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Common macrofaunal dominant species in the sediments of some north Norwegian and Svalbard glacial fjords

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Abstract Based on own data from the north Norwegian Holandsfjord and two Svalbard fjords (the Van Mijenfjord and the Raudfjord), and literature data from three other fjord regions at Svalbard, soft-bottom communities are analysed and discussed in order to identify common and numerically dominant species in glacier-derived fine-particulated inorganic impacted sediments. The most abundant common taxa in the inner and presumed most glacier-impacted parts of the Holandsfjord, the Van Mijenfjord and the Raudfjord were the surface-feeding detrivorous polychaetes *Laonice cirrata*, *Chaetozone setosa*, *Myriochele* sp. and *Terebellides stroemi*, the subsurface-feeding detrivorous polychaetes *Scoloplos armiger*, *Ophelina acuminata*, *Maldane sarsi* and *Praxillella* spp., the carnivorous polychaete *Lumbrineris* sp., and the subsurface detrivorous bivalves *Yoldiella lenticula*, *Nuculoma tenuis*, *Nuculana pernula* and *Thyasira*. In addition to these taxa, results from the other reviewed surveys in Svalbard indicate that glacier-influenced fjords may also be numerically dominated by the presumed surface-feeding detrivorous polychaete *Levinsenia gracilis*, the subsurface-feeding detrivorous polychaete *Heteromastus filiformis*, the carnivorous polychaetes *Harmothoe* and *Aglaophamus malmgreni*, and the subsurface-feeding detrivorous bivalves *Yoldiella frigida*, *Yoldiella nana* and *Portlandia arctica*. The generally quite frequent *Heteromastus filiformis*, *Maldane sarsi* and *Praxillella*, which feed head down at some depth in the sediments, may contribute, through selective feeding and recycling of organic carbon by depositing faecal products at the sediment surface, to the maintenance of relatively high faunal abundances in the organically poor sediments of glacier-influenced fjords.

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Introduction

Fjords with glaciers are known to be seasonally influenced by finely particulated inorganic material originating from glacial-derived melt-water. This influence affects the benthic environment and generally increases towards the head of the fjords where the major glacier melt-water outflows are usually located (e.g. Elverhøi et al. 1983; Görlich et al. 1987; Syvitski 1989). The present paper is based on the combined data from quantitative benthic investigations along the length of two such fjords at Svalbard (re-analyses of original records collected by Gulliksen et al. 1985) and one at the Norwegian mainland (Holte 1998), which are discussed in concert with the results from other relevant published quantitative surveys in Svalbard fjords (Weslawski et al. 1990; Gromisz 1992; Kendall and Aschan 1993). The aim is to contribute to an identification of species which might be quite common and frequent in the glacier-derived inorganic impacted sediments of north Norwegian and Svalbard glacial fjords.

Area and Environment

Topography and oceanography

The 30-km-long Holandsfjord, located in Nordland county, Norway, has two major basins with maximum depths of 195 and 240 m and maximum sill depths of 50 and 100 m, respectively, and one minor basin at the fjord head with a maximum depth of 90 m and a maximum sill depth of 60 m (Fig. 1). The salinity usually ranges from 4‰ in the surface water to 35‰ in the bottom water, while the lowest temperature below sill depth has been recorded as 3.5°C (Molvær et al. 1994).

The 22-km-long Raudfjord is located on the northern coast of Spitsbergen, Svalbard, and has a single basin with a maximum depth of 233 m and a maximum sill depth of 130 m (Fig. 1). The twin-basined and 50-km-

