefaction method using the BIODIVERSITY package.

Results

Annelids made up 48%, molluscs 25% and crustaceans 14% of 118 taxa found in the material examined, most of them being identified to the species level. Regarding the number of individuals, annelids made up 62% of the fauna, molluscs 28% and crustaceans 2%. The most prominent taxa are listed in Table 3. Four species occurred in all bays excluding Bettybukta: *Chaetozone*/*Tharyx* sp., *Cossura longocirrata*, *Lumbrinereis fragilis* s.l. and *Thyasira flexuosa*. Eight species occurred on over 50% of the stations sampled: *Chaetozone*/*Tharyx* sp., *Cossura longocirrata*, *L. fragilis* s.l., *Thyasira flexuosa*, *Nuculoma tenuis*, *Yoldiella fraterna*, *Aglaophamus malmgreni* and Fabricinae ND. In Skoddebukta, *Chaetozone*/*Tharyx* sp. made up 33% of the total abundance, *Cossura longocirrata* 27% and *Yoldia hyperborea* 11%. In Kongsfjord the dominating species were: *Cossura longocirrata* (37%) and *Chaetozone*/*Tharyx* sp. (36%); in Julibukta, *Chaetozone*/*Tharyx* sp. (33%) and *Thyasira flexuosa* (12%); in Ekmanfjord: *Yoldiella fraterna* (34%), *L. fragilis* s.l. (13%) and *N. tenuis* (12%); in Tempelfjord: *Chaetozone*/*Tharyx* sp. (34%) and *Yoldiella fraterna* (28%); in Bettybukta: *Rhabdaminia abysorum* (74%) and *Portlandia arctica* (10%); and in Yoldiabukta: *Chaetozone*/*Tharyx* sp. (59%) and *L. fragilis* s.l. (20%).

Twenty-nine species were classified as arctic species, 33 arctic-boreal, 4 boreal and 13 cosmopolitan. Thirty-Seven taxa were not classified. The *Chaetozone*/*Tharyx* sp. group was classified as cosmopolitan as it was dominated (probably in over 80%) by cosmopolitan *Chaetozone setosa* and the other species included in it are either cosmopolitan or boreal species. In all bays (excluding

Table 1 Stations sampled characteristics

Bay	Number of stations	Depth range (m)	Glacier front distance range (nm)
Skoddebukta	3	30–75	1.3–1.9
Kongsfjord	2	50–70	0.3–1
Julibukta	2	30–50	0.5–2
Ekmanfjord	3	30–55	3–4
Tempelfjord	3	40–70	0.7–3
Bettysbukta	3	40–80	1–2.5
Yoldiabukta	3	57–75	0.7–1.7

Table 2 Near-bottom water salinity and temperature (from Lech and Walczowski 1994), inorganic suspensions concentration in surface waters and sediment granulometry (from Zajączkowski, personal communication) measured on studied stations

Bay	Near-bottom salinity (PSU) Min-max	Near-bottom temperature (°C) Min-max	Inorganic suspensions (mg/l) Min-max	Granulometry		
				% pelite (< 0.063)	% sand (1–0.063)	% gravel (> 1)
Skoddebukta	33.5–34.5	−0.46–0.74	8.8–26.8	81.7	13.2	5.1
Kongsfjord	34.1–34.2	−0.65–−1.03	37.3–101.4	94.8	2.8	2.4
Julibukta	33.94[a]	−0.14[a]	17.2–28.7	95.8	2.5	1.7
Ekmanfjord	33.2–33.6	−0.72–0.34	8.8–31.6	92.7	5	2.4
Tempelfjord	33.5–34.1	−0.85–0.41	22–34	95.9	2.5	1.6
Bettysbukta	34.2–34.4	−0.5–0.1	15–35	–	–	–
Yoldiabukta	34.2–34.3	−1.4–−1.43	10.1–40.8	91.2	6.4	2.4

[a] One station sampled

Table 3 Mean abundances of selected species in the bays studied. The list is composed of species represented by more than 20 individuals/m^2 in at least one bay (*A* Annelida, *C* Crustacea, *M* Mollusca, *F* Foraminifera)

