Benthic studies of the Southern Bight of the North Sea and its adjacent continental estuaries

Progress Report I

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Introduction

The North Sea and its estuaries are amongst the best known areas in the world as far as benthos is concerned. Nevertheless, there is still much basic knowledge missing. The efforts of the marine biology group of our institute are concentrated on several basic aspects of benthic ecosystems, including the systematics of marine nematodes, the ecology of meio- and macrobenthos, the measurement of benthic activity and the interactions between benthic systems and the overlying water column. This report synthesizes some of the studies that have been made during the last three years in the field of benthic ecology.

In investigations of the North Sea our efforts are directed mostly towards the measurement of structural parameters of populations and community organisation, such as density, biomass and diversity, because these parameters yield a maximum amount of information per unit effort. Because our research originated as part of a system analysis programme, the rates of change in the values of the state variables were required to characterize the system. However, our poor knowledge of benthic microbial processes and inadequate logistic support on board, our research vessel forced us to abandon the idea of direct measurement of these fluxes; instead we now try to infer them from the proportionality which, within certain limits, exists between the magnitude of the structural parameters and the fluxes within the system. Though this approach is valid for the meio- and macrobenthic compartments of the system, there remains a need for a set of holistic measures to characterize the overall behaviour of the benthic system. This is not within the scope of our North Sea research for the moment, but methods for the measurement of aerobic community respiration and nutrient regeneration are now being developed in lagoonal situations (the Sluice Dock of Ostend) and will hopefully be applied to the North Sea in near future.

Benthic communities are more difficult to sample than planktonic communities but have some important advantages as the benthos is a stabler system in both the temporal and spatial domain. For sampling purposes it can be considered as being two-dimensional in most situations and types of problems. This eliminates the necessity to sample the vertical dimension which requires a large additional effort in order to avoid aliasing, giving spurious results in some situations (Platt & Denman, 1975). Patchiness in the horizontal plane is, at least in large areas of the North Sea, also less intense in the benthos than in the plankton. Analysis of the variance of benthic processes in the time domain as performed by e.g. spectral analysis can elucidate the periodicities in the system, but requires the establishment of long time series, a task not easilly fulfilled in marine situations. Consequently, such long time series ara rare and even for important or key species there are only a few census programs going on. The COST 47 project of the EEC will increase considerably the available data, but on the whole governmental agencies remain rather inhibited in their attitude towards such lengthy and costly programs.

The establishment of long time series is useful for purposes other than the characterization of the system in the time domain as well. The prediction of future states of ecological systems with the tools of system analysis has been reasonably successful for certain compartments but probably requires frequent monitoring to remain effective. However, it is doubtful whether such an approach will be successful when characteristics of single biological populations are to be predicted. This is not only because modelling techniques are inadequate but it is also inherent in the nature of biological interactions which are stochastic phenomena with a highly variable outcome or indeed no directed outcome at all. When prediction cannot be based on dynamic model, it can only depend on a statistical model (Poole, 1978), and the estimation of the parameters of such models requires large numbers of accurate observations. The recognition of this problem and its implications for the management of marine systems led us to a high frequency monitoring program of a meiobenthic community in brackish water which started in 1968 and is still being continued.

Although monitoring is a regular part of our North Sea studies now, earlier work in the Southern Bight was concentrated on the description of characteristic species-assemblages of both meio- and macrobenthos (Van Damme & Heip, 1977; Govaere et al., 1977). From these studies we now have basic information on the distribution of species and their abundance and biomass in this area. Additional base-line studies are concerned with a large area of accumulating sediments to the south-west of the mouth of the Western Scheldt where particulate material from this heavily polluted river is deposited. Large-scale harbour constructions risk to change the hydrodynamical regime of the area with possible redistribution of sediments. Other human activities with possible important consequences include the exploitation of sand banks in the region, which threatens to become increasingly important, and possible thermal and radioactive pollution by the French nuclear power plant at Gravelines at the entrance of the Channel.

Macrobenthos of the delta region in The Netherlands has been studied qualitatively by Wolff (1973), who made an extensive survey of the area. Efforts of our group are restricted to the hard-bodied meiofauna of three of the estuarine branches, Lake Grevelingen, the Eastern Scheldt and the Western Scheldt. These investigations started only recently and a number of quantitative samples has been collected in collaboration with several Dutch institutions (Rijkswaterstaat Vlissingen, Delta Institute of Hydrobiological Research Yerseke and Biological Research Group Ems-Dollard estuary in the north. The investigations are still in a descriptive phase but have allowed us to draw a fairly consistent picture of the meiofauna of these estuaries. In order to approach the meiobenthic compartment dynamically the dominant species of nematodes and harpacticoid copepods from these areas are now being cultured in the laboratory in order to establish generation times, number of offspring, etc., in controlled conditions, with the eventual goal of obtaining an adequate picture of the energy flow through these populations.

Material and methods

SAMPLING

The localisation of the stations will be given per study area. In subtidal stations three macrofauna samples were taken with a 0.1 m^2 Van Veen grab. The material in each grab was immediately collected in a bucket, without sieving, and fixed with formalin to a final concentration of 4 %. In very shallow estuarine stations or stations exposed at low tide, samples were handcollected with plastic cores covering a surface of 77.8 cm^2, pushed 15 cm into the sediment. 15 cores were collected into 3 buckets on the spot.

In our earlier work, meiofauna samples were taken by subsampling a Van Veen grab. Two plastic cores covering a sufface area of 10.2 cm^2 were pushed through a small hatch in the upperside of the grab into the collected sediment. From April 1978 onwards a modified Reineck-boxcorer (Farris and Crezee, 1976) was used. Four subsamples were taken from each box-core. Two replicates for meiofauna were fixed with warm formalin (70° C) to a final concentration of 4 %. The two other cores for chemical and sediment analysis were immediately frozen.

At some stations samples were taken by SCUBA divers with the same 10.2 cm^2 inner surface plastic cores. The overlying water was removed gently and collected, and the cores were subdivided into 2 cm-slices and fixed. Reineck-cores from the same locality were also divided into 2 cm-slices to allow comparison.

In shallow water (-3.5 m) samples could be collected with a 'meiosticker', a telescoping tube (max. length : 5.5 m) equiped with a head into which a plastic core can be screwed in. Inside the head, a valve-spring-combination opens when the tube is lowered and closes when the sample has been taken. (Govaere & Thielemans, in press).

In the laboratory the meiobenthos samples were elutriated from sand using the trough-method (Barnett, 1968; Heip, 1976a). The material was collected on sieves with mesh sizes of 250 µm and 38 µm.

The extraction of the organisms from muddy sediments from the smaller fraction was done using a density-gradient centrifugation technique (Bowen et al., 1972; de Jonge & Bouwman, 1977).

Macrobenthos samples were gently rinsed on a sieve with round meshes of 0.87 mm. All material was restored in formalin for further determination.

SYSTEMATICAL METHODOLOGY

Permanent benthos can be subdivided following Mare (1942) and Hulings and Gray (1971), into meiobenthos and macrobenthos. Members of the higher taxonomical groups Hydrozoa, Turbellaria, Nematoda, Gastrotricha, Oligochaeta, Polychaeta (interstitial forms), Mollusca, Harpacticoida, Ostracoda, Tardigrada and Halacarida are commonly considered to belong to the meiobenthos; young stages of larger Oligochaeta, Polychaeta and Mollusca are temporary meiobenthos (McIntyre, 1969).

In the meiobenthos, Nematoda and Harpacticoida are systematically studied. Of the macrobenthos, the Polychaeta, Mollusca, Crustacea (Mysidacea, Tanaidacea, Isopoda, Cumacea, Amphipoda, Decapoda) and Echinodermata were identified to species. Nemertinea, Oligochaeta and Phoronida were only counted.

BIOMASS

Meiofauna was weighed with an accuracy of 0.1 ug with a Mettler ME 22/BA 25 Microbalance. The organisms were transmitted into pre-dried small aluminum recipients. Each of those was put into a covered small petri-dish and dried again at 110° C for 2 hours. Thirty minutes after drying, the recipient was weighed.