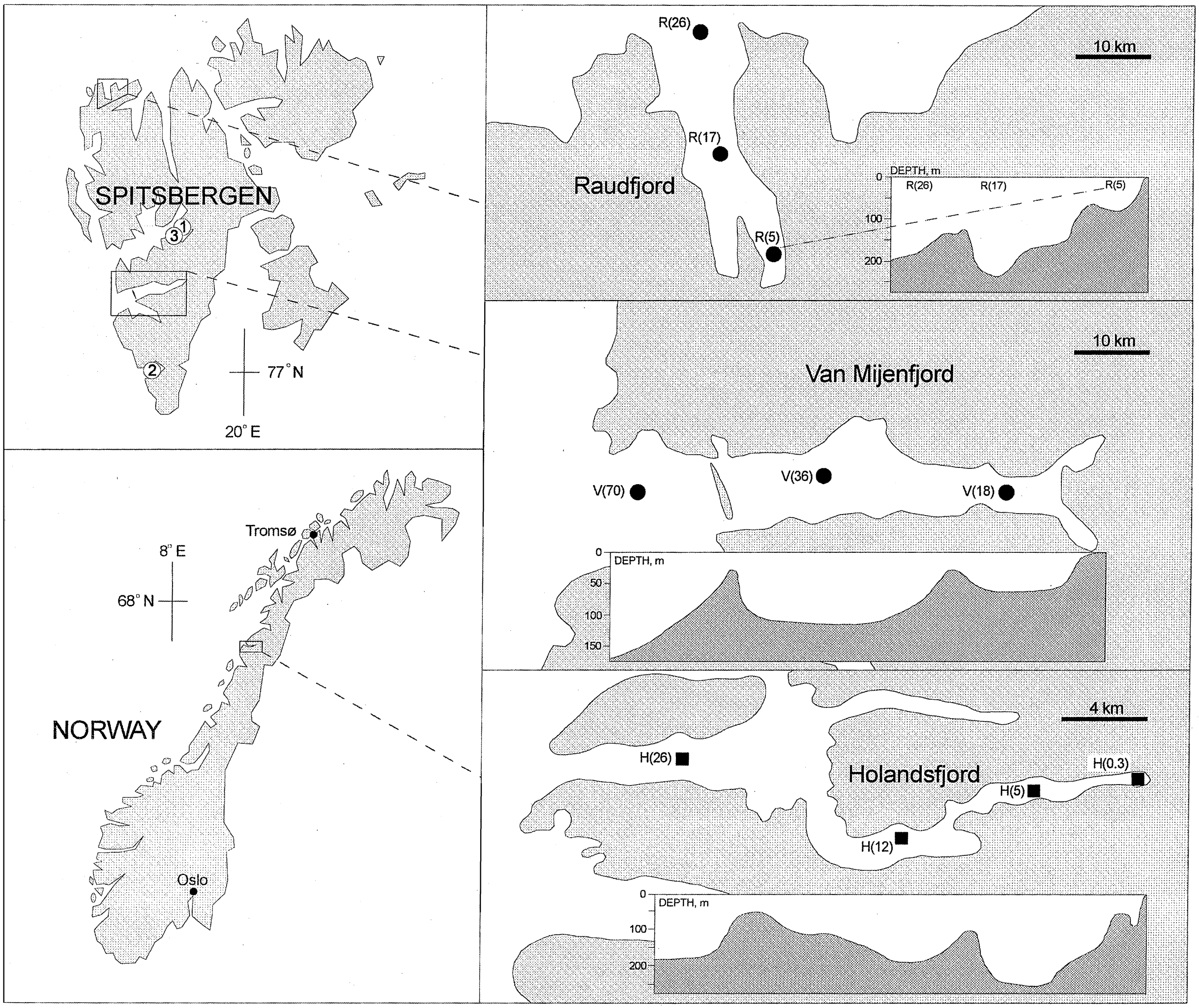

Fig. 1 The location of the reviewed sampling stations in the Holandsfjord, the Raudfjord and the Van Mijenfjord. The locations in the Svalbard fjords, where two sampling stations were included for each location, are marked with *filled circles*, while the sampling locations in the Holandsfjord, consisting of one station for each sampling year, are marked with *filled squares*. The name of the locations includes distance (km) from the respective fjord heads shown in *parentheses*. Other investigated areas in Spitsbergen fjords, with results discussed in the text, are shown: *1* Gipsvik Bay (Weslawski et al. 1990); *2* the Hornsund fjord (Gromisz 1992); *3* the Sassenfjord (Kendall and Aschan 1993)

long Van Mijenfjord is located on the southwest coast of Spitsbergen and has maximum depths of 96 and 60 m with maximum sill depths of, respectively, 30 and 45 m. In the basin of the Raudfjord, Gulliksen et al. (1985) recorded bottom water temperatures of −1.8°C and in the Van Mijenfjord, −1.5°C in the inner basin and 1.3°C in the outer basin. The salinity of the bottom water of both fjords ranged between 33 and 34‰. The mouth of the Van Mijenfjord is partly blocked by an island (see Fig. 1). Compared to the Holandsfjord and Raudfjord, the presence of this island reduces water exchange between the Van Mijenfjord and the coastal shelf waters.

The basin water in all the three fjords is probably exchanged during the winter by both vertical convection and an inflow of oceanic water with relatively high density (Elverhøi et al. 1983; cf. Normann and Pettersen 1984; Molvær et al. 1994). The vertical convection (especially in the two Spitsbergen fjords) is probably caused mainly by the freezing of seawater at the surface and a subsequent sinking of relatively heavy (high salinity) and oxygen-rich water to the bottom. In the Holandsfjord, Molvær et al. (1994) recorded well-oxygenated bottom water masses throughout the year (minimum oxygen concentration was 6.2 mg l^{-1}).

Sedimentation and sediments

An accumulated sedimentation of 0.8–1.6 cm $year^{-1}$ has been recorded at the innermost sampling location in the Holandsfjord (Molvær et al. 1994). Over a geological time scale, an accumulated sedimentation in the inner basin of the Van Mijenfjord was calculated by Elverhøi et al. (1983) to be 1–2 cm $year^{-1}$, while 0.1–0.2 cm $year^{-1}$ was calculated in the outer part of both the Van

Mijenfjord and the Raudfjord. These estimates indicate, together with the results presented by Görlich et al. (1987), Syvitski (1989) and Swerpel (1992), that the fjords at Svalbard have relatively high inorganic sedimentation rates. Görlich et al. (1987) claimed that sedimentation rates of up to 35 cm year^{-1} may occur locally, close to the source glaciers. Thus, in general, a gradient of increasing sedimentation with decreasing distance from the fjord heads may occur within glacier-influenced fjords. Results from in situ measurements of sedimentation rates in Spitsbergen fjords are not available. Gulliksen et al. (1985) presumed that the sedimentation rates in the Raudfjord and the Van Mijenfjord increase from the outer margin of the fjords to their heads while Molvær et al. (1994) recorded glacier-derived inorganic impacts in the innermost part of the Holandsfjord.