Species	Kongsfjord	Julibukta	Yoldiabukta	Ekmanfjord	Tempelfjord	Skoddebukta	Bettybukta
Aglaophamus malmgreni (A)	39		52	22	44		
Axinopsida orbiculata (M)	6		4	33			
Capitella capitata (A)		100			15	11	
Chaetozone/Tharyx sp. (A)	739	988	1359	226	1193	763	
Cossura longocirrata (A)	767	241	100	22	170	622	
Dacrydium vitreum (M)				15	44		
Diastylis lucifera (C)				37	4		
Eteone longa (A)	6	44	4		22	48	
Eudorella emarginata (C)	6		4	37			4
Fabricinae ND (A)	172		74	93	119		
Heteromastus filiformis (A)		6	11	119	4		
Leitoscoloplos armiger (A)	6	255			33	167	
Levinsenia gracilis (A)		96	19		22		
Liocyma fluctuosa (M)							52
Lumbrinereis fragilis s.l. (A)	11	39	467	363	178	22	
Macoma calcarea (M)		135				4	
Maldane sarsi (A)		7			4	4	52
Melita formosa (C)						22	
Miliolina sp (F)		6		52	144		
Myriochele oculata (A)		44	4	30	7		
Nuculana pernula (M)		22					4
Nuculoma tenuis (M)		66	11	330	78	22	
Ophelina cylindricaudata (A)			4	81			
Paraonis sp (A)	11	96	19	4	11		
Pectinaria hyperborea (A)		6				37	
Pontoporeia femorata (C)		29			4	26	
Portlandia arctica (M)							267
Pseudoscalibregma parvum (A)						30	
Rhabdaminia abyssorum (F)							1000
Syllis cornuta (A)				37	15		
Terebellides stroemi (A)		61		15	4		
Thyasira flexuosa (M)	39	321	7	107	126	104	
Unciola leucopis (C)		22					
Yoldia hyperborea (M)	6	96				256	
Yoldiella fraterna (M)	6		59	926	985		15
Yoldiella lenticula (M)	189		4	15	48		

Bettybukta) the zoogeographical species composition was very similar, with around 20% arctic elements, 20–30% cosmopolitan, 20–40% arctic-boreal and up to 5% boreal species. In the exceptional Bettybukta, arctic species made up 30%, arctic-boreal 40% and cosmopolitan and boreal elements 4% each. Regarding the quantitative composition, cosmopolitan species dominated the fauna in most bays (Fig. 1) (excluding Ekmanfjord and Bettybukta) mainly as a result of dominance by *Chaetozone/Tharyx* sp. (33% of total abundance on average). Other important cosmopolitans in those localities were *Cossura longocirrata*, *Leitoscoloplos armiger*, *Eteone longa*, *Aglaophamus malmgreni* and *Terebellides stroemi*. Both dominants in Bettybukta, *R. abysorum* and *P. arctica*, are classified as arctic species, and therefore this zoogeographical class dominated very strongly the fauna in this

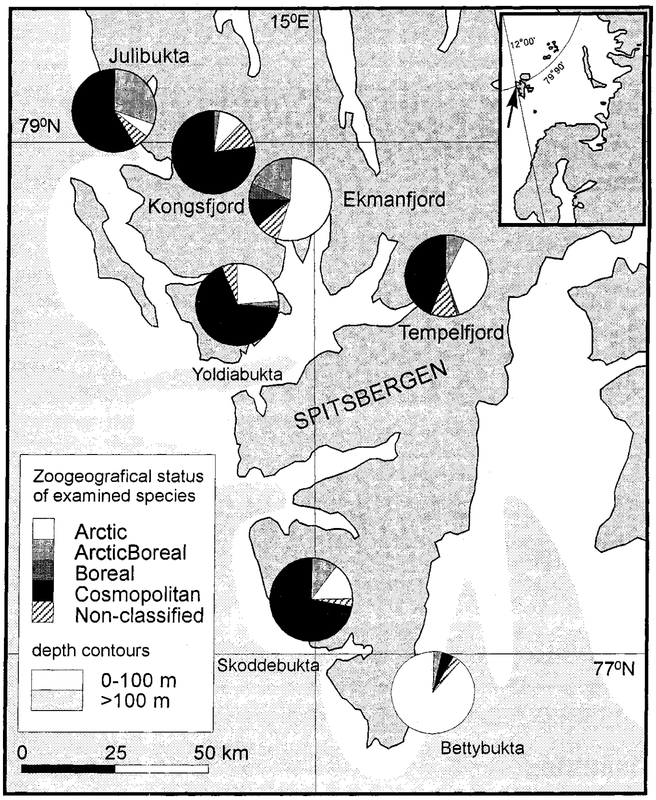

Fig. 1 The contribution of percentages of animals of different zoogeographical status to the total faunal abundance in studied bays