Macrobenthic organisms were divided into size classes. From the length-measurements and the length-weight regressions calculated by Govaere (1978) for species of the Southern Bight, we obtained the wet weight and the ash-free dry weight per species.

SEDIMENT ANALYSIS

A subsample of the sediment was oven-dried at 110° C during 2 hours. After homogenization 25 g was used for further analysis. The gravel fraction was separated from the rest by a 2 mm-mesh size sieve. The sand-mud fraction was stirred mechanically for 20 min. over an 18-sieves set with diminishing mesh sizes (1000, 850, 710, 600, 500, 420, 355, 297, 250, 210, 180, 149, 125, 105, 90, 74, 63 and 53 µm).

The fraction remaining on each sieve was weighed with an accuracy of ± 10 µg and a cumulative f.d., using phi-units, was plotted. For classification of the sand fraction of the sediment the Wentworth-scale was used. The terminology for the degree of sorting of this fraction is similar to that used by Wolff (1973) and Govaere (1978).

Table 1

Wentworth scale			Sorting coefficient $\sigma\phi$	
ϕ-units	µm	Name	ϕ-units	Name
0 - 1	500 - 1000	coarse sand	0.35	very well sorted
1 - 2	250 - 500	medium sand	0.35 - 0.50	well sorted
2 - 3	125 - 250	fine sand	0.50 - 2.00	less well sorted
3 - 4	62 - 125	very fine sand	2.00	poorly sorted

MATHEMATICAL METHODS

All results are expressed with their standard error.

To measure species diversity H in samples we used the Brillouin formula (Pielou, 1975) :

$$H = \frac{1}{N} \log \frac{N!}{n_1\, n_2\, n_3 \, \ldots \, n_s}$$

where H is expressed in bits per individual, N is the total number of individuals, n_i the number of individuals belonging to i^{th} species ($i = 1, \ldots, s$).

Eveness e refers to the equitability of the allocation of individuals between the species. The lower the e, the higher is the dominance of one (or several) species in the sample. It must be borne in mind that calculation of eveness depends on knowledge of the number of species in the community, and that when only a few species are present, sample estimates will be biased to too low values.

$$e = \frac{H}{H_{max}}$$

where e is the equitability or eveness (range : 0 to 1), H is the observed species diversity,

$$H_{max} = \log_2 S$$

where S is the observed number of species.

Results and discussion

THE BELGIAN COASTAL ZONE OF THE NORTH SEA

Localisation and co-ordinates of the sampling stations are given in fig. 1 and table 2. Three areas were investigated :

(1) A near coastal zone with the majority of 18 regularly monitored stations concentrated along the Belgian eastern coast (Ostend - Knokke) and the mouth of the Scheldt estuary.

(2) A zone in a sand exploitation-area (ZB-stations)

(3) A near coastal zone along the Belgian west coast (De Panne - French border), which is a wintering area of the common scoter, *Melanitta nigra* L. (z-stations) and where water from the Channel is entering the North Sea.

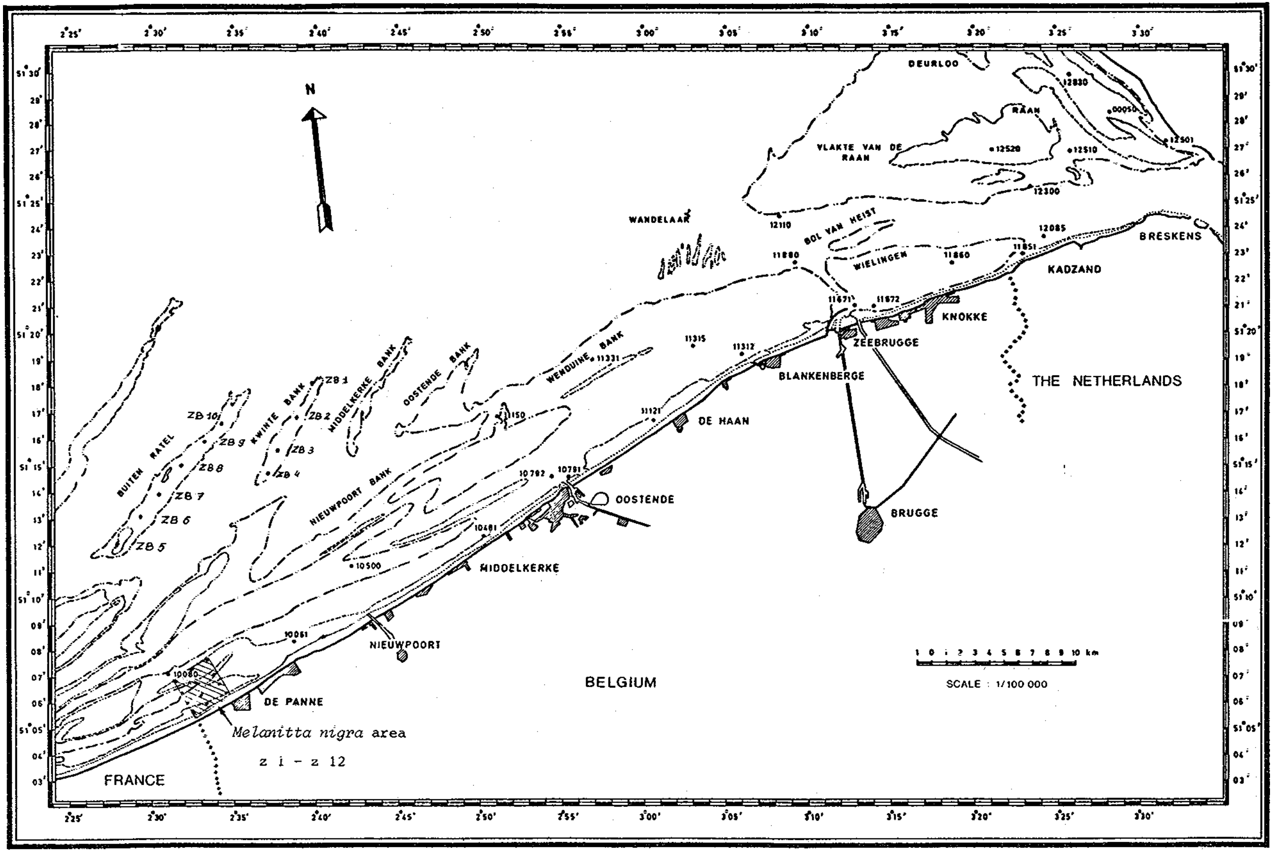

fig. 1.

Localisation of the stations in the Belgian coastal zone

Table 2

Co-ordinates of the stations in the Belgian coastal zone and the mouth of the Scheldt Estuary

Near coastal zone stations			Sandbank stations		
	N lat.	E long.		N lat.	E long.
10080	51° 07' 10"	02° 35' 00"	ZB 1	51° 17' 30"	02° 39' 30"
10061	51° 08' 21"	02° 31' 40"	ZB 2	51° 16' 42"	02° 38' 57"
10500	51° 11' 06"	02° 42' 09"	ZB 3	51° 15' 40"	02° 37' 40"
10481	51° 12' 20"	02° 50' 14"	ZB 4	51° 14' 48"	02° 37' 08"
11150	51° 16' 32"	02° 51' 08"	ZB 5	51° 12' 05"	02° 27' 52"
10971	51° 14' 35"	02° 55' 25"	ZB 6	51° 13' 08"	02° 29' 20"
10792*	51° 14' 25"	02° 54' 50"	ZB 7	51° 14' 08"	02° 30' 30"
11331	51° 19' 01"	02° 56' 51"	ZB 8	51° 14' 57"	02° 31' 38"
11121	51° 16' 40"	03° 00' 30"	ZB 9	51° 15' 45"	02° 32' 40"
11315	51° 19' 30"	03° 03' 00"	ZB 10	51° 16' 28"	02° 33' 58"
11312	51° 19' 10"	03° 06' 00"			
12110*	51° 24' 04"	03° 07' 00"	*Melanitta nigra* L. stations		
11880	51° 22' 38"	03° 09' 15"	z 1	51° 05' 50"	02° 32' 30"
11671*	51° 21' 00"	03° 12' 40"	z 2	51° 06' 10"	02° 33' 40"
11672	51° 21' 00"	03° 14' 00"	z 3	51° 06' 25"	02° 34' 40"
11860	51° 22' 38"	03° 18' 41"	z 4	51° 06' 20"	02° 32' 10"
11851	51° 23' 02"	03° 22' 56"	z 5	51° 06' 40"	02° 33' 10"
12085*	51° 23' 40"	03° 24' 20"	z 6	51° 06' 55"	02° 34' 00"
12300	51° 25' 31"	03° 23' 24"	z 7	51° 06' 50"	02° 31' 35"
12520*	51° 26' 58"	03° 21' 02"	z 8	51° 07' 15"	02° 32' 50"
12510	51° 26' 55"	03° 21' 45"	z 9	51° 07' 25"	02° 33' 30"
12830	51° 29' 49"	03° 25' 45"	z 10	51° 07' 20"	02° 31' 20"
00050*	51° 28' 25"	03° 28' 07"	z 11	51° 07' 40"	02° 32' 25"
12501	51° 27' 17"	03° 31' 33"	z 12	51° 08' 00"	02° 33' 20"