Through visual observation of the sediments, Gulliksen et al. (1985) and Holte (1998) suggested that the generally clay-silt dominated sediments in the three studied fjords in general were oxygenated (light grey sediments without any smell of H_2S) throughout the sampled sediment column (approximately 15 cm). The total organic carbon content (TOC) in the sediment surface (0–2 cm) of the Holandsfjord varied between 7 and 11 mg · g^{-1} while 21.5 mg · g^{-1} was recorded in the outer margin of the fjord. Such sediment data from the Raudfjord and the Van Mijenfjord (or other pristine Svalbard fjords) are not available. In general, however, glacially derived sedimentation from turbid fjord water probably dilutes and rapidly buries organic material in the bottom sediments and is also believed to be the main sediment source for fine grained deposits in glacial fjords (Elverhøi et al. 1983; Görlich et al. 1987).

Materials and methods

The field sampling in the Holandsfjord was carried out at four stations on 15–16 May 1991, 23–24 April 1992 and 14 October 1994. The depth of each station and their distance from the fjord head were 95 m and 0.3 km, 240 m and 5 km, 195 m and 12 km and 180 m and 26 km (Fig. 1). The two most distant stations relative to the fjord head were, however, not sampled in 1994. Four fauna samples were taken at each station and for each sampling year using a 0.1-m^2 van Veen grab.

Gulliksen et al. (1985) sampled 18 stations in the Raudfjord and 12 stations in the Van Mijenfjord, each with 3 replicate 0.1-m^2 van Veen grab samples. In each of the fjords, the sampling stations were arranged along three transects that went transversely relative to the shore from a depth of 25 m to the deepest part of the fjords. To achieve comparable data with the Holandsfjord, where the stations were located in the deepest part of the fjord, the results from the two deepest stations in each transect were studied (Fig. 1). The depths and distances from the fjord heads of these two deepest stations were, in the Raudfjord, 50 and 75 m and 5 km, 200 and 225 m and 17 km, 150 and 175 m and 26 km, and in the Van Mijenfjord, 50 and 75 m and 18 km, 75 and 100 m and 36 km, and 125 and 150 m and 70 km. Stational data sets were not presented by Gulliksen et al. (1985); their original records were therefore reanalysed. Apart from the classification analysis where stational data were used (3×0.1 m^2) (see below), the data from each pair of stations (i.e. 6×0.1 m^2) were combined and treated as one data-set, which is referred to as a "location" (see Fig. 1). This term is also occasionally used for the sampling stations in the Holandsfjord.

Faunal diversity was calculated using the Shannon-Wiener index (H, log$_2$-bas; Shannon and Weaver 1963) and the Hurlbert rarefaction function where the expected number of taxa was calculated after sampling 100 individuals (ES100; Hurlbert 1971). However, due to a maximum number of sampled individuals of 66 at the innermost location in the Van Mijenfjord, ES66 was additionally calculated for all 3 locations for this particular fjord. Multivariate classification was carried out using the Bray-Curtis coefficient calculated from double square root transformed fauna data (Rohlf 1989). The analysis was carried out on the original station data from the Van Mijenfjord and the Raudfjord, including three replicate samples per station, and the Holandsfjord where four replicates per station were sampled (the samples were unfortunately lumped before identification of fauna). This difference in sample size cannot be eliminated due to "species-area" -effects, but was reduced by converting the fauna data to number of individuals per square meter before the classification analysis. Thus, the interpretation of the resulting dendrogram was mainly restricted to identifying faunal similarity within each of the three fjords involved (and not between-fjord comparisons involving the Holandsfjord).

Both Gulliksen et al. (1985) and Holte (1998) sieved the sediment samples through round-holed 1-mm-mesh-sized sieves.

Results

One hundred and fifty-seven different taxa occurred in the data-sets from the three fjords of which the polychaetes and bivalves were the most abundant groups. Thirty-one taxa were represented both in the data from Svalbard (the Raudfjord and/or the Van Mijenfjord) and the Holandsfjord. Of these, 12 taxa were among the 10 most abundant ones present both in the data from Svalbard and the Holandsfjord (in total 41 "top 10" dominants were recorded, see Table 1).