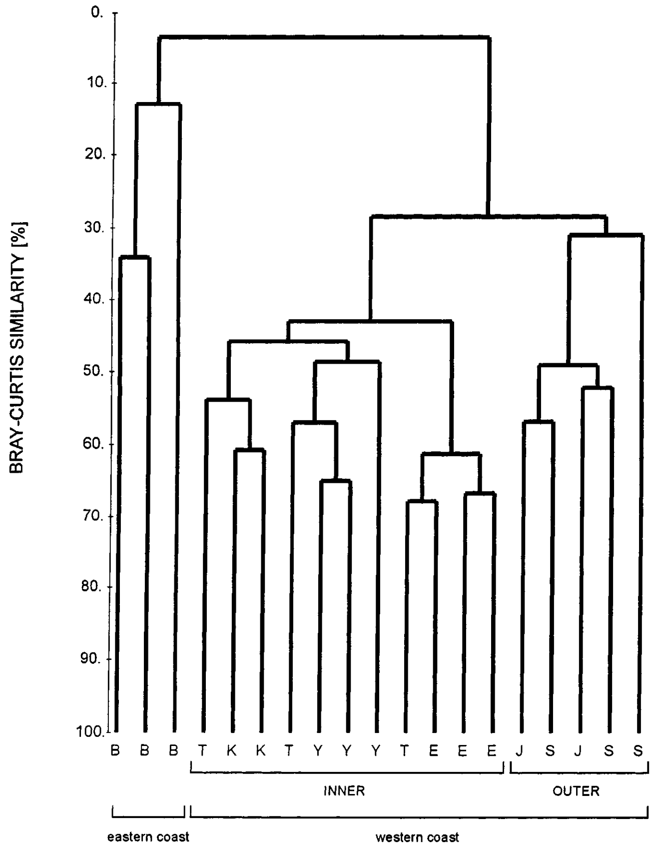

Fig. 2 Dendrogram resulting from cluster analysis of samples: *B* Bettybukta, *E* Ekmanfjord, *J* Julibukta, *K* Kongsfjord, *S* Skoddebukta, *T* Tempelfjord, *Y* Yoldiabukta

bay (89% of individuals). Arctic elements dominated fauna in Ekmanfjord (55%), Tempelfjord (38%) and Yoldiabukta (24%), with *Lumbrinereis fragilis* s.l. and *Yoldiella fraterna* as the most prominent arctic species. Their shares in the total faunal abundance did not exceed 15% in the other three bays.

The total faunal abundance exceeded 1000 ind./m^2 on most stations; the highest value, 4133 ind./m^2, was recorded in Tempelfjord (Table 3). The biomass ranged from 6 g/m^2 in Yoldiabukta to 310 g/m^2 in Skoddebukta. The number of species per sample varied from 10 (Kongsfjord and Bettybukta) to 32 (Ekmanfjord). The lowest diversity measured both by the Shannon index (0.43) and by the Hurlbert index (6) was observed in Bettybukta. In the west Spitsbergen bays, Shannon diversities varied from 1.49 (Kongsfjord) to 2.54 (Skoddebukta), and Hurlbert indices from 8 (Kongsfjord) to 20 (Ekmanfjord).

Both cluster and MDS analysis showed that the samples from Bettybukta differed greatly from samples from the western coast of Spitsbergen (Figs. 2, 3). Among the western coast samples two groups were distinguished: (1) samples from Skoddebukta and Julibukta (referred to as OUTER assemblage); (2) samples from the other basins which were inner fjords and bays of Kongsfjord and Isfjord (referred as to INNER assemblage).

Chaetozone setosa, *Cossura longocirrata* and *Thyasira flexuosa* dominated fauna in both groups. In addition, *Leitoscoloplos armiger* s.l., *Nuculoma tenuis*, *Eteone longa* and *Yoldia hyperborea* were identified as characteristic species for the OUTER group and *Aglaophamus malmgreni*, *Yoldiella fraterna*, *Lumbrinereis fragilis* s.l. and Fabricinea ND. for the INNER group.