* Samples taken in summer 1976 only. The 18 other stations were sampled in June-September 1977 and March-April - June - September 1978.

Sediment analysis

The mean values for the sediment analysis of samples from six cruises covering all 18 near-shore stations is given in table 3. The stations can be divided into 3 groups (table 4).

Table 3

Medium grain size (ϕ - units and mm), skewness Sk_q, sorting $\sigma\phi$ of the sandfraction and the mud- and gravelpercentage per station. Mean values of six campaigns : 06-09/1977; 03-04-06-09/1978.

Station	Med. grain size ϕ-units	mm	$\sigma\phi$	Sk_q	% mud	% gravel
10061	2.484	0.193	0.404	0.358	4.3	-
10080	2.100	0.239	0.381	0.297	0.3	1.3
10481	2.758	0.148	0.426	0.389	31.4	0.2
10500	2.501	0.177	0.411	0.289	22.7	2.5
10791	2.689	0.157	0.422	0.373	57.7	1.1
11121	2.528	0.174	0.413	0.347	14.2	-
11150	2.008	0.252	0.374	0.209	14.8	0.5
11312	2.751	0.149	0.426	0.382	61.8	-
11315	2.576	0.168	0.416	0.374	53.2	-
11331	2.992	0.134	0.433	0.333	61.3	-
11672	2.512	0.179	0.410	0.357	21.7	-
11851	2.823	0.129	0.435	0.390	59.1	0.1
11860	2.450	0.185	0.407	0.324	31.2	0.5
11880	2.451	0.202	0.385	0.265	54.7	2.2
12300	2.398	0.196	0.402	0.326	33.9	0.1
12501	2.347	0.198	0.401	0.341	2.9	-
12510	2.411	0.192	0.404	0.343	11.2	0.7
12830	2.507	0.180	0.410	0.327	15.1	1.7

Table 4

				Md (mm)	Mud (%)
(1)	Sand stations (n = 3)	< 5 %	mud-content	0.210	2.54
(2)	Muddy-sand stations (n = 8)	5 - 32 %	mud-content	0.180	20.29
(3)	Sandy-mud stations (n = 7)	> 32 %	mud-content	0.162	54.53

The mean medium grain size of the sand fraction (Md) decreases with increasing percentage of mud. The muddy-sand and the sandy-mud stations are mostly concentrated along the eastern coast. The sediment of the stations of the other areas (ZB- and z-st.) consists mostly of fine sand with a low mud-content.

An analysis of variance of these data shows that the medium grain size is stable in time (table 5). This is not true for the mud-content.

Table 5

Anova table for the medium grain size of the sandfraction, mud-content, real and transformed values of the number of nematodes for the 18 monitored stations

Source of variation	df	Mean grain size SS	Mean grain size MS	Mean grain size Fs		Mud-content SS	Mud-content MS	Mud-content Fs	
Date	3	0.003	0.001	0.75	n.s.	5752	1917	4.27	⁎
Station	17	0.073	0.004	3.21	⁎	30912	1818	4.05	⁎
Error	51	0.068	0.001			22847	449		
Total	71	0.143				59561			

Source of variation	df	Number of Nematodes: Real values SS	Real values MS	Real values Fs		Transformed log (N + 1) values SS	Transformed MS	Transformed Fs	
Date	3	$36\ 10^6$	$12\ 10^6$	4.06	⁎	2.1090	0.7030	2.07	n.s.
Station	17	$82\ 10^6$	$5\ 10^6$	1.64	n.s.	10.5042	0.6179	1.82	n.s.
Error	51	$15\ 10^7$	$3\ 10^6$			17.2876	0.3390		
Total	71	$27\ 10^7$				29.9007			

⁎ Significant at 1 % level

Meiobenthos

Meiobenthos was only studied at the near coastal zone in the east.

Taxonomic group diversity

The most abundant taxon is the Nematoda followed by the Copepoda Harpacticoida, Polychaeta, Turbellaria and occasionally Ostracoda and Halacarida. The mean group-diversity is relatively low (table 6). This

Table 6

Mean number of higher taxonomic groups present per station group and per sampling series

	July 76	June 77	Sept. 78	April 78	Mean + St. E.
Sand	3.5	3.7	4.3	3.0	3.6 ± 0.3
< 32 % mud	3.0	2.6	3.5	2.4	2.9 ± 0.2
> 32 % mud	2.0	3.0	3.1	2.4	2.6 ± 0.3
Mean	2.7	2.9	3.2	2.8	3.0 ± 0.1

low diversity indicates the high stress conditions of this shallow zone with high velocity and turbidity pollution effects, etc...

In the sand-stations the diversity is always higher than in mud-stations. The mean diversity for the coastal area is 3.0 with the highest value in late summer. This value is slightly higher than the one found by Van Damme and Heip (1977) for the same zone. They found an average of 1.5-2.3 taxonomic groups in the winter-summer periods over 5 years.

Density

The mean density of the Nematoda over the four sampling periods is 1.6 10^6 ind..m^{-2} or 97 % of the total meiofauna (table 7). They are followed by Harpacticoid Copepods (24,000 ind. m^{-2} or 1.14 %) and Polychaeta (20,000 ind. m^{-2} or 0.92 %).

Table 7

Nematoda

Density per station (ind./10 cm^2) and mean density and biomass per sample serie (μg/10 cm^2)

Station	June 1977	Sept. 1977	March 1978	April 1978	Mean ± St. Err.
10061	770	1790	560	430	890 ± 310
10080	1230	210	440	110	500 ± 250
10481	3680	5370	1420	960	2860 ± 1030
10500	4360	2710	1220	700	2250 ± 820
10791	2770	2450	90	3610	2230 ± 750
11121	3140	4280	1050	770	2310 ± 840
11150	110	80	340	290	200 ± 70
11312	2420	6240	170	470	2320 ± 1400
11315	760	1440	410	700	830 ± 220
11331	180	360	170	110	300 ± 50
11672	250	7660	20	860	2200 ± 1820
11851	1680	5180	650	4000	2880 ± 1040
11860	80	330	2320	3750	1620 ± 870
11880	410	320	710	10	360 ± 140
12300	1410	90	190	2170	960 ± 500
12501	90	3040	1430	1420	1500 ± 600
12510	40	4390	300	460	1300 ± 1040
12830	1870	5560	8750	700	4220 ± 1830
Mean	1400	2860	1150	1200	1650
St. Err.	330	580	470	300	260
Biomass	840	1720	690	720	990

Analysis of variance on the log (N + 1) transformed data shows that within station variance is larger than between station variance, and that these populations are in this sense stable both in space and time. However, when untransformed data are used the analysis shows a significant influence of time, and in fact density is higher in September than in other months (table 5). The highest densities were found in muddy sand stations (mean = 2.1 10^6 ind. m^{-2}). No correlation was found between density and the percentage of mud in the sediment.