Taking only the innermost sampling locations in each fjord into account, 114 different taxa were recorded, of which 16 occurred both in the Svalbard data and the data from the Holandsfjord. Two taxa, the polychaetes *Lumbrineris* sp. and *Chaetozone* spp. (may also comprise individuals of the genera *Tharyx* and *Caulleriella*), were present as top ten dominants at the innermost locations in all the three fjords and were the only taxa that were present at all the reviewed sampling stations (Table 1). Although less frequent, the following taxa were also well represented in all the three fjords: Nemertini indet., *Laonice cirrata*, *Scoloplos armiger*, *Ophelina acuminata*, *Myriochele* sp., *Maldane sarsi*, *Praxillella* spp. (at least 2 species), *Terebellides stroemi*, *Yoldiella lenticula*, *Nuculoma tenuis*, *Nuculana pernula*, *Thyasira equalis* and *Thyasira* spp. In contrast, the following taxa occurred as top-ten dominants in the Holandsfjord while they were absent from the Svalbard data: *Levinsenia gracilis*, *Prionospio cirrifera*, *Pseudopolydora paucibranchiata*, *Ceratocephale loveni*, *Jasmineira candela*, *Thyasira minuta*, *Kelliella miliaris* and *Yoldiella lucida*. *Heteromastus filiformis* was also highly dominant specifically in the Holandsfjord, but did occur – although only in one individual – in the data from Svalbard. Fourteen of the

Table 1 Number of individuals per square metre and assumed feeding strategies for the ten most frequently occurring taxa at each sampling location shown as distance from the heads of the Norwegian Holandsfjord (average abundance per sampling year; after Holte 1998) and the Svalbard fjords Raudfjord and Van Mijenfjord (see Fig. 1 for identification of stations). The presented taxa are manually sorted relative to their abundance in each fjord from left to right in the table. The "top-ten" selected abundances are shown in *italics*. The average number of totally sampled individuals per sampling year in the Holandsfjord (0.4 m^2), and the total number of sampled individuals in the Svalbard fjords (0.6 m^2) are shown at the bottom of the table (*B* bivalves; *G* Gastropoda; *P* Polychaetes. Suspensivorous taxa are marked "$*$").

Surface-feeding detrivores	No. of individuals m^{-2} relative to distance from the fjord heads									
Subsurface-feeding detrivores	Holandsfjord				Raudfjord			Van Mijenfjord		
Carnivores	0.3 km	5 km	12 km	26 km	5 km	17 km	26 km	18 km	36 km	70 km
Levinsenia gracilis (P)	*1471*	5	*135*	6						
Heteromastus filiformis (P)	*659*	*546*	*139*	*65*					2	
Prionospio cirrifera (P)	*221*	26	*256*	23						
Ceratocephale loveni (P)	*154*	*215*	29	1						
Pseudopolydora paucibranchiata (P)	3			*11*						
Thyasira minuta (B)		*288*	*279*	5						
Yoldiella lucida (B)		*43*	*63*	*36*						
Jasmineira candela (P)*				*14*						
Kelliella miliaris (B)*				*11*						
Myriochele sp. (P)	*589*	*133*	*151*	6	3		12			*63*
Maldane sarsi (P)	*318*	*530*	324	3	*205*	*60*	*22*		2	*18*
Chaetozone spp. (P)	*318*	4	41	4	*138*	*130*	*58*	*3*	*47*	*40*
Praxillella spp. (P)	*221*	*75*	29			*28*	2		3	
Scoloplos armiger (P)	*163*	1	56		3	*88*	*43*			*85*
Lumbrineris sp. (P)	*117*	*395*	*194*	9	*135*	*165*	*33*	*23*	*82*	*177*
Terebellides stroemi (P)	1	*106*	53	*59*	5	8	10	*2*		*15*
Aricidea spp. (P)	7	*43*	53	3					*17*	
Yoldiella nana (B)		18	*118*	*25*				*3*	*12*	
Yoldiella lenticula (B)	48			*51*	8		2	*2*		*22*
Thyasira sp. (B)		2	1	*10*	*152*	*178*	*18*		2	
Thyasira equalis (B)			1	*10*	*48*	*63*	8		*72*	3
Nemertini indet.	17	23	4	1	*12*	*17*	2	*2*	5	10
Laonice cirrata (P)	7				*10*	*33*	7		*12*	3
Nuculoma tenuis (B)	26		3		*277*	10	*23*		*110*	2
Nuculana pernula (B)				6	*33*	5	*73*		*8*	12
Eteone flava/longa (P)	5							*2*		5
Ophelina acuminata (P)		1	6	1	2	*68*	*97*		2	*18*
Macoma calcarea (B)(*)					*48*		*22*			
Yoldia hyperborea (B)					8	2	*18*			
Lysippe labiata (P)					8	2			2	*15*
Maldanidae indet. (P)					5	*17*	12			
Retusa sp. (G)					3			*2*		
Ampharete finmarchica (P)					2	3	*18*			3
Portlandia arctica (B)						8		*28*		
Yoldiella frigida (B)						2		*8*	*68*	
Bathyarca glacialis (B)*						2		*2*	2	12
Ciliatocardium ciliatum (B)*							7			*20*
Harmothoe sp. (P)							4	*3*	2	8
Hiatella arctica (B)*							2	*2*		
Aglaophamus malmgreni (P)								*28*	3	
Dacrydium vitreum (B)*									*73*	
Total no. of sampled individuals	5413	3161	1607	341	691	545	335	66	375	359

top-ten dominants in the Svalbard data were absent from the Holandsfjord. The remaining 3 of 41 top-10 dominant taxa in total (Table 1), *Aricidea* sp., *Eteone flava/longa* and *Yoldiella nana*, were present only in the data from the Holandsfjord and the Van Mijenfjord.