Discussion

The material presented does not give the full list of species inhabiting glacial bays of Spitsbergen. Both the spatial range, limited to a single specific habitat (muddy bottom influenced by an active glacier, 30–80 m deep), and the small number of stations sampled in a bay do not permit the presentation of a complete description of the benthos of each bay studied. The number of species obtained in the present study for Skoddebukta (39) shows the limitations of our material, since extensive sampling in the same area by Włodarska et al. (1996) reported the occurrence of 109 species there. The list presented includes 118 species, which makes up a modest fraction of the entire Spitsbergen shelf benthos, reported by Gulliksen and Holte (1992) to comprise almost 1000

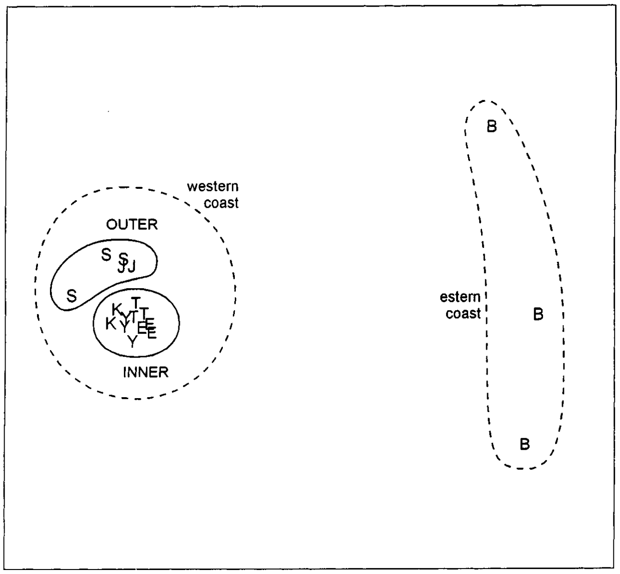

Fig. 3 MDS plot resulting from ordination of samples: *B* Bettybukta, *E* Ekmanfjord, *J* Julibukta, *K* Kongsfjord, *S* Skoddebukta, *T* Tempelfjord, *Y* Yoldiabukta

species. However, we have focused on the presentation of the most common and abundant species, that dominate the glacial bay macrofauna. The separation of sampling sites in a bay by hundreds of meters resulted in low similarity of samples; rare species were variable, but the common species remained constant. The set of the most common species found in the present study is also reported by other researchers from the Svalbard fjords (Gromisz 1983, 1992; Kendall 1994; Holte et al. 1996). The most prominent taxa (dominating numerically in almost all sites) were *Chaetozone/Tharyx* sp. dominated by *Chaetozone setosa*, which has been also reported to dominate the fauna in the young bays of Brepollen originating from the regression of Hyrnebreen and Storbreen (Gromisz 1992). Holte et al. (1996) suggested that *Chaetozone/Tharyx* sp. (which was also dominated by *Chaetozone setosa*), the most abundant and stable taxa in Adventfjord, was an indicator of the glaciofluvial outflow-induced disturbances in this basin when compared with the non-glaciated Gronfjord. This opportunistic, eurytopic species, which inhabits different types of substrate and tolerates a wide range of salinities (Gajewska 1948), seems to have adapted very well to the stressful conditions provided by the glaciated Spitsbergen bays.

The fauna was dominated by annelids and molluscs with regard to both the number of species and the number of individuals and had low numbers of crustaceans. Similar proportions were observed in Gronfjord and Adventfjord by Holte et al. (1996). Görlich et al. (1987) observed that polychaetes dominated the faunal biomass in glacier-impacted parts of Hornsund. The results obtained by grab-sampling (van Veen grab sampler in our case) can underestimate the presence and quantities of highly mobile epifaunal organisms. In studies of glacier-influenced basins employing other methods (dredge, underwater photography), the dominating infaunal polychaets and bivalves are often accompanied by abundant populations of motile crustacean or ophiuroid species well adapted to such an environment (Syvitsky et al. 1989; Włodarska et al. 1996). Among the species common to the bays studied and dominating the fauna in most samples, we observed deposit-feeding polychaetes and bivalves (*Chaetozone/Tharyx* sp., *Cossura longocirrata*, *Yoldia hyperborea*, *Yoldiella fraterna*, *Thyasica flexuosa*) and a large carnivorous polychaete (*Lumbrinereis fragilis*). This agrees with a general trend of increasing domination of deposit-feeding infauna with a decreasing distance from the glacier and an increasing level of glacier activity (Farrow et al. 1983; Syvitsky et al. 1989; Holte et al. 1996; Włodarska et al. 1996). The factor responsible for such a structure of macrofauna communities in glacier bays is inorganic material carried by glacier meltwaters; this is stressful to suspension feeders, affecting their feeding processes by the dilution of nutritious suspensions and the clogging of filtering organs (Moore 1977).