Vertical distribution was investigated for three stations : 11315, 11851 and 12501, both on SCUBA samples and on Reineck-boxcore samples. Fig. 2 shows the vertical profile of nematode density per 2 cm-layer.

In the mud-stations 11315 and 11851 (resp. 53 % and 59 % mud) the majority of the nematodes is found in the upper 4 cm layer (93-99 %).

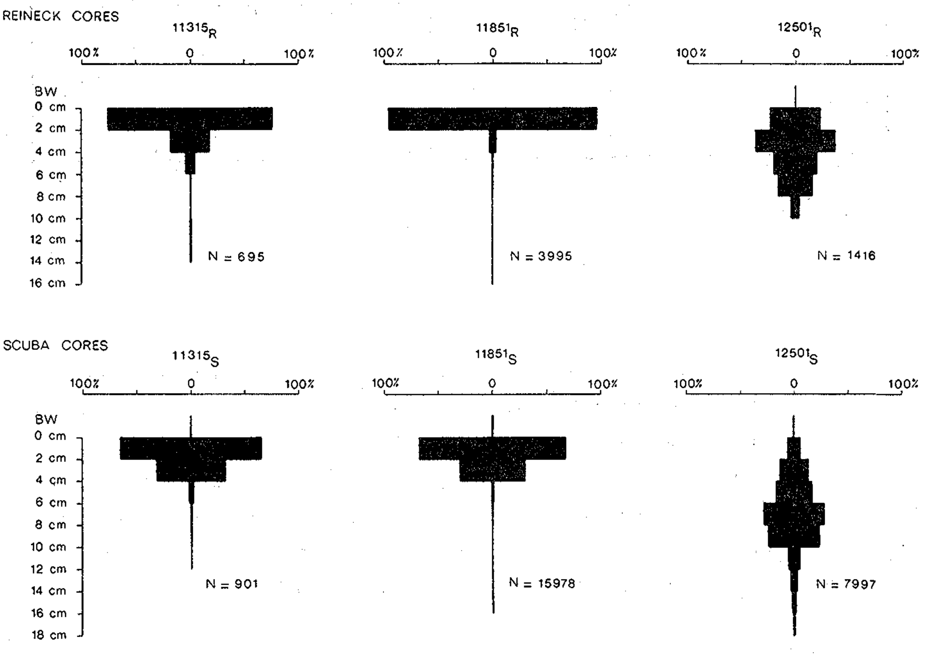

fig 2

Comparison of vertical distribution of Nematoda between REINECK-samples (R) and SCUBA-samples (S) at three coastal stations (N : number of individuals per 10 cm^2)

The sediment of station 12501 is fine sand with a medium diameter of 0.199 mm. In this typical sand station the nematodes penetrate the deeper layers in considerable numbers (table 8). This agrees with recent findings of several authors (e.g. Heip et al., 1977) who found non-negligible numbers of nematodes even at more than 20 cm depth), and contrasts with the opinion commonly held only a few years ago that nematode numbers below 4-5 cm are negligible even in sandy semiments.

Table 8

Comparison of the vertical distribution of Nematoda in different areas (percentage of total)

	JUARIO (1975) German Bight silty sand	BISSCHOP (1977) Southern Bight muddy sand	HOLVOET (1978) Western Scheldt muddy sand	This study	
				Mudst.	Sandst.
0 - 2 cm	70 - 86	50 - 68	63 - 69	65 - 96	6 - 23
2 - 4 cm	9 - 21	11 - 24	18 - 26	2 - 32	13 - 37
4 - 6 cm	5 - 12[1]	7 - 39	7 - 9	0.2 - 4	17 - 20
6 - 8 cm		1 - 10	2 - 5[2]	0.2 - 0.6	16 - 28
8 - 10 cm				0.1 - 0.2	5 - 24

1. 4 - 7 cm
2. 6 - 10 cm

Biomass

Biomass is not only dependent on density, but also on speciescomposition and on the reproductive state of the population. The mean biomass of an individual nematode in this area is 0.6 + 0.1 μg dry weight per individual (range 0.2 - 1.35 μg dwt; Bisschop, 1977). The mean biomass per sampling period is given in table 7 and the overall mean for the 4 cruises is nearly 1 g dwt. m^{-2}. This value is close to that found by Van Damme and Heip (1977) for this zone (± 1.5 g dwt. m^{-2}).

Species composition

The numbers of species is higher in sand-stations (20-30 species) than in mud-stations (4-12 species). Nematode communities in mud are dominated by the *Sabatieria pulchra*-group (up to 95 %), *Daptonema tenuispiculum* (up to 71 %), *Paramicrolaimus conothelis* and species belonging to the genera *Theristus* and *Monhystera*. Their importance decreases in the sand-stations and other species become more important, such as *Spirinia parasitifera, Richtersia inaequalis, Ascolaimus elongatus, Microlaimus marinus, Tubolaimoides tenuicaudatus* and *Enoplolaimus propinquus*. (see table 9).

Table 9

Nematoda of the Southern Bight
Density (♂, ♀, juveniles, damaged and total) and Feedingtype

	♂	♀	juv.	D	Tot.	Ft[3]
Aegialolaimus sabulicola Allgen, 1933	9	8	20		37	1A
Odontophora armata Allgen, 1929	9	20	25		54	1B
Odontophora Bütschli, 1874 *spec.*	1	19	33		53	1B
Leptolaimus de Man, 1876 *spec.*	4	1	2		7	1A
Dagda bipapillata Southern, 1914	1				1	2A
Dagda Southern, 1914 *spec.*			1		1	2A
Camacolaimus longicaudatus de Man, 1922			2		2	2A
Camacolaimus de Man, 1889 *spec.*	1		2		3	2A
Terschellingia longicaudata de Man, 1880		1			1	1A
Metalinhomoeus de Man, 1907 *spec.*	2		2		4	1B
Rhadinema flexile Cobb, 1920	1	1	1	1	4	2B
Tubolaimoides tenuicaudatus Allgen, 1934	3	36	14		53	2A
Linhomoeus Bastian, 1865 *spec.*			1		1	2A
Eleutherolaimus Filipjev, 1922 *spec.*	1		4		5	1B
Sphaerolaimus Bastian, 1865 *spec. 1*[1]	1				1	2B
Sphaerolaimus Bastian, 1865 *spec. 2*[1]			1		1	2B
Cylindrotheristus longicaudatus Filipjev, 1922	1	4	15		19	1B
Cylindrotheristus normandicus de Man, 1880	6	9	25	1	41	1B
Daptonema tenuispiculum (Ditlevsen, 1918) Lorenzen, 1977	172	141	72		385	1B
Monhystera Bastian, 1865 *spec.*	39	8	78		125	1B
Paramonhystera Steiner, 1916 *spec.*	1	2			3	1B
Theristus mirabilis De Coninck & Stekhoven, 1933	12	13	26		51	1B
Theristus parasetosus De Coninck & Stekhoven, 1933	1				1	1B
Theristus Bastian, 1865 *spec.*	31	19	105		155	1B
Cobbia de Man, 1907 *spec.*	1				1	2A
Xyala striata Cobb, 1920		1			1	1B
Cyartonema Cobb, 1920 *spec.*[2]	3	1	8		12	1B
Onyx perfectus Riemann, 1966	1	1	6		8	2A
Onyx Cobb, 1920 *spec.*		4	13		17	2A

Table 9

(continuation)

