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Meiofauna response to iceberg disturbance on the Antarctic continental shelf at Kapp Norvegia (Weddell Sea)

Abstract The impact of iceberg scouring on meiofauna communities, especially nematodes, was studied on the Kapp Norvegia shelf in the Weddell Sea, Antarctica. Three stations with different stages of recolonisation following scour were selected on the basis of seafloor video images, sediment characteristics and faunal occurrences. These stations comprised a fresh scour, an older scour, and an undisturbed control site where a sponge spicule mat covered the sediment with dense epifauna. Meiofaunal abundance and taxonomic diversity of meiofauna groups were significantly reduced in the fresh scour. The highest abundance and diversity were found in the older scour as compared with the undisturbed site. The abundance and diversity of nematodes also decreased due to scouring. The abundance in the older scour recovered to the level of the undisturbed site whereas the diversity remained low. Scouring also changed the nematode community structure, with the suborders Desmoscolecina and Leptolaimina as the most sensitive groups. In addition, scouring resulted in the decrease of selective deposit feeders and the Maturity Index. The low diversity and the change in nematode generic composition in the older scour compared with the undisturbed site, despite the complete recovery in terms of abundance, suggest that the deep continental shelf nematode community in this area is sensitive to iceberg disturbance.

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Introduction

Iceberg scouring is a catastrophic event that physically disturbs benthic ecosystems in polar regions. Scouring affects wide areas in both polar systems, in depths down to about 70 m in the Arctic and 500 m in the Antarctic (Gutt et al. 1996). Iceberg scouring is thus an ecologically important structuring factor in polar benthic ecosystems (Arntz and Gallardo 1994), and although its long history must have controlled the ecology and evolutionary adaptation of polar benthic organisms, few studies have been published (for a review see Gutt, 2001). Most of these studies focus on shallow coastal communities.

There have been few ecological studies of Antarctic meiofauna (Dahms et al. 1990; Herman and Dahms 1992; Vanhove et al. 1995, 1998, 1999; Fabiano and Danovaro 1999; Lee et al., 2001). Although ice scour has been identified as an important structuring force in deep-water nematode distribution (Vanhove et al. 1999), the present study is the first to consider the effect of iceberg scour on deep-water meiofauna.

Materials and methods

Sampling area and methods

The continental shelf off Kapp Norvegia in the eastern Weddell Sea is one of the areas where intensive biological studies have been conducted during the EPOS (European "Polarstern" Study) and the first and second EASIZ (Ecology of Antarctic Sea Ice Zone) cruises. Our knowledge about the benthic fauna in this area is substantial, and it is one of the places where iceberg scouring activity is very high. Therefore this area was selected for our study (Fig. 1).

During the second EASIZ cruise from 13 January to 26 March 1998, samples were taken by means of a multi-box corer (Gerdes 1990) in order to study the impact of iceberg scouring on meiobenthic communities. Three contrasting stations were selected for this study: 225 (water depth, 278 m), 187 (water depth, 255 m) and 228 (water depth, 298 m). These stations were regarded as a very fresh scour, a relatively older scour and an undisturbed site, respectively. This discrimination was based on the combination of

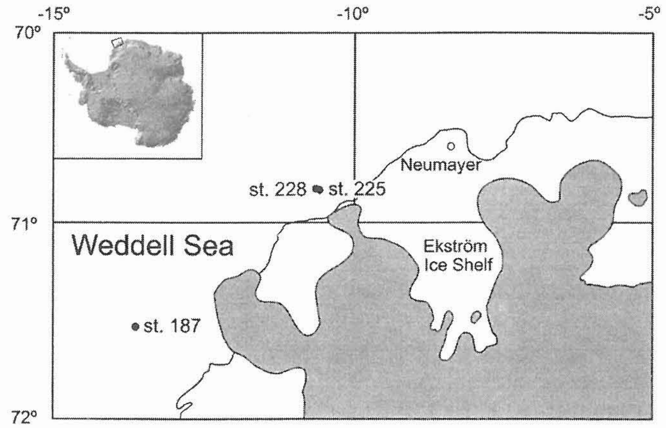

Fig. 1 Map showing the sampling sites (stations, *filled circles*) for this study during EASIZ II (ANT XV/III). Station 225 was a fresh scour; station 187 was an older scour and station 228 was an undisturbed site