Benthic biomass in shallow Arctic coastal waters varies from a few grams to several kilograms per square meter, with the maximum values found on rocky substrates inhabited by large epifaunal animals (Curtis 1975). The biomass of glacial bay communities dominated by species of small body size is much lower. The higher values observed in Skoddebukta and Julibukta resulted from the number of large bivalves (*Macoma calcarea* and *Yoldia hyperborea*) occurring in these bays. Görlich et al. (1987) attributed the low faunal biomass in the forefields of glaciers to the scarcity of food available to sediment-ingesting organisms resulting from low levels of primary production and the dilution of organic matter in the sediment by intensive inorganic sedimentation. Both the sampling gear used (grab sampler) and the small numbers of samples taken may result in some underestimation of the whole macrofauna biomass. Most of the biomass comes from large, usually rare, and often highly motile animals. There was an example of this in Ekmanfjord, where the biomass of one specimen of Ascidiacea made up half of the total faunal biomass recorded at this station.

All the diversity measures used showed a large range of values. We did not find any relation between the diversity and the position of the site sampled as described by the cited environmental factors values, its latitude or its distance from the open ocean. The differences in the diversity of macrofauna in similar environments have been often attributed to differences in inorganic sedimentation levels (Kendall and Aschan 1993; Włodarska et al. 1996). The surface inorganic suspension concentration was not correlated to diversity in our study; however, this is not the best indicator of the amount of inorganic matter reaching the bottom at a particular site. The ranges of values of the most popular diversity measure, the Shannon index, observed in the bays studied and reported for different Spitsbergen glacial or

Table 4 Biological parameters in the bays studied (*A* abundance ind./m^2, *B* biomass g ww/m^2, *S* number of species per sample, *H* Shannon Index, *E(S100)* Hurlbert index per 100 individuals)

Bay	A	B	S	H	E(S100)
Skoddebukta	489	22	19	2.54	–
	2178	161	13	1.50	11
	3100	310	23	1.75	14
Kongsfjord	1644	11	10	1.49	8
	1944	6	16	1.49	11
Yoldiabukta	1222	4	13	1.48	12
	3500	8	17	1.26	11
	1933	6	19	1.64	14
Julibukta	2533	147	27	2.22	18
	2571	91	17	2.30	15
Ekmanfjord	1622	15	21	2.22	16
	1344	23	25	2.31	18
	1689	171	32	2.27	20
Tempelfjord	4133	11	29	1.85	16
	1044	19	25	1.96	16
	1522	6	19	2.01	14
Bettybukta	178	–	10	2.11	–
	3022	–	10	0.43	6
	1256	–	12	1.27	11

glaciofluvial bays are similar (Table 5). The comparison of our results with most of the cited data is difficult due to differences in sampling methodology. Kendall and Aschan (1993) who used a similar grab sampler and the same sieve mesh size (0.5 mm) as we did reported Shannon diversities exceeding the range of values observed in our study. This can be explained by lighter sedimentation regimes provided by the retreated glacier-fed river Gipselva in Sassenfjorden in comparison to active glacier-influenced bays.