	♂	♀	juv.	D	Tot.	Ft[3]
Spirinia parasitifera Bastian, 1865	3	3	11	4	21	2A
Spirinia Gerlach, 1963 *spec.*			5		5	2A
Microlaimus honestus de Man, 1922	2	2	11		15	2A
Microlaimus marinus Schulz, 1932	13	5	39		57	2A
Microlaimus de Man, 1922 *spec.*	6	13	25		44	2A
Paramicrolaimus conothelis Lorenzen, 1973	35	28	115		178	2A
Desmodora de Man, 1889		1			1	2A
Monoposthia mirabilis Schulz, 1932		1	2		3	2A
Monoposthia de Man, 1889 *spec.*		1			1	2A
Richtersia inaequalis Riemann, 1966	1	2	16	1	20	1B
Richtersia Steiner, 1916 *spec.*	2	7	36	3	45	1B
Sabatieria Rouville, 1933 *spec.*	204	328	477		1009	1B
Dichromadora hyalocheile De Coninck & Stekhoven, 1933	9	5	1		15	2A
Dichromadora Kreis, 1929 *spec.*	1	1	1		3	2A
Neochromadora poecilosoma ~~Mickoletzky, 1924~~	1	1	1		3	2A
Neochromadora quinquepapillata Stekhoven, 1935	13	10	5		28	2A
Chromadorina Filipjev, 1918 *spec.*	2	3	8		13	2A
Prochromadorella Mickoletzky, 1924 *spec.*	1				1	2A
Paralongicyatholaimus macramphis Lorenzen, 1972	3	2	3		8	2A
Anticoma Bastian, 1865 *spec.*			2		2	1A
Halalaimus longicaudatus Filipjev, 1927			1		1	1A
Halalaimus de Man, 1888 *spec.*	8	11	23	2	44	1A
Enoploides Ssaveljev, 1912 *spec.*			5		5	2B
Enoplolaimus propinquus de Man, 1922	1	2	1		4	2B
Viscosia viscosa Bastian, 1865	3	2	11		16	1B
Viscosia de Man, 1890 *spec.*	11	2	42	3	58	1B
Fam. Chromadoridae Filipjev, 1917	8	12	23	3	46	-
Not identified, damaged species	6	4	67	45		

1. *Sphaerolaimus* Bastian, 1865 *spec. 1* : aff. *S. makrolasius* Schulz, 1932
spec. 2 : aff. *S. ostrae* Filipjev, 1918

2. *Cyartonema* Cobb, 1920 *spec.* : aff. *C. flexile* Cobb, 1920
aff. *C. germanicum* Juario, 1972

3. Ft = Feeding type
1A : Selective deposit feeders
1B : Non-selective deposit feeders
2A : Epigrowth feeders
2B : Omnivorous with capacity for predation and predators

Macrobenthos

The macrobenthic fauna was studied in three zones :

- Zone 1 : The near coastal zone and the mouth of the Scheldt estuary

(Vanosmael, 1977). In this zone, monitoring of 18 stations is still going on.

- Zone 2 : Two sandbanks, in an exploited and a non-exploited zone, were compared (Rappé, 1978).
- Zone 3 : A wintering-area of the common scoter, *Melanitta nigra* L. (Van Steen, 1978).

Zone 1 : The near coastal zone

Density and Biomass

Density varies between 80 ind. m^{-2} (st. 11671) and 31000 ind. m^{-2} (st. 12085) (table 10). In this last station and in st. 00050 the high density is due to the abundant mollusc *Mysella bidentata*. In the other stations, the most abundant taxon is generally the Polychaeta.

Out of 82 species found the most frequent are *Cistena cylindraria*, *Modiolus modiolus*, *Mysella bidentata*, *Nephtys cirrosa*, *N. hombergii*, *Tharyx marioni* and *Abra alba*. They were found in more than 50 % of the 40 replicates (table 11).

Biomass is calculated by means of species-specific regression curves between length and size (Govaere, 1978). The highest values are 42.67 g and 21.00 g ash free dry weight m^{-2} (resp. in st. 12085 and 00050), the lowest value is in st. 11671 with 0.004 g ash free dwt. m^{-2}. *Nephtys* spp., *Cystena cylindraria*, *Macoma baltica* and *Abra alba* are the most important species in terms of biomass.

Species diversity is quite stable (mean H = 2.1), the high dominance of *C. cylindraria* and *M. bidentata* is reflected in the eveness value of some stations (see also table 10).

Similarity

Using the Czekanowski-index for continuous data to study the similarity between replicates and between stations, and using the Mc.Connaughy-index for species affinity, Vanosmael (1977) found the macrofauna of replicates from the same station to be quite similar, and a rather high homogeneity of the macrofauna species composition over the whole area.

Table 10

Macrobenthos of the coastal zone of the Southern Bight
Density per taxonomical group and total density (ind./m^2), biomass in wet weight (g ww m^{-2})
and ash free dry weight (g Adwt m^{-2}), diversity H and evenness e per station

Station	Polychaeta	Mollusca	Crustacea	Echinodermata	Others	Total	g ww m^{-2}	g Adwt m^{-2}	H	e
10791	210	30	20	0	0	260	4.20	0.35	2.30	0.75
11851	1350	520	20	0	340	1830	24.55	1.75	2.01	0.45
12520	1400	130	10	0	0	1540	1.55	1.30	2.20	0.37
12501	360	520	160	3	160	1200	5.35	0.65	2.51	0.69
11671	20	50	20	0	0	80	0.05	0.004	0.80	0.63
12110	1160	120	70	3	0	1350	12.00	1.20	2.50	0.67
11331	60	110	10	0	0	180	1.25	0.15	2.05	0.83
11121	80	30	30	0	0	140	2.60	0.20	2.84	0.94
10972	1350	170	30	3	10	1570	18.65	1.50	2.71	0.65
12085	5960	24580	10	0	230	30780	1046.75	42.65	0.89	0.24
11315	110	130	20	0	0	260	8.95	0.45	2.23	0.79
11880	2380	700	10	0	310	3400	23.10	1.55	1.49	0.39
00050	3800	5630	100	5	190	9720	228.65	21.00	2.64	0.53
Mean	1400	2520	40	1	100	4020	106.00	5.60	2.10	0.61
St. Err.	490	1880	10	0.5	40	2340	80.20	3.40	0.18	0.06

Table 11

Macrobenthos of the Southern Bight
Absolute number and frequency per species for 40 replicates

Species	Number	Frequency	Species	Number	Frequency
POLYCHAETA			MOLLUSCA		
Harmothoe lunulata	90	2	*Modiolus modiolus*	618	29
Harmothoe ljunglmani	2	1	*Mysella bidentata*	9163	29
Lagisca extenuata	6	2	*Montacuta ferruginosa*	31	4
Pholoe minuta	68	4	*Cerastoderma edule*	14	6
Sthenelais boa	5	2	*Venerupis pullastra*	1	1
Eteone longa	90	9	*Petricola pholadiformis*	1	1
Eteone flava	1	1	*Donax vittatus*	9	7
Hesionura augeneri	38	2	*Macoma balthica*	23	11
Anaitides mucosa	161	5	*Tellina fabula*	10	1
Eumida sanguinea	335	5	*Tellina tenuis*	3	3
Microphthalmus similis	20	3	*Abra alba*	370	21
Gyptis capensis	4	1	*Spisula solida*	4	2
Autolytus prolifer	4	1	*Spisula elliptica*	2	1
Autolytus edwardsi	1	1	*Sphenia binghami*	3	3
Websterinereis glauca	3	2	*Thracia papyracea*	1	1
Eunereis longissima	13	2	CRUSTACEA		
Nephtys cirrosa	95	21	*Crangon crangon*	12	10
Nephtys hombergii	92	21	*Carcinus moenas*	11	1
Nephtys caeca	1	1	*Gastrosaccus spinifer*	34	4
Glycera capitata	4	1	*Mysida sp.*	1	1
Lumbrinereis latreilli	1	1	*Schistomysis kervillei*	4	3
Protodorvillea kefersteini	1	1	*Gammarus sp.*	10	4
Scoloplos armiger	219	17	*Melita obtusata*	4	1
Spio filicornis	169	17	*Nototropis falcatus*	7	5
Polydora ciliata	11	3	*Urothoe grimaldii*	5	3
Polydora pulchra	9	2	*Bathyporeia guilliamsoniana*	2	2
Pygospio elegans	8	6	*Bathyporeia elegans*	12	5
Spiophanes bombyx	73	13	*Microprotopus maculatus*	6	2
Polydora ligni	48	10	*Corophium sp.*	1	1
Scolelepis foliosa	1	1	*Corophium volutator*	1	1
Scolelepis bonnieri	7	4	*Pariambus typicus*	6	4
Magelona papillicornis	45	14	*Pseudocuma longicornis*	6	4
Caulleriella alata	1	1	*Diastylis rathkei*	39	15
Tharyx marioni	169	25	ECHINODERMATA		
Chaetozone setosa	1	1	*Ophiura texturata*	1	1
Ophelia limacina	5	3	*Ophiura albida*	1	1
Capitella capitata	148	18	*Echinocardium cordatum*	3	3
Capitomastus minimus	4	2	NEMERTINEA		
Notomastus laterceus	17	3	*Nemertinea spp.*	170	9
Heteromastus filiformis	79	12	PHORONIDA		
Cistena cylindraria	3484	33	*Phoronida spp.*	24	4
Lanice conchilega	309	15	OLIGOCHAETA		
Protodrillus sp.	10	2	*Oligochaeta spp.*	196	13
Saccocirrus papillocercus	2	1			

However, the classification of stations in relation to the sediment composition was not clear.