in situ observations of the bottom scenery produced by a video camera attached to the multi-box corer, the sediment textual conditions and the macro- and epifauna occurrence (Table 1). The video images at station 225 showed a very fresh scour, based on the lack of epifauna and, especially, on the very fluid sediment condition. The ploughing and pumping activities of the iceberg must resuspend the sediment (Lien et al. 1989), and this resuspended sediment will settle down, especially in the depression of the scour. This sediment will be more fluid, because it contains more interstitial water than under normal conditions. After some time, however, water currents will redistribute the fluid fine sediment and underlying compact sediments will remain in scour marks. The fluid sediment at station 225 can thus be considered as evidence of a very fresh scour mark.

The sediment from station 187 was not as fluid as at station 225, and the presence of a sessile hydrozoan found in 1 sediment sample from this station, *Symplectoscyphus plectilis* (about 1 month old; J-M Gili, personal communication), suggests that the scour mark at this station is at least older than 1 month. Although the actual age of this scour remains uncertain, it is considered that it is not older than 1 year. The undisturbed reference station, station 228, showed a typical dense cover of epifauna on the seabed, in contrast to the barren surface at the scoured sites. The sediment samples from this station were also different from the sediments of the other stations, in that they were covered with a sponge spicule mat about 1 cm thick.

Three standard meiofauna hand-cores (10 cm^2 surface area) for the meiofauna, and a large hand-core (diameter about 6 cm) for sediment analyses were taken from one box core of each station.

Sample treatment

The sediment cores were sliced into 5 layers (0–1, 1–3, 3–5, 5–10 cm and the rest) immediately after the samples were recovered on board. Only the 3 top layers up to 5 cm, where the majority of meiofauna dwells, were used for this study. Meiofauna samples were preserved with 4% neutral hot (60°C) formaldehyde solution on board before further studies in the home laboratory. Sediments were decanted and sieved over 1,000-μm and 32-μm mesh sizes. Animals passing the 1,000-μm sieve and retained on the 32-μm sieve were regarded as meiofauna. Final extraction of meiofauna was achieved using the LUDOX centrifugation flotation technique (McIntyre and Warwick 1984). The number of all metazoan meiofauna was counted after staining with Rose Bengal. Approximately 100 nematodes (all, in samples with less than 100 individuals) per replicate were randomly picked out and dehydrated in a series of glycerin-alcohol solutions. The dehydrated nematodes were mounted on slides with anhydrous glycerin medium and sealed with paraffin wax. Observations were carried out under a Wild M20 light microscope. Identification to genus level was based on morphological characters (Platt and Warwick 1988). Developmental stages and sex of specimens were categorised into four different groups: juvenile, non-gravid female, gravid female and male. The feeding types were classified into four categories; selective deposit feeders (1A), non-selective deposit feeders (1B), epistratum feeders (2A) and predators/omnivores (2B).

Sediment analysis was performed with a Coulter-Counter (the sponge spicule mats on the top of sediments from station 228 were removed prior to analysis).

Statistical analysis

Analysis of variance (ANOVA) was used to determine significant differences ($P < 0.05$) for the following parameters: diversity, feeding type, age guild, maturity index and dominance of nematode genera between stations. Subsequent post-hoc comparison (Tukey HSD) was used on stations.

Nematode diversity at genus level was measured using the suite of diversity indices proposed by Hill (1973; Fig. 2), where N_0 is the number of genera, N_1 is the exponential of the Shannon index, N_2 is the reciprocal of the Simpson index and N_∞ is the reciprocal of the relative abundance of the most dominant genus. The maturity index (MI; Bongers 1990; Bongers et al. 1991) was used to characterise the life-style of nematode communities.