The species composition was not dominated by any zoogeographical group. Similar results obtained for molluscs by Rózycki (1990) allowed him to classify the west Spitsbergen area as the transition zone between arctic and boreal regions. Dunton (1992) included Spitsbergen (together with, for example, southwest Baffin Bay, Iceland, southeast Greenland and the Chukchi Sea) in ecotones – boundary areas between truly arctic and non-arctic waters, characterised by reduced winter ice cover, net positive temperatures and the predominance of north Pacific or north Atlantic water masses. The arctic conditions may, however, still prevail in the innermost semi-enclosed basins with weak water exchange with the ocean. While the zoogeographical status of the fauna studied was quite similar regarding species composition, the proportions of individuals representing arctic species varied from around 10% of the total faunal abundance in the sites that we can classify as open to the influence of Atlantic water masses to 40–50% in Yoldiabukta, Ekmanfjord and Tempelfjord – the inner basins of Isfjord. We suggest that this indicates their more arctic, relict character and restricted transport of Atlantic waters to these sites. A similar situation was observed by Gulliksen et al. (1984) in Van Mijenfjord, where arctic fauna inhabited the innermost part of the fjord where cold and dense water was trapped behind two sills. Similarly, Węsławski (1981) described an arctic-dominated fauna in Brepollen, the innermost site studied in Hornsund, and an increasing domination of arctic-boreal components towards the outlet of the fjord. Arctic elements were also observed in several semi-enclosed basins with entrapped cold water masses along the Norwegian coast (Brattegard 1980).

The Bray-Curtis similarity index clusters the stations in a similar manner to the zoogeographical division, forming INNER and OUTER groups of samples taken at west Spitsbergen localities. Therefore, it seems that the composition of zoobenthos in the sites studied can be attributed to the level of the relative influence of the

Table 5 Ranges of Shannon index (*H*) recalculated for log e, from different glacial or glaciofluvial Spitsbergen bays at depths up to 80 m (*1* Kendall-Aschan 1993 *2* Gromisz 1983 *3* Włodarska et al. 1996 *4* Gulliksen et al. 1984 *5* Holte et al. 1996

Site	Depth	H
Seven bays, present study	30–80	0.43–2.54
Sassenfjord (1)	30–95	2.6–2.9
Hornsund at Hyrnebreen (2)	5–53	0.7–1.38[a]
Hornsund at Storbreen (2)	18–37	1.2–2.07[a]
Skoddebukta (3)	2–60	0.38–2.49
Van Mijen fjord (4)	25–75	2–2.5[a]
Raudfjord (4)	25–75	2.7–3.2[a]
Adventfjord (5)	26–52	1.38–1.79

[a]Values taken from charts

West Spitsbergen Current. However, since the presence of the Atlantic water masses of this current in the shallow shelf waters of west Spitsbergen is questioned (A. Beszczyńska-Möller unpublished work), it might influence the fauna not by creating hydrological regimes here but by supplying larvae. Wildish (1977) suggested that colonising larval supply and interspecific competition were the major factors controlling the sublittoral benthic community composition when the physical parameters could be ignored. According to Pearson (1980), the curtailment of the free exchange of planktonic larvae with open coastal waters may affect the development of benthic communities in fjords. The glacial bay beds are young habitats, recently (in the successional time scale) exposed to the colonisation of species that are able to live in the highly unstable, stressful conditions provided by the presence of an active glacier. The potential pool of larvae of different species is connected with the distance between the site studied and the open ocean with the West Spitsbergen Current water masses.

The Bettybukta fauna demands special attention as it differs significantly from the communities of the other sites studied. The quantitative differences must stem from the larger sieve mesh size used; however, the major qualitative differences are probably connected with the position of Bettybukta on the east coast of Spitsbergen, influenced by the cold, arctic East Spitsbergen Current waters (Tantsiura 1959). In that region there is still a lack of benthic studies (apart from Brotskaia's 1930 paper on the central part of Storfjorden). Our results suggest that the faunas of the western and eastern banks of Spitsbergen differ significantly. This needs to be verified by more extensive studies in the east Spitsbergen coastal waters.

Conclusions

Glacial bays are physically distinctive habitats, characterised by cold and dense near-bottom water, silty sediment, high mineral sedimentation rates and young sea bed. The physical similarities are accompanied by similarities in macrobenthos content. The fauna is dominated by deposit-feeding polychaetes and bivalves. The low number of samples taken in a given bay resulted in the low number of species common to all localities, but the set of the dominants was similar in all west Spitsbergen bays; one of them – *Chaetozone*/*Tharyx* sp. dominated by eurytopic, opportunistic polychaete *Chaetozone setosa* – significantly dominated the fauna in all basins. The relatively low biomass is a common feature of the communities studied, while diversity is variable. The inner fjordic areas have more arctic character, which is supposed to be a relict from the changing hydrological conditions during the last century. The similarity of inner bays fauna as opposed to the open coast localities may be connected with the impeded transport of larvae to these places and a different potential pool of species accessible to colonise the young sea bed of glacial bays.

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