Although *Terebellides stroemi* appeared with only 1 individual m^{-2} at the innermost station in the Holandsfjord and was scarcely represented, or absent, from two of the locations in the Van Mijenfjord, it was nevertheless, together with *Lumbrineris* sp. and *Chaetozone* spp., the only top-ten species that was represented throughout all the three fjords. Among the 21 top-10 selected taxa in the Holandsfjord (see Table 1), 6 showed their highest abundance at the innermost sampling stations, namely *Levinsenia gracilis*, *Heteromastus filiformis*, *Myriochele* sp., *Chaetozone* spp., *Praxillella* spp. and *Scoloplos armiger*. Of these, only one taxon (*Chaetozone*) had a similar quantitative position at the innermost location in the Raudfjord where *Maldane sarsi*, *Macoma calcarea* and *Nuculoma tenuis* also occurred with high abundances specifically at the innermost sampling locations. At the innermost location in the Van Mijenfjord, where all the sampled taxa were top-ten selected, three taxa (*Aglaophamus malmgreni*, *Retusa* sp. and *Portlandia arctica*) occurred with their highest abundance compared to the other locations in the Van Mijenfjord. Thus, the faunal differences among the top-ten dominating taxa in the innermost part of the respective fjords may generally be associated with some very abundant surface- and subsurface-feeding detrivorous polychaetes found in the Holandsfjord, some subsurface-feeding detrivorous bivalves found in the Raudfjord, and some particular protobranch detrivorous bivalves and carnivorous polychaetes in the Van Mijenfjord.

In the Holandsfjord and the Raudfjord the number of taxa and the total abundance increased markedly from the outer part of the fjords to the innermost parts while the Shannon-Wiener diversity index and the Hurlbert ES100/ES66 index decreased from, respectively, 4.1/4.0 to 3.2 and from 26.6/25 to 15–16 (Fig. 2). In contrast, the number of taxa and total abundance in the Van Mijenfjord decreased significantly from the outer to the inner part, as did also the diversity indices (see Fig. 2). Recalling that the Holandsfjord was sampled three times with four grab samples per location while the Svalbard fjords were sampled once with six grab samples per location (three samples per original station), it was noticed that the number of taxa at the innermost locations were 40, 33 and 14 in, respectively, the Holandsfjord, the Raudfjord and the Van Mijenfjord. Thus, the relatively high number of taxa at the innermost location in the Holandsfjord is probably influenced by the relatively high number of samples taken here (in total 12 grab samples), while the low number of taxa in the Van Mijenfjord is certainly realistic compared to the Raudfjord. Also, the results from the classification analysis clearly separate the respective fjord locations with regard to distance from the fjord head (Fig. 3). In particular, it was noted that the innermost location in the Van Mijenfjord only showed 15% similarity compared to all the other stations in both the Holandsfjord and the Raudfjord, while the similarity between the Holandsfjord and the Svalbard fjords otherwise was 24%.

Discussion

The composition of benthic communities within glacier-affected fjords seems generally to change with distance from the glacier-fed river outlets that are usually located at the fjord heads. Farrow et al. (1983) found the epifauna of steep rocky fjord walls within the Knight Inlet, British Columbia, to profoundly decrease in abundance and number of species with increased amounts of gla-