Results

Sediment composition

The sediments from the fresh scour and the undisturbed site consisted of silt (median grain size 43.4 μm and 32.4 μm, respectively), while that of the older scour was very fine sand (median grain size 101 μm) (Table 1). Although the grain size distributions of the fresh scour and the undisturbed site were similar to each other, there were clear differences in sediment condition. The sediment from the fresh scour was very fluid, with more interstitial water than that of the older scour or the

Table 1 Coordinates and description of the sampling stations in the Weddell Sea, Antarctica

Scour condition	Station no.	Depth (m)	Latitude	Longitude	Sediment median size (μm)	Sediment condition	Epifauna on the sediment samples
Fresh	225	278	70°50.1S	10°35.2W	43.4	Very fluid	None
Older	187	255	71°32.3S	13°31.7W	32.4	Normal	One hydrozoan
Undisturbed	228	298	70°49.8S	10°38.0W	101.0	Sponge spicule mat	Diverse

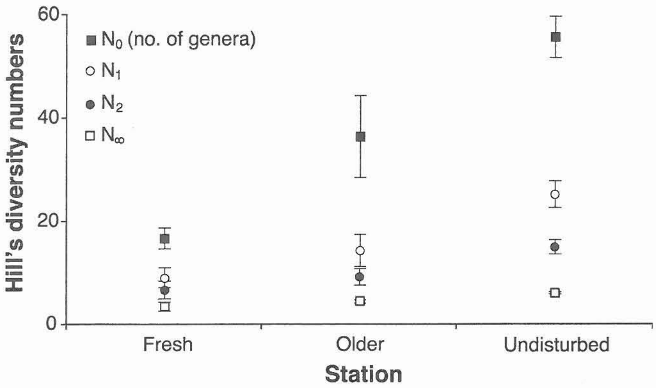

Fig. 2 Hill's diversity numbers of the nematode communities (*error bar*, standard deviation)

undisturbed site. The sediment from the undisturbed site differed from the other stations in having a surface sponge spicule mat forming the top 1 cm of the sample.

Meiofauna

A total of 20 different meiofauna groups were recovered from the 3 stations (Table 2). There were large differences in density between the fresh scour and the other stations (fresh scour, 120 ± 15.4 ind./10 cm^2; older scour, 1,326 ± 287.5 ind./10 cm^2; undisturbed site, 1,342 ± 70.8 ind./10 cm^2). The number of meiofauna groups was also very low in the fresh scour (7 groups) compared with the older scour (16 groups) and the undisturbed site (13 groups).

Nematodes were the most dominant meiofaunal group at all stations, and their relative abundance increased from the fresh scour (60.6%) to the older scour (77.6%) and the undisturbed site (92.0%). Crustaceans (copepods, ostracods and nauplii) were the second most dominant group. These 2 groups made up more than 97% of community density at all stations.

Table 2 Mean density (ind./10 cm^2) of the meiofauna with standard deviation in parentheses ($n = 3$)

Station	Fresh	Older	Undisturbed
Nematoda	72.7 (9.3)	1028.7 (217.5)	1234.3 (69.3)
Copepoda	21.0 (11.3)	89.7 (23.1)	30.7 (10.6)
Ostracoda	1.3 (1.5)	12.0 (10.1)	5.7 (4.7)
Nauplii	22.7 (8.0)	162.0 (25.2)	49.7 (17.1)
Priapulida	0	2.0 (1.0)	0
Kinorhyncha	0	0.7 (1.2)	4.3 (4.9)
Tardigrada	0	0.7 (0.6)	4.7 (0.6)
Turbellaria	0	2.7 (3.1)	0.3 (0.6)
Tanaidacea	0.3 (0.6)	0	0
Rotifera	1.3 (1.5)	0.7 (0.6)	3.0 (1.0)
Isopoda	0	0.3 (0.6)	0
Amphipoda	0	0.7(1.2)	0
Polychaeta	0.7 (0.6)	22.0 (10.8)	5.3 (5.9)
Oligochaeta	0	1.0 (1.0)	0
Bivalvia	0	1.0 (1.0)	0
Sipuncula	0	0.3 (0.6)	0
Hydrozoa	0	0	1.0 (1.0)
Acari	0	1.7 (2.9)	2.0 (1.0)
Aplacophora	0	0	0.3 (0.6)
Bryozoa	0	0	1.0 (1.0)
Total	120 (15.4)	1326.0 (287.5)	1342.3 (70.8)

Nematode communities

The abundance of nematodes was significantly lower (73 ± 9.3 ind./10 cm^2) in the fresh scour compared with the older scour (1,029 ± 217.5 ind./10 cm^2) and the undisturbed site (1,234 ± 69.3 ind./10 cm^2), which were comparable (Tables 2, 3).