Zone 2 : Sandbank-zone

Two cruises (Oct. '77 and March '78) were to compare two sandbanks, the Buiten Ratelbank and the Kwintebank. A part of the latter is used for sand exploitation. The macrofauna study of this bank is still going on.

In eight stations the sediment consists of fine sand, but in station ZB 7 and ZB 1 we found medium and coarse sand respectively.

Density, biomass and species composition are quite similar on the two sandbanks, both in October and March. Mean density (biomass) for Oct. '77 and March '78 was resp. 200 (0.36 g) and 120 ind. m^{-2} (0.21 g ash free dwt. m^{-2}).

These values are rather low when compared with the surrounding area. The most abundant species were *Hesionura augeneri, Nephtys cirrosa, Spio filicornis, Scolelepis bonnieri, Ophelia limacina* (all Polychaeta), Archiannelida, the Mysid *Gastrosaccus spinifer*, the Tanaid *Tanaissus lilljeborgii* and the Amphipod *Bathyporeia elegans*. Diversity was also quite similar and mean values of 2.1 (October) and 1.5 (March) were found.

Zone 3 : Melanitta nigra-zone

Every year, from November till February a large population (up to 8500 ind.) of the common scoter, *Melanitta nigra* L., which feeds mainly on Mollusca, is wintering off the Belgian west coast.

Density of the macrobenthos varies between 190 and 26200 ind. m^{-2}, biomass between 0.6 and 33.3 g ash-free dwt. m^{-2}. Except for one station (z 8) the Mollusca were the most important taxon in terms of biomass. The most important species are *Tellina fabula, Abra alba, Mysella bidentata, Venerupis pullastra* and *Macoma balthica*.

Mean biomass for the whole area was 95.7 g wet weight m^{-2}. Based on the estimated daily food-consumption rate per scoter and the average number of days the population remains in this area, the food consumption during the winter period was estimated at 7.5-18 % of the stock.

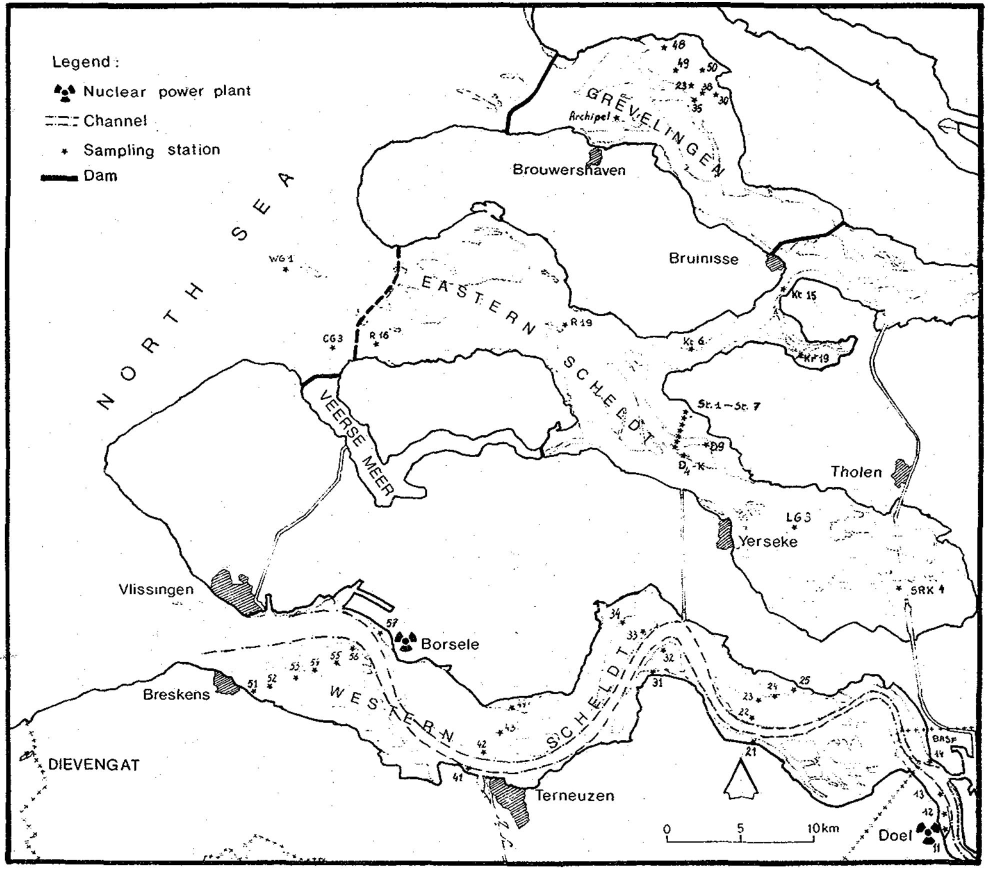

fig. 3.

Localisation of the stations in the Western Scheldt, Eastern Scheldt, Lake Grevelingen and Dievengat.

ESTUARIES

The delta region of the Scheldt, Meuse and Rhine in the Netherlands (fig. 3) has been the subject of intensive biological surveys since the establishment of the Delta Institute of Hydrobiological Research at Yerseke. One of the few gaps remains the study of hard-bodied meiofauna, although de Man already studied nematodes in this area at the beginning of the century. Some of the soft-bodied taxa were studied qualitatively by Den Hartog (e.g. 1966), Bilio (1966), Wolff et al. (1974) and Boaden (1976). Our data give the first quantitative information about Nematoda and Harpacticoida, but many of them are preliminary. These data are supplemented by data of the Ems-Dollard estuary in the north of the Netherlands.

The Western Scheldt estuary

Five transects from Doel (mesohaline) at the Belgian-Dutch border to Vlissingen at the mouth are currently being studied. Stations are situated mostly in the shallow sandy parts of the river; because the deeper channels are being frequently disturbed by the intense traffic and periodical dredging they do not allow the development of stable populations. Density of nematodes is extremely low at Doel (164 ind./10 cm^2 in 1978) whereas it varies between 1096 ind./10 cm^2 and 1691 ind./10 cm^2 in the other transects in September 1978, with a tendency of increasing towards the mouth (fig. 4). However, very high densities are found in the salt marsh of Saaftingen (WSS1 and WSS2) and in the river near it at Valkenisse. The density of all meiobenthic taxa is given in table 12, averaged for the transect, for September 1978, except for Doel, where a yearly average is given. The number of higher taxa increases towards the mouth of the river, from only 4 at Doel (Nematoda, Polychaeta, Oligochaeta and Copepoda) to 10 at Vlissingen, the only transect where Hydrozoa and Tardigrada are present. Harpacticoid density is rather low in all transects and varies between 1000 and 2000 ind./m^2, but up to 35,000 ind./m^2 are found in the salt marsh at Saaftingen and 21,000 ind./m^2 occur at the mouth. In this last transect there is a rich fauna with typical interstitial forms such as *Kliopsyllus constrictus*, *Paramesochra similis*, *Paraleptastacus espinulatus*, *Evansula pygmaea* and *Arenocaris bifida*. Other common