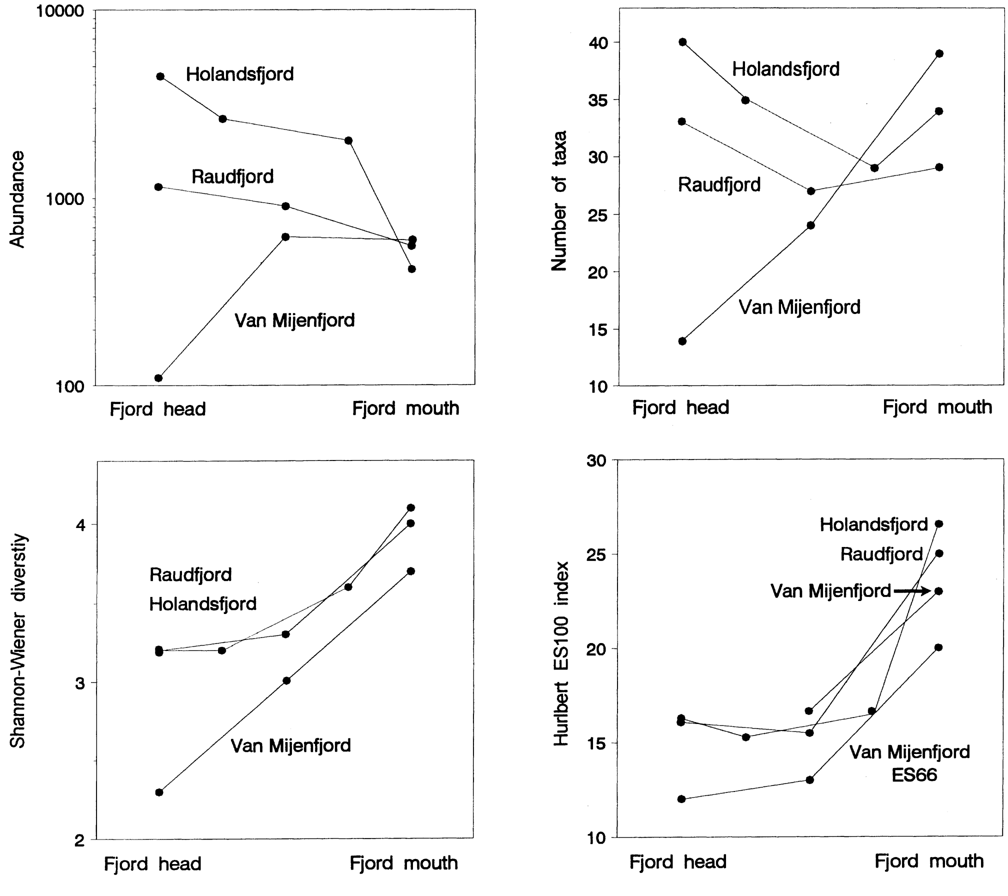

Fig. 2 Abundance (no. of individuals per square metre), number of taxa, the Shannon-Wiener diversity index and the Hurlbert ES100 value at the sampling locations in the Holandsfjord, Raudfjord and Van Mijenfjord

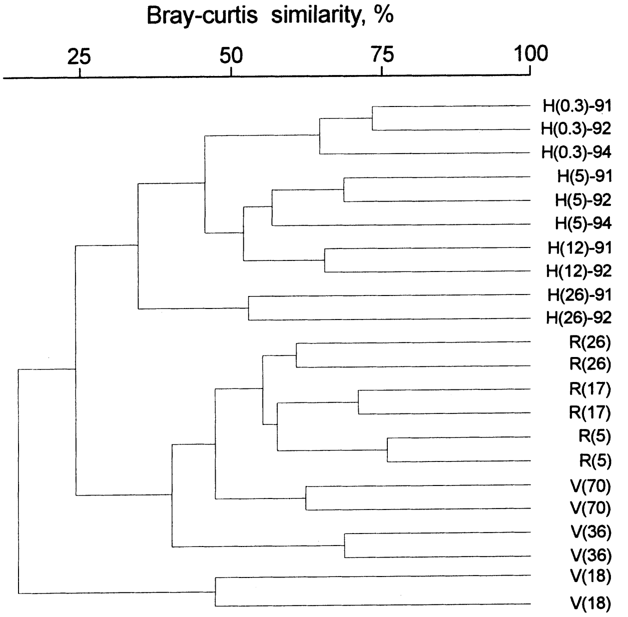

Fig. 3 Dendrogram showing the results from the classification analysis. The two neighbouring sampling stations per "location" (see text) in the Van Mijenfjord (*V*) and the Raudfjord (*R*) are shown specifically with identical station names (see Fig. 1). The sampling stations in the Holandsfjord (*H*) are shown for each sampling year. Due to different sample sizes, the fauna data were converted to abundance per square metre, thus leaving a possible "species-area" effect left between the Holandsfjord (0.4 m^2 per station) and the Svalbard fjords (0.3 m^2 per station)

cier-derived inorganic sedimentation towards the fjord head. Similarly, Görlich et al. (1987) recorded a significantly decreased faunal richness close to the head of the Hornsund fjord at Svalbard (Fig. 1), where the benthic biomass ranged from ca. 180 g · m^{-2} (wet weight) in the outer part of the fjord to below 1 g · m^{-2} at 150-m depth close to the fjord head. A parallel to these results seemed to occur in the Van Mijenfjord where the total faunal abundance decreased from 625 individuals m^{-2} in the middle part of the fjord (36 km from the fjord head), to the quite low 110 individuals m^{-2} in the inner part (5 km from the fjord head) while, by contrast, the abundance in the Raudfjord and the Holandsfjord increased towards the innermost sampling locations from 558 to 1152 and from 426 to 4511 individuals m^{-2}, respectively (Fig. 2).