The average genus number expressed as N_0 of Hill's diversity numbers increased significantly with the stage of recolonisation (fresh scour, $N_0 = 16.7 \pm 2.0$; older scour, $N_0 = 36.3 \pm 8.0$; undisturbed site, $N_0 = 55.7 \pm 4.0$) (Fig. 2). All other Hill diversity numbers showed the same tendency, although the differences of other indices between the fresh scour and the older scour were not significant. In the case of N_∞, only the difference between the fresh scour and the undisturbed site was significant.

There were clear differences in genus composition between all three stations (Fig. 3, Table 3). The genus *Monhystera* was the most dominant at all stations, but the dominance decreased towards the undisturbed site (26.1% in the fresh scour, 18.8% in the older scour and 16.7% in the undisturbed site). Next to *Monhystera*, *Neochromadora* and *Daptonema* were the subdominant genera in the fresh and the older scour, but of less importance in the undisturbed site. *Desmoscolex* and *Leptolaimus* were the second and third dominant genera in the undisturbed site, although they were less important in the older scour and absent or very rare in the fresh scour. The most unexpected observation was the rarity of the suborders Leptolaimina and Desmoscolecina in the fresh scour. Leptolaimina were represented only by *Aegialoalaimus* (1.3%), *Prismatolaimus* (2.7%) and *Teratocephalus* (0.7%), and the suborder Desmoscolecina was entirely absent from the samples.

The genus number and abundance of these suborders increased with the age of the scour (older scour: 9.3%, 6 genera; the undisturbed site: 34.2%, 14 genera); neither *Prismatolaimus* nor *Teratocephalus* occurred in the undisturbed site. *Sabatieria* was one of the common genera at all stations, although this genus was less important in the fresh scour compared with the other stations. The dominance of *Desmoscolex*, *Leptolaimus*, *Acantholaimus*, and *Tricoma* showed an increasing tendency from the fresh scour to the undisturbed site (Fig. 3a). *Sabatieria*, *Halalaimus*, *Amphimonhystrella* and *Sphaerolaimus* showed no constant pattern (Fig. 3b). The proportions of *Monhystera*, *Neochromadora*, *Daptonema*, *Cervonema* and *Prismatolaimus* tended to increase at the more recently scoured site (Fig. 3c). A similar trend was found at a coarser taxonomic level (mostly family level), except for the family Comesomatidae. Table 4 shows the dominance rank of families with a