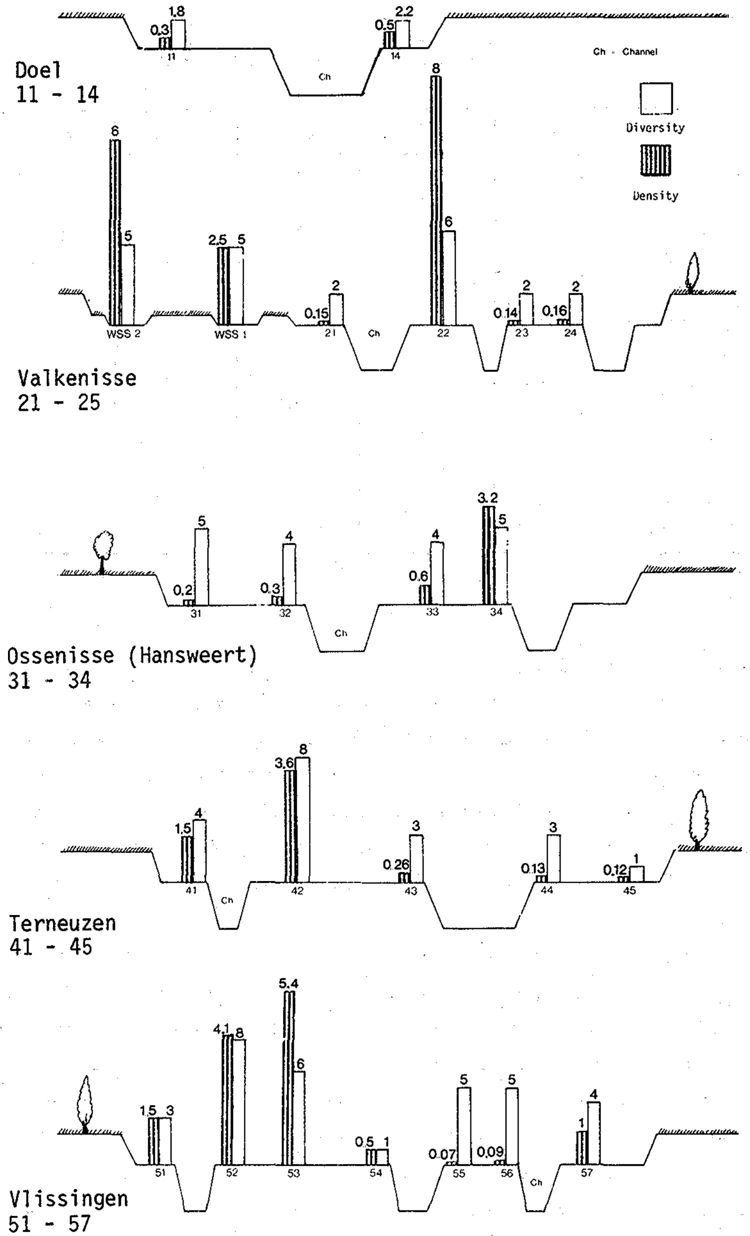

fig. 4.

Taxonomic group diversity and nematode density (ind. 10^6 m^{-2}) in the Western Scheldt Estuary

Table 12

Mean density (ind./10 cm^2) and average number of taxa per sample in five transects along the Western Scheldt estuary in September 1978

	Doel[1]	Valkenisse	Ossenisse	Terneuzen	Vlissingen
Hydrozoa	-	-	-	-	1.0
Turbellaria	-	3.3	6.8	1.5	6.3
Nematoda	164	2087	1096	1348	1691
Gastrotricha	-	-	3.8	6.0	50.9
Oligochaeta	1.0	5.8	1.8	1.5	6.1
Polychaeta	2.5	0.3	-	6.8	0.6
Mollusca	-	1.0	1.3	4.8	1.4
Harpacticoida	0.2	1.8	5.8	2.3	20.4
Ostracoda	-	5.3	0.3	7.3	6.0
Tardigrada	-	-	-	-	4.3
Total	178	2104	1115	1378	1788
Taxa per sample	2.2	3.0	4.0	4.3	4.4
Taxa per transect	4	7	7	8	10

1. Average over 1977-1978

species include *Canuella perplexa, Halectinosoma herdmani, H. gothiceps, Pseudobradya minor, P.* cf. *beduina, Tachidius discipes, Stenhelia palustris, Asellopsis intermedia* and *Euterpina acutifrons*. The same species, but in lower overall density, occur in the transects near Terneuzen and Ossenisse, whereas at Valkenisse only one species is present (*Stenhelia palustris*). In the salt marsh of Saaftingen only *Nannopus palustris, Stenhelia palustris* and *Platychelipus littoralis* were found in December 1978.

However, in the detailed study of the Doel transect by Holvoet (1978), harpacticoid copepods occurred, but only in 5 out of 64 samples taken at 9 stations on both sides of the river in 1977-1978. They belonged to only three species : *Asellopsis intermedia* (2 females at one station and one date), *Nitocra typica* (one male at one station and one date) and *Stenhelia palustris* (4 individuals at four stations and four dates). Mean nematode density over all these samples was 164,000 ind./m^2 , an extremely low figure. Density was consistently low at the BASF stations situated on the right bank near the BASF chemical plant, but fluctuated wildly at the WS stations situated near the outlet of the thermal effluents from the nuclear power plant at Doel. Biomass was low as well (mean value 24 mg dwt./m^2 for all stations and samples), and so was diversity, with an average value of 1.5 bits, but a significantly higher diversity at the BASF-stations. Populations in the WS-stations are very unstable though the taxocene is quite similar in both station-groups. Dominant species are *Trichotheristus mirabilis*, *Mesotheristus setosus* and *Chromadorita nana*, which account for 61 % of the fauna. Other important species are *Enoplolaimus litoralis*, *Tripyloides marinus*, *Ascolaimus elongatus* and *Microlaimus spec.* These seven species account for 72 % of the fauna.

The Eastern Scheldt estuary

Preliminary studies of the harpacticoid copepods and nematodes of this fully marine estuary have been made by Janssens de Varebeke (1977), Surkyn (1977) and Willems (unpublished). Nematodes were studied from Van Veen samples and SCUBA diver samples from 10 stations covering the whole estuary in August 1976 (fig. 3). Although 97 species were found, only seven of them occur in more than five stations and they account for 73 % of all individuals which were found during the investigation. These seven species are *Theristus spp.*, *Viscosia viscosa*, *Sabatieria spec.*, *Odontophora armata*, *Cylindrotheristus spec.*, *Cyatholaimidae spec.* and *Axonolaimus spec.* Species occurring at less than five stations are probably too rare to be sampled adequately : 39 species were found at only one station, 10 species at only two stations. Only one species has both high density and is rare : *Dichromadora hyalocheile*, although only occurring at three stations, was extremely numerous in CG3, a station situated outside the estuary, where only 5 species were found. Usually, the average number of species per sample varies between 14 and 25 and is lower in Van Veen samples than in SCUBA diver samples, when this could be compared. In the North Sea station WG1, where extremely strong currents occur, 15 species were found in the Van Veen grab but 23 in SCUBA diver samples; in station SRK 4, at the head of the Eastern Scheldt, these figures are 15 and 34 respectively. Diversity varied between 0.6 bits in CG3 (see above) and 3.3 bits in LG3. When these extreme stations are not included the average value is 2.7 ± 0.2 bits per individual.

Density of nematodes was only estimated in the SCUBA diver samples. In the muddy station SRK 4 3285 ind./10 cm^2 were found but only 92 ind./10 cm^2 in station WG1 at the mouth of the estuary. This very low value is probably due to the very strong currents in this area forcing the nematodes to remain deeper into the sediment (sampling was to 10 cm depth).

Surkyn (1977) studied 7 intertidal stations forming a transect from high to low water level and one subtidal station on the same transect in August 1976. Although there is a trend of increasing density towards the low water level, at least in the upper 4 cm of the sediment, overall density was not significantly different in the intertidal stations (930 ± 253 ind./10 cm^2) when compared to the subtidal station (1829 ind./10 cm^2). The same is true for biomass where values of 1.02 ± 0.29 g dwt./m^2 (intertidal) and 1.85 g dwt./m^2 (subtidal) were found.

Harpacticoid copepods from the same transect were also studied. There was no clear trend in density, nor a significant difference between intertidal and subtidal stations. An overall average is 119 ± 36 ind./10 cm^2. Foorteen species were found during this study; dominant were *Asellopsis intermedia*, *Harpacticus flexus*, *Hastigerella spec.*, *Halectinosoma herdmani*, *Pseudobradya minor* and *Enhydrosoma propinquum*, which together account for 96 % of all individuals found. Mean diversity of the whole transect was 1.8 ± 0.7 bits/ind. Willems (unpublished) determined 18 species in the subtidal stations covered in the study of Janssens de Varebeke (1977). Although quantitative information is lacking, important species appear to be *Canuella perplexa*, which occurs throughout the whole estuary but not in the mouth, *Paraleptastacus espinulatus*, *Kliopsyllus constricta*, *Halectinosoma herdmani* and *H. gothiceps*, *Pseudobradya beduina* and *Longipedia spp.*

Lake Grevelingen

The meiofauna of this landlocked marine lake (the estuary was closed in 1971) has been studied by Goossens (1976), Surkyn (1977) and Heip et al. (1977). It is the subject of an ongoing detailed study by Willems (in preparation). Surkyn (1977) studied seven stations, in a former intertidal area now permanently submerged, from samples taken in August 1976. In this area 18 species of harpacticoids were found with an overall average density of 200 ± 94 ind./10 cm^2. Dominant species are *Canuella perplexa, Ameira parvula, Harpacticus flexus, Ectinosoma spec., Longipedia minor* and *Pseudobradya minor*, accounting for 94 % of all individuals. Mean diversity was 1.9 ± 0.8 bits/ind. Goossens (1976) found *Asellopsis hispida* to be dominant in the shallow sandy station Archipel in November 1974, with a density of 416 ± 44 ind./10 cm^2 on a total of 655 ± 67 ind./10 cm^2 (n = 4) as estimated with small cores (Heip et al., 1977).

The average density of nematodes in the area studied by Surkyn (1977) was 1291 ± 335 ind./10 cm^2, with a corresponding biomass of 1.4 g dwt./m^2. However, density at Archipel was considerably lower : 853 ± 105 ind./10 cm^2 as estimated from large cores (Heip et al., 1977). In this station the dominant species of nematodes were *Prochromodorella ditlevseni, Theristus problematicus, Microlaimus spec., Anticoma limalis, Enoploides cephalophorus* in the upper layers whereas *Sabatieria spec., Cobbia spec.* and *Theristus spec.* occurred deeper in the sand.

The Ems-Dollard estuary

The harpacticoid copepods of five station groups along a 40 km transect from the head to the mouth of this estuary, which is situated on the Dutch-German border, have been studied by Vaeremans (1977). Density, biomass and diversity of the harpacticoids showed a trend of increasing values towards the mouth (table 13).

Table 13

Mean density (ind./10 cm^2), biomass (mg dwt./m^2) and diversity (bits/ind.) of Harpacticoid Copepods at six station groups along the Ems-Dollard estuary

	Uithuizer Wad	Eemsnaven	Hoog Watum	Reiderplaat	Heringsplaat	Oost-Fr. plaat
Density	77 ± 48	79 ± 12	34 ± 20	33 ± 7	36 ± 22	21 ± 7
Biomass	106 ± 45	122 ± 20	43 ± 29	33 ± 7	32 ± 11	22 ± 16
Diversity	1.5 ± 0.2	2.2 ± 0.1	1.4 ± 0.1	1.4 ± 0.1	0.9 ± 0.2	0.3 ± 0.1
Nr. species	21	13	16	10	7	6
Nr. stations	14	16	6	13	4	17
Nr. dates	2	3	2	2	1	4
Distance	40 km	38 km	28 km	10 km	8 km	1.4 km

Outside the mouth of the estuary, at the Uithuizer Wad in the Wadden Sea, the taxocene is dominated by *Harpacticus flexus, Tachidius discipes, Asellopsis intermedia, Canuella perplexa, Enhydrosoma propinquum, Halectinosoma herdmani* and *Microarthridion littorale*. This is the same community as found at Eemshaven, although *Halectinosoma herdmani* appears to be more common there, and at Hoog Watum. At Reidersplaat two other species appear or become dominant : *Paronychocamptus nanus* and *Nannopus palustris*, whereas other species disappear : *Canuella perplexa, Paronychocamptus curticaudatus* and *Asellopsis intermedia*. Reidersplaat is situated in the Dollard itself and a general impoverishment of this area is apparent : only three species remain important at Heringplaat (*Paronychocamptus nanus, Stenhelia palustris* and *Nannopus palustris*) and the same three species characterize Oost-Friese plaat. In November 1976 only one species *Stenhelia palustris*, survived the huge input of organic material at that time at this site. It occurs throughout the estuary, but remains rare as long as conditions are favourable for other species, and it could serve as an indicator species.

The nematodes of this area are being investigated by Bouwman (in press) who found the following species to be important in the polluted area : *Eudiplogaster pararmatus, Hypodontolaimus geophilus, Mesotheristus setosus, Anoplostoma viviparum* and *Sabatieria vulgaris*.

The Dievengat

This shallow polyhaline brackish water pond in northern Belgium has been the subject of intense meiofauna research since 1968 dealing with harpacticoid copepods, ostracods and nematodes (e.g. Heip, 1976; Heip et al., 1978). These investigations aim at the establishment of long time series, spatial patterns and the elucidation of the dynamics of the dominanat populations in the field. It is mentioned here because many of the species occurring in the Dievengat are important in other brackish water areas as well. Dominant harpacticoid copepods are *Paronychocamptus nanus, Tachidius discipes, Canuella perplexa* and *Amphiascoides debilis* in some years. Important nematode species are *Oncholaimus oxyuris, Anoplostoma* *viviparum, Theristus spp., Leptolaimus limicolus, Sabatieria spec., Metalinhomoeus filiformis* and others.

Of the harpacticoid copepods, only four species were common during the period of investigation. *Canuella perplexa* and *Paronychocamptus nanus* are mainly detritivores and show complicated dynamics with more than one peak yearly. *Halicyclops magniceps* and *Tachidius discipes* are mainly herbivorous and show simple dynamics with only one peak each year. In both these species-pairs there is segregation in the temporal dimension and the larger species of both pairs occurs later in the year. In all the species the number of generations occurring during a year is much smaller than what is possible according to their reproductive potential.

The dynamics of these populations were analysed by spectral analysis. All parameters which were examined (density and biomass of populations, density and diversity of the taxocene) have most of their variance explained by phenomena with low periodicities. This is a desirable property for parameters in monitoring especially on sea, as the number of samples necessary to characterize the phenomenon will be low (Heip, in press).

Summary

A summary of work on benthic communities in the Southern Bight of the North Sea and adjacent estuaries is presented. This work investigates patterns in species composition, in density and biomass which are stable enough, both in the temporal and spatial domain, to be used as baseline data in monitoring, and from which information on systems functioning can be obtained.

Acknowledgments

Much of the work reported here was assisted by biology students among whom André Goossens, Guy Janssens de Varebeke, Guido Rappé, Rudy Surkyn, Marleen Vaeremans and Els Van Steen have been particularly helpful. Technical assistance from Alex Braeckman, Rosette De Boever, Mark De Keere, Gerrit Lambert, Anita Van Bost and Dirk Van Gansbeke is gratefully acknowledged. We are also particularly grateful to all public instances that have always assisted us with great competence : the Management Team of the Mathematical Model North Sea (Ministry of Public Health, Belgium), the Sea Service of Antwerp (Ministry of Works, Belgium), the Rijkswaterstaat at Vlissingen (Flushing) (Ministry of Works, The Netherlands), the Delta Institute of Hydrobiological Research at Yerseke (The Netherlands) and the Biological Research Ems-Dollard Estuary Group at Groningen (The Netherlands).

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