The dramatically reduced abundance in the inner part of the Van Mijenfjord may indicate that this fjord is more influenced by inorganic sedimentation than the Raudfjord, and this was also physically indicated by the calculated sedimentation rates made by Elverhøi et al. (1983). The very low representation of tube-building polychaetes (*Myriochele* sp. and *Maldane sarsi*, see Table 1) in the sediments at the inner part of the Van Mijenfjord is believed to reflect the assumed very high sedimentation rates which, in addition to increased physical instability, may contribute to a restricted species richness as a result of fast and lethal burial of larvae and juveniles (Rhoads and Young 1970; cf. Davies 1993). Similarly, the suspensivores were scarcely represented at the innermost location in the Van Mijenfjord (Table 1), probably due to elevated inorganic sedimentation (Moore 1977) and, periodically, resuspension of poorly compacted sediments that typically occur in glacial fjords (Syvitski et al. 1987). *Macoma calcarea* is known as both a suspensivore and detrivore, which may reflect its tolerance to particulate material and thus its occurrence as a top-ten dominant both at the innermost and outermost locations in the Raudfjord.

Although the recorded sedimentation rates in the Holandsfjord (Molvær et al. 1994) were similar to the estimated sedimentation rates in the inner basin of the Van Mijenfjord (Elverhøi et al. 1983), the difference in faunal abundance between the innermost locations of these fjords is striking. Holte (1998) suggested that the relatively high abundance in the Holandsfjord might be an effect of recycling of organic material by faecal deposits at the sediment surface mainly made by the deep subsurface-feeding polychaetes *Heteromastus filiformis* and *Maldane sarsi* (see Neira and Höpner 1994). In contrast to the Van Mijenfjord, such a recycling effect may also have taken place in the inner part of the Raudfjord where *Maldane sarsi* was a numerical dominant (*Heteromastus filiformis* was almost absent from both the Svalbard fjords). Based on these observations, and the discussions and results from Elverhøi et al. (1983), Gulliksen et al. (1985), Syvitski (1989) and Holte (1998), the inner part of each of the three studied fjords obviously represent the most affected fjord zones with regard to glacier-induced fine-particulated sedimentation.

Presumably, the most abundant taxa at the innermost sampling locations in the Holandsfjord, the Raudfjord and the Van Mijenfjord are relatively tolerant to glacier-derived inorganic sedimentation and also to the presumed specific ecological regimes formed in such sediments. Of these taxa, the polychaetes *Lumbrineris* sp. and *Chaetozone* spp. were the only taxa that occurred as top-ten dominants at the innermost location in all the three fjords. Representatives for the cirratulid group *Chaetozone* spp. are well-known opportunists and have been recorded with high abundances in physically disturbed and organic polluted sediments (Hily 1987; Feder and Jewett 1988). *Chaetozone* has been recorded as numerically highly dominant also in other quantitative soft-bottom studies in Svalbard fjords (Weslawski et al. 1990; Gromisz 1992; Kendall and Aschan 1993; Holte et al. 1996) (Table 2). It was thus interesting to learn that this taxon was almost absent at the innermost location in the Van Mijenfjord. *Heteromastus filiformis* is another opportunistic species known to occur with high abundances in organically polluted sediments (Pearson and Rosenberg 1978). This species was quantitatively very dominant in the inner part of the Holandsfjord but seems generally to be scarce in the Svalbard fjords.

Seven of the numerically dominant species recorded in the Holandsfjord, the Raudfjord and the Van

Table 2 The ten most frequent taxa at the innermost sampling locations of the Holandsfjord, Raudfjord and Van Mijenfjord, including the most numerically dominant taxa from other relevant quantitative surveys in Svalbard fjords (for Gipsvik, only polychaetes in "heavy sedimentation areas" are shown; for Sassenfjord, numerically top-ten dominant taxa that occurred at two or more stations are shown). Apart from Hornsund, from which only polychaetes were presented, all these works comprised whole communities. For the Van Mijenfjord, the seven shown taxa are the only ones that were recorded in more than one specimen (i.e. more than 2 specimen m^{-2}, see Table 1) [carnivores are marked with two asterixes (**). *B* bivalves; *P* polychaetes]

Raudfjord, Svalbard (Gulliksen et al. 1985)	Van Mijenfjord, Svalbard (Gulliksen et al. 1985)	Gipsvik, Svalbard (Weslawski et al. 1990)	Hornsund, Svalbard (Gromisz 1992)	Sassenfjord, Svalbard (Kendall and Aschan 1993)	Holandsfjord, Norway (B. Holte 1998)
Chaetozone setosa (P)	*Aglaophamus malmgreni* (P)**	*Astarte montagui* (B)	*Anaitides groenlandica* (P)**	*Chone duneri* (P)	*Ceratocephale loveni* (P)**
Laonice cirrata (P)	*Chaetozone setosa* (P)	*Chaetozone setosa* (P)	*Antinoella sarsi* (P)**	*Cirratulidae* indet. (P)	*Chaetozone setosa* (P)
Lumbrineris sp. (P)**	*Harmothoe* sp. (P)**	*Lumbrineris fragilis* (P)**	*Chaetozone setosa* (P)	*Cossura longocirrata* (P)	*Heteromastus filiformis* (P)
Macoma calcarea (B)	*Lumbrineris* sp. (P)**	*Maldane sarsi* (P)	*Harmothoe imbricata* (P)**	*Lumbrineris tetraura* (P)**	*Lumbrineris* sp. (P)**
Maldane sarsi (P)	*Portlandia arctica* (B)	*Nephtys ciliata* (P)**	*Lumbrineris fragilis* (P)**	*Maldane sarsi* (P)	*Maldane sarsi* (P)
Nemertini indet.**	*Yoldiella frigida* (B)	*Terebellides stroemi* (P)	*Scoloplos armiger* (P)	*Nuculoma tenuis* (B)	*Myriochele* sp. (P)
Nuculana pernula (B)	*Yoldiella nana* (B)	*Thyasira flexuosa* (B)	*Spio filicornis* (P)	*Levinsenia gracilis* (P)	*Levinsenia gracilis* (P)
Nuculoma tenuis (B)				*Scoloplos armiger* (P)	*Praxillella* sp. (P)
Thyasira equalis (B)				*Terebellides stroemi* (P)	*Prionospio cirrifera* (P)
Thyasira sp. (B)				*Yoldiella fraterna* (P)	*Scoloplos armiger* (P)