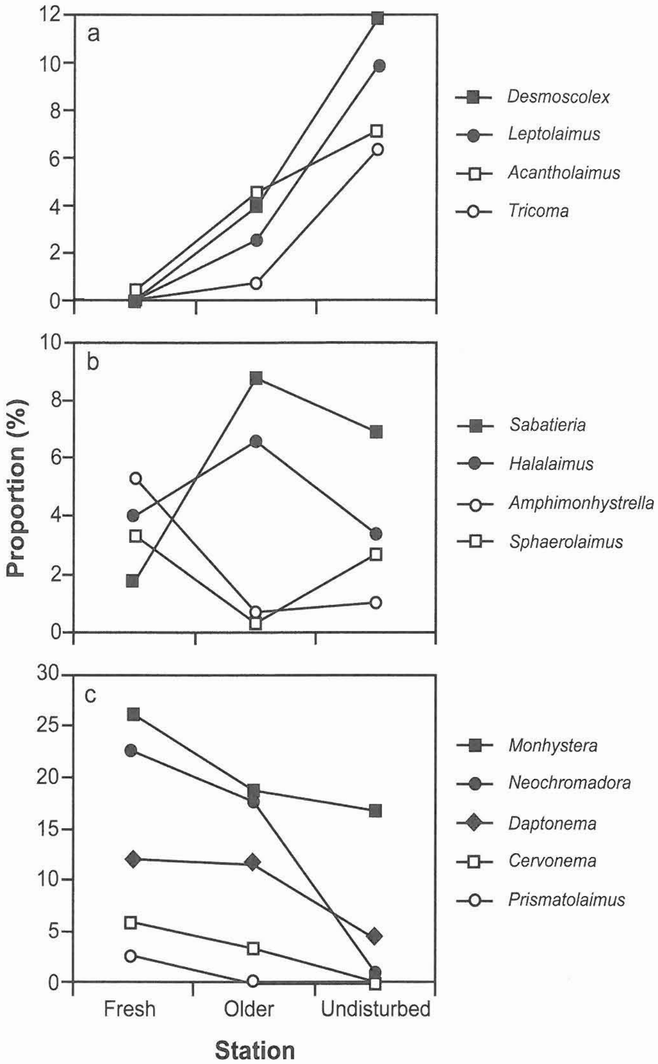

Fig. 3a–c Different tendencies of major nematode genera expressed as the relative proportion according to different degrees of freshness of scours. The nematodes that proportionally decreased due to scouring were regarded as persisters (**a**), and those that increased after scouring were regarded as colonisers (**c**). The intermediate group (**b**) did not show a clear trend

density higher than 0.5%. The families Monhysteridae, Chromadoridae and Xyalidae were commonly dominant at all stations. The families Comesomatidae and Oxystominidae were also common and subdominant at all three stations.

Juvenile stages were predominant at all stations (average: 64.0–69.3%) followed by males (average: 13.7–17.7%), but the differences between stations were not significant (Fig. 4). The non-gravid females, the third dominant group (average: 7.9–19.7%), were significantly ($P < 0.05$) lower in the fresh scour compared with the undisturbed site, but differences between the samples were not significant. The gravid females were least abundant (average: 1.3–6.0%) and their proportion was significantly lower in the undisturbed site compared with the other stations.

Table 3 Mean density (ind./10 cm^2, $n = 3$) of the important nematode genera (> 1% at any station)

Genus	Fresh	Older	Undisturbed
Monhystera	19.7	192.4	206.1
Neochromadora	17.0	181.9	13.2
Daptonema	9.0	119.4	52.6
Sabatieria	1.3	90.4	85.4
Leptolaimus	–	25.1	121.6
Acantholaimus	0.3	45.7	88.0
Halalaimus	3.0	67.5	42.4
Tricoma	–	7.6	78.4
Desmoscolex	–	39.9	145.8
Cervonema	4.3	35.0	1.9
Amphimonhystrella	2.5	3.3	33.1
Molgolaimus	–	9.4	24.9
Aegialoalaimus	1.0	14.6	15.9
Prochromadorella	0.5	19.3	6.4
Sphaerolaimus	4.0	7.0	11.7
Odontanticoma	–	18.5	1.8
Anticoma	0.3	17.0	2.5
Actinonema	–	7.3	12.6
Diplolaimella	–	18.5	–
Tylenchidae genus	1.3	6.1	10.9
Spilophorella	–	11.2	6.7
Camacolaimus	–	5.6	12.0
Microlaimus	–	0.3	15.0
Oxystomina	1.0	2.3	3.0
Pseudosteineria	1.3	3.3	–
Chromadoridae genus	1.5	–	1.9
Prismatolaimus	2.0	0.3	–
Other (No. of other genera)	2.7 (11)	78.8 (39)	240.4 (67)
Total	72.7	1028.7	1234.3

Among the four feeding guilds, the 1A group showed increased importance from the fresh scour to the undisturbed site (Fig. 5). The proportion of this group was significantly higher in the undisturbed site compared with the other stations. The feeding group 1B showed an opposite tendency to the 1A group. The proportion of 1B group was significantly lower only in the undisturbed site compared with the fresh scour. No significant difference between the stations was observed for the 2A group. Amongst the feeding guilds, the 2B group was the smallest. The proportion of this group was significantly higher in the fresh scour compared with the other stations.

The maturity index showed a significant decreasing tendency with the freshness of disturbance (Fig. 6).

Discussion

Influence of iceberg scouring on meiofauna

The very low meiofaunal abundance in the fresh scour (< 10% that in the older scour and the undisturbed site) is similar to the 93% reduction of meiofauna abundance after iceberg scouring in the shallow coastal sediments of Signy Island (Lee et al., 2001). Iceberg scouring also decreased the range of meiofauna taxa. Initially it removed most sessile and some motile animals, e.g.

