

## Species composition and diversity

The diversity or variety of the fauna in a given area can be expressed in terms of the number of species (or taxa). Besides, it is also important to know whether the total density present is evenly divided over all the species or, as is the case in most situations, over only a few dominant species, representing the majority of the individuals. Therefore mathematical formulas are used to express the diversity of a community in a studied area, allowing the comparison in time and with communities in (sedimentologically) identical areas elsewhere. The zoobenthic diversity is given here by the Hill diversity formula, expressed as Hill's diversity numbers (Hill, 1973). The relationship between other commonly used measures of diversity and Hill's numbers ( $Hill_a$  or  $N_a$ ) is as follows:

$Hill_0 = N_0$  the number of species/taxa present in a sample.

$Hill_1 = N_1 \exp(H')$  ( $H'$  = Shannon-Wiener index; Shannon & Weaver, 1949).

$Hill_2 = N_2 / SI$  ( $SI$  = Simpson's index of dominance; Simpson, 1949).

$Hill_\infty = N_\infty$  the reciprocal of the proportional abundance of the most common species/taxa.

A higher Hill's number ( $a$ ) gives relatively more weight to the dominant species than a lower Hill's number.

## Macrobenthos

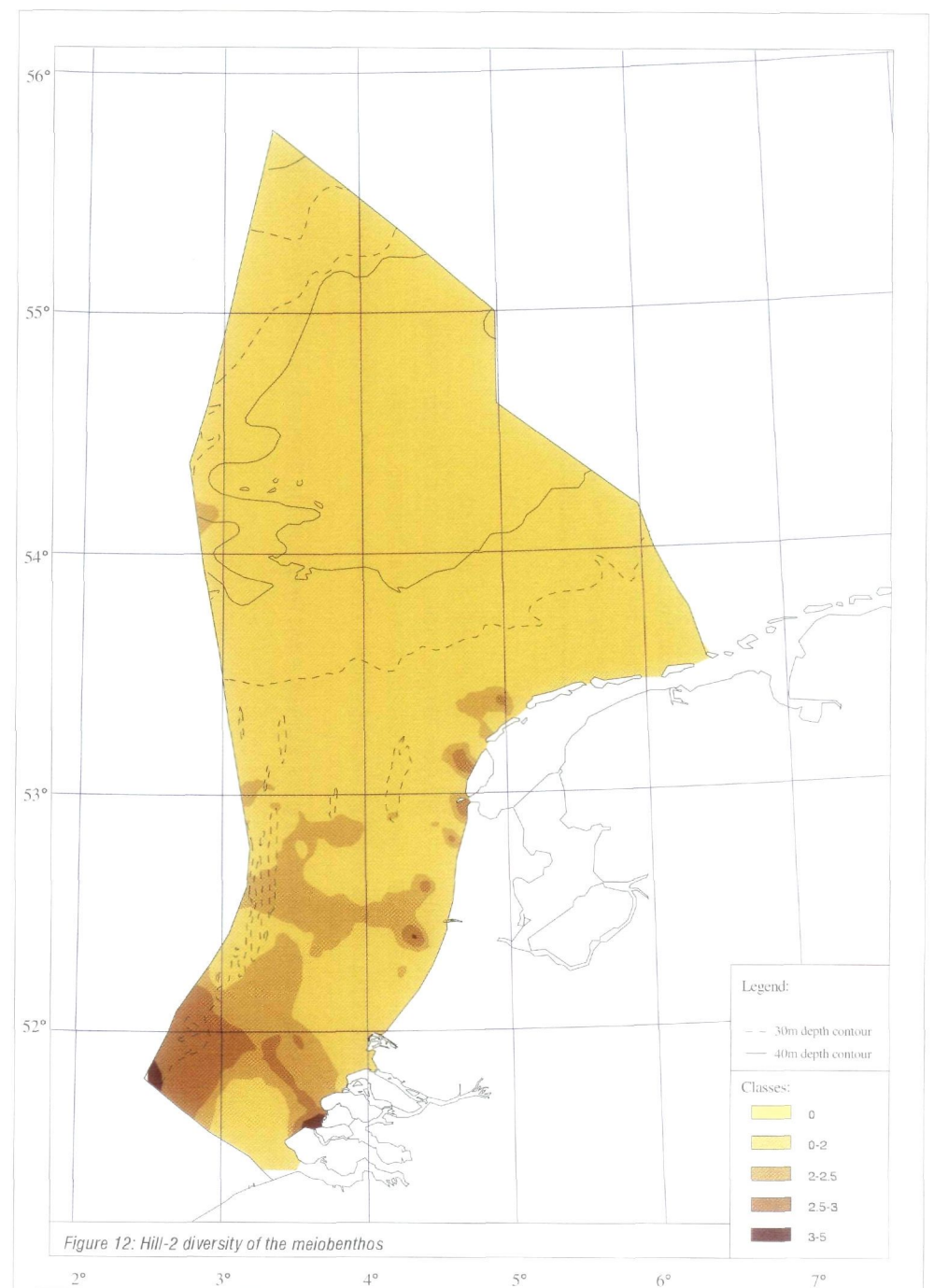
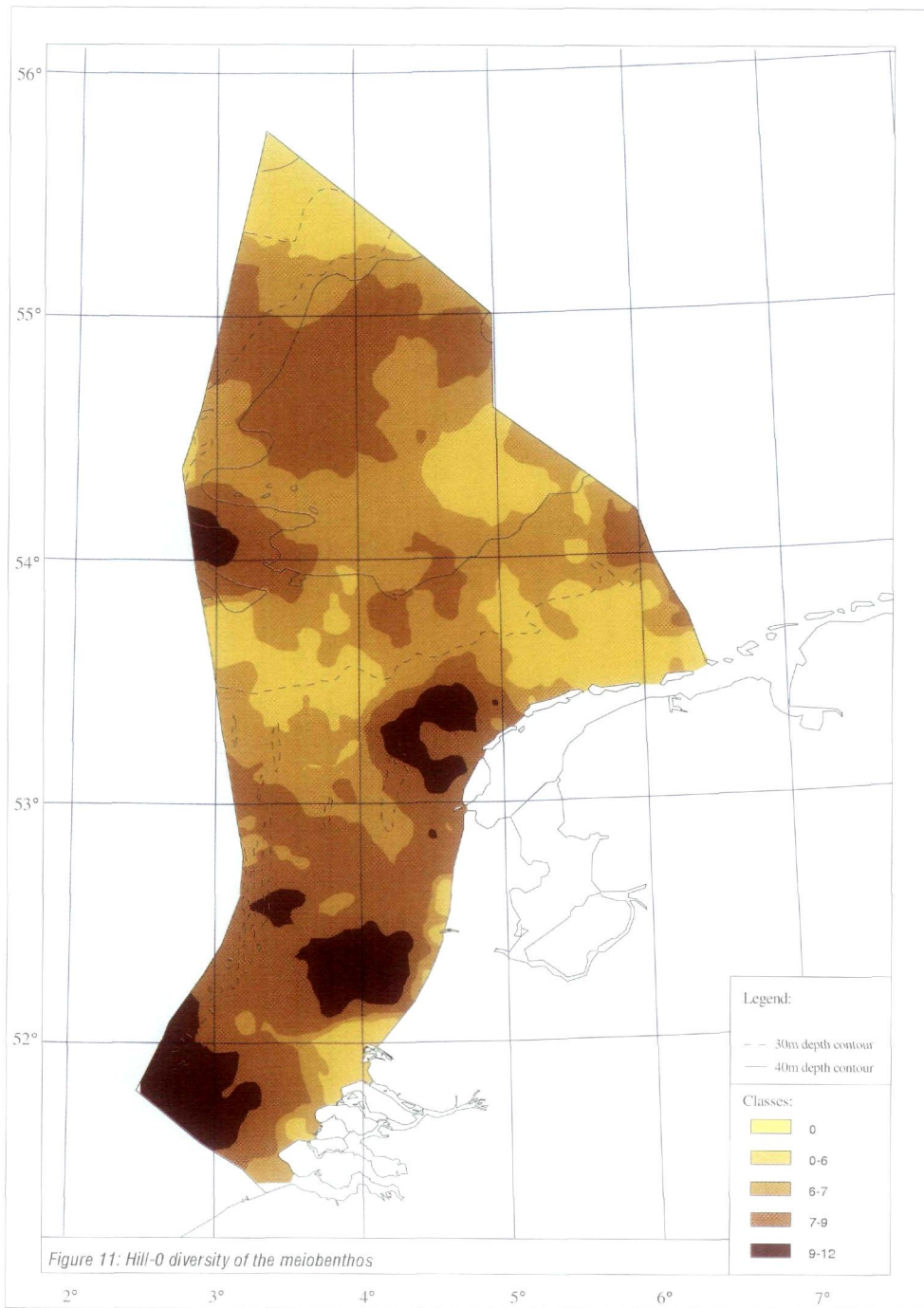
A total of 451 macrobenthic species were identified in 1091 samples. The major part of the species is either polychaete or crustacean, while molluscs and echinoderms are represented with a lower number of species in the southern North Sea.

Besides a small set of very common species occurring in more than 60% of the samples, (e.g. *Echinocardium cordatum*, *Spiophanes bombyx*, *Nephtys cirrosa*, *Scoloplos armiger* and *Magelona papillicornis*) an important part of the species has a particular distribution pattern linked with sediment preference. Examples of species exclusively found in the northern part of the study area with fine grained muddy sediment are *Chaetopterus variopedatus*, *Harpinia antennaria* and *Nucula nitidosa*, while *Aricidea minuta* and *Donax vittatus* represent species only found in the southern part, where sandy bottoms predominate. Because the 30 m isobath (circa 53°30'N) separates the southern sand from the northern muddy bottom, it also coincides with the major break in the composition of the macrofauna (see also section 'Assemblages of the