Mijenfjord (Table 1) have also been recorded as numerical dominants in the Svalbard glacial fjords Gipsvik (Weslawski et al. 1990), Hornsund (Gromisz 1992) and Sassenfjord (Kendall and Aschan 1993) (see Table 2 and Fig. 1). Apart from the carnivorous *Lumbrineris* sp., these are *Chaetozone* spp., *Levinsenia gracilis*, *Scoloplos armiger*, *Maldane sarsi*, *Nuculoma tenuis* and *Thyasira* spp./*equalis*. *Lumbrineris* and *Chaetozone* were, however, the only numerical dominants in all six reviewed fjords (Table 2) and were, by Kendall (1996), as well found to be typical genera in sediments in open waters around Svalbard. The community in the Hornsund fjord showed relatively few common dominants with the other fjords, probably because three out of five sampling sites were located in small bays just outside the fjord, where the influence from coastal shelf waters is relatively high.

Each of the 22 remaining taxa shown in Table 2 occurred in only 1 of the fjords/bays. These taxa are, therefore, probably not very tolerant to highly glacier-influenced environments. However, the assumed relatively great glacier-derived sedimentation in the inner part of the Van Mijenfjord implies that some of the sampled taxa at this location, specifically thrive in environments exposed to heavy glacier-induced sedimentation. Excluding the taxa sampled in one individual (2 individuals m^{-2} in Table 1) and the carnivores, these taxa comprised the protobranch bivalves *Portlandia arctica*, *Yoldiella frigida* and *Yoldiella nana*.

Out of the 41 numerically most dominant taxa (top-10 abundants) in the Holandsfjord, the Raudfjord and the Van Mijenfjord (Table 1), 8 are probably climatically restricted to either Arctic or boreal Atlantic regions. *Portlandia arctica*, *Yoldia hyperborea and Ciliatocardium ciliatum* are known as high Arctic species that have not been recorded in boreal waters (Warén 1989; A. Warén, personal communication). *Lysippe labiata* is recorded south to Finnmark county, North Norway (Holthe 1986), while *Ceratocephale loveni* is recorded north to Finnmark (B. Holte, own observation). *Pseudopolydora paucibranchiata*, *Jasmineira candela* and *Kelliella miliaris* are not known to have been recorded in Svalbard waters.

Conclusion

In contrast to the Van Mijenfjord, gradients of increasing faunal abundance and species richness may occur towards the heads of the Holandsfjord and the Raudfjord. The innermost sampling locations generally were numerically dominated by detrivorous polychaetes and subsurface-feeding bivalves. Probably, these results reflect an annually occurring intensive, and for some species – particularly in the Van Mijenfjord – lethal, glacier-induced sedimentation. The sediment communities at the innermost sampling locations in the Raudfjord and the Holandsfjord are believed to be less affected than the community at the innermost location in the Van Mijenfjord, thus allowing the establishment of relatively complex and carbon-conserving communities comprising some selectively and subsurface-feeding detrivorous polychaetes and bivalves that dispose their faecal deposits on the sediment surface (Cadee 1979; Clough and Lopez 1993; Holte 1998). In general, the reviewed glacier-influenced fjord locations at Svalbard and North Norway (see Table 2) seem to be numerically dominated by the deep subsurface-feeding detrivorous polychaetes *Heteromastus filiformis*, *Maldane sarsi* and *Praxillella* spp., the subsurface-feeding detrivorous polychaete *Scoloplos armiger*, the surface-feeding detrivorous polychaete *Levinsenia gracilis*, the carnivorous polychaetes *Aglaophamus malmgreni*, *Harmothoe* and *Lumbrineris*, the subsurface detrivorous protobranch bivalves *Yoldiella frigida*, *Yoldiella nana*, *Nuculoma tenuis*, *Portlandia arctica*, and representatives of the subsurface detrivorous lamellibranch bivalve genus *Thyasira*.

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