Table 4 Relative importance, feeding type (*FT*) and *c-p* (coloniser-persister) value of the nematodes (Bongers et al. 1991) grouped into families, except for Comesomatidae where the different genera showed different tendencies (* >0.5%, ** 2.5–5%, *** 5–10%, **** 10–20%, ***** >20%, ? unknown)

Nematode group	Fresh	Older	Undisturbed	FT	c-p value
Monhysteridae	*****	*****	****	1B	1
Chromadoridae	*****	*****	****	2AB	3
Xyalidae	****	****	****	1B	2
Oxystominidae	***	***	***	1A	4
Comesomatidae *Cervonema*	***	**	*	1A	2
Sphaerolaimidae	***	*	*	2B	3
Prismatolaimidae	**			1B	?
Rhabditidae	*	*		1A	1
Teratocephalidae	*	*		1A	3
Comesomatidae *Sabatieria*	*	***	***	1B	2
Trefusiidae			*	1A	4
Epsilonematidae			*	1A	4
Microlaimidae			*	2A	3
Ceramonematidae		*	*	1A	3
Diplopeltidae		*	*	1A	3
Cyatholaimidae		*	*	2A	3
Desmodoridae		*	*	2B	3
Meyliidae		*	***	1A	4
Leptolaimidae		**	****	1A	3
Desmoscolecidae		**	****	1A	4

hydrozoans, bryozoans, kinorhynchs, tardigrades, turbellarians and acarines. The first immigrants into the scour were motile organisms such as amphipods and isopods, which can be considered as early colonisers. The absence of some lesser motile burrowers, e.g. priapulids, bivalves, sipunculids and oligochaetes, in the undisturbed site in spite of their presence in the older scour may be related to the presence of sponge spicule mats covering the sediment.

Previous studies of disturbance have shown time scales of meiofaunal recovery ranging from days to years (e.g. Coull 1969; Sherman and Coull 1980; Danovaro et al. 1995). A general conclusion is that the recovery of meiofauna is relatively fast although it may depend on the type, frequency and scale of disturbance.

In our study, the meiofaunal abundance in the older scour had already recovered to the level of the undisturbed site and the taxon number in the older scour even exceeded that of the undisturbed site (Table 2). Unfortunately, we cannot provide a good estimate of the recovery time for the meiofauna community in the current deep-water study. Recolonisation of the shallow-coast meiofauna community at Signy Island occurred between 30 and 80 days (Lee et al., 2001), but as there are major differences in the ecological conditions between shallow coastal and deep-water habitats, one might expect that recolonisation of meiofauna in deep water will occur at a slower rate. Complete recovery of the nematode community in this area may take some years.

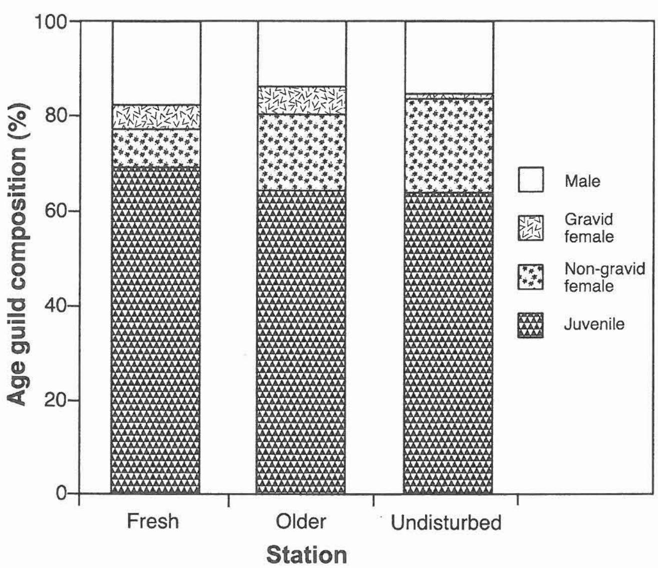

Fig. 4 Age and sex composition of the nematode community in the three stations with different stages of recovery

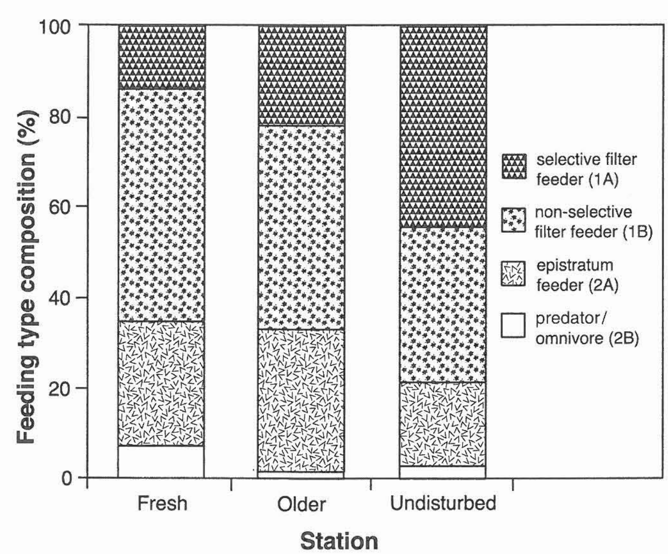

Fig. 5 Trophic guild composition of the nematode community in the three stations with different stages of recovery

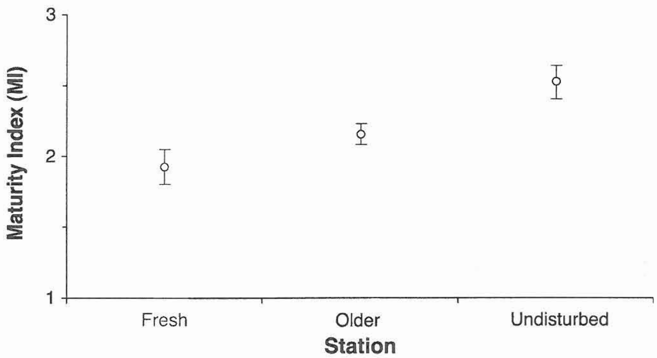

Fig. 6 Maturity Index (MI) of the nematode community (*error bar*, standard deviation)

Influence of iceberg scouring on the nematode community

Abundance

The pattern of nematode abundance between samples was similar to that of total meiofauna abundance. The extremely low density in the fresh scour shows the severity of iceberg scouring impact in the initial stage. Although the nematode density in the older scour recovered to the level of the undisturbed site, their proportions among meiofauna were still low in the scours, implying that nematodes recolonise more slowly than other major meiofauna, e.g. copepods and ostracods. This is probably because of the slower dispersal of nematodes.

Diversity

Nematode diversity was greatly influenced by scouring. The relatively high diversity of nematodes in terms of genus number in the undisturbed site ($N_0 = 55.7 \pm 4.0$) was in accordance with the results of Vanhove et al. (1999) from Kapp Norvegia and Halley Bay ($N_0 = 56 \pm 5.0$ and 52 ± 10.8, respectively) in the Weddell Sea. However, it was very low in the fresh scour of this study ($N_0 = 16.7 \pm 2.0$). The nematode genus number in the older scour site was, unlike the abundance, still low ($N_0 = 36.3 \pm 8.0$) compared with the undisturbed site, which means that the restoration of nematode community structure is slower than the recovery in abundance.

Iceberg scouring also resulted in the increase of the dominance of a few nematode genera. Each of the three most abundant genera in the fresh and the older scour, *Monhystera*, *Neochromadora* and *Daptonema*, composed more than 10% of the population, while only *Monhystera* exceeded 10% in the undisturbed site. These three dominant genera made up 60.6% in the fresh scour and 48.1% in the older scour. The three most dominant genera in the undisturbed site, *Monhystera*, *Desmoscolex* and *Leptolaimus*, composed only 38.4% of the community.

Composition

The nematode genus composition of the fresh scour was more similar to the community in the older scour than that in the undisturbed community, despite the fresh scour being located much closer to the undisturbed site than to the older scour. Three different trends of nematode response to scouring effects were found (Fig. 3). A group of nematodes showed a higher relative abundance in the fresh scour, reflecting their recolonisation ability. The common feature of this nematode group was that most of them were non-selective deposit feeders (1B). The second group, which showed a higher relative abundance in the undisturbed site, was represented by selective deposit feeders (1A). *Acantholaimus* (2A, an exceptional genus in this group) seems to be a typical deep-sea nematode (Soetaert and Heip 1995; Vanaverbeke et al. 1997) and prefers physically more stable environments. It is not clear which parameters influence the sensitivity of *Acantholaimus* to iceberg scouring. The last group, which was composed of nematodes with various feeding types and different reproductive strategies, showed intermediate properties. Among these three groups, the second group seemed to be most sensitive to iceberg scouring. The sensitivity of nematodes in this group is probably caused by their restricted food preference and/or due to their reproductive strategy, because these nematodes were either selective deposit feeders (1A) or extreme colonisers.

In general, the feeding guilds in the Antarctic deeper water are more or less evenly shared between 1A, 1B and 2A groups, with a slight dominance of the 2A group, while the 2B group appears to be the least abundant group (Vanhove et al. 1999). The results of the present study mainly confirmed this tendency, although it was biased towards the 1A group in the undisturbed site and towards the 1B group in the other stations.

Sex and age

Reproductive activity at the scoured sites was higher than at the undisturbed site. One of the reasons for the high proportion of gravid females in the scour samples was the change of nematode generic composition in the communities. The dominant genera in the undisturbed site, *Desmoscolex*, *Leptolaimus* and *Tricoma*, showed a relatively lower fecundity. Therefore the low proportion of *Leptolaimus* and Desmoscolecina genera in the scours must have influenced the proportion of gravid females. However, the lower density of the population and therefore the lower competition in the scours may have stimulated the reproduction of nematodes.

Shallow-water community versus continental-shelf community in the Antarctic

The influence of iceberg scouring has also been investigated at a shallow-coast site at Signy Island (Lee et al., 2001). The comparison of the results from Signy Island and the Weddell Sea, from this study, provides further insight into the impact of iceberg scouring on the meiofauna and nematode communities. Both areas are under the influence of catastrophic physical disturbances of iceberg scouring. However, the frequency of disturbance is different. The study site on the shelf off Kapp Norvegia is deeper and an occasional iceberg scouring happens at each square metre once every 340 years on average (Gutt, 2001), whereas scouring can happen much more frequently in the case of the coast at Signy Island (50–75 years, Peck and Bullough 1993). Between scouring events, the seabed of Kapp Norvegia remains more or less constant, whereas the seabed close to Signy Island is under the continuous disturbance of wave action and frequent ice-induced disturbances. Therefore a combination of several physical disturbances structures the nematode community at shallow Antarctic coasts, whereas only occasional iceberg scour disturbs the nematode community at Kapp Norvegia. The nematode communities of undisturbed habitats in the two areas are also very different. At Signy Island, they are characterised by a low diversity, a high dominance, a low MI and a low proportion of the 1A feeding group. The undisturbed nematode community at Kapp Norvegia shows opposite characteristics. However, iceberg scouring leads to a higher similarity between the characteristics of the two nematode communities at Kapp Norvegia and Signy Island. Similarly, Conlan et al. (1998) found that the scour communities of macrofauna closely resembled inshore shallow-water benthos despite the remoteness of several hundred metres.

Conclusions

It is likely that a significant threat for the Antarctic deep-water communities comes from increased iceberg scouring as a result of global warming (Doake and Vaughan 1991; Gammie 1995). Gutt et al. (1996) concluded that a slight increase in iceberg scour could be accommodated by the macrobenthic system because of its adaptation to such disturbance. Meiofaunal communities have a strong natural capacity for recovery from all kinds of disturbance including iceberg scour, but a large contrast is observed between shallow- and deep-water communities. Shallow meiofauna seems to be strongly adapted to iceberg scouring as it is frequently faced with different kinds of physical constraints characteristic of shallow-water environments. However, the structural recovery of the meiofauna, and more specifically the nematodes, from the deeper continental shelf is a slower process which can take some years, in contrast to the rapid recovery of abundance. This indicates that the communities are much more fragile and that they do not show similar adaptation to shallow-water communities. Probably this is mainly because of the relative constancy of the Antarctic deep-water environment. Hence, the increasing frequency of iceberg scouring due to global warming might have much greater effects on a deep-water meiofauna community, as compared with a shallow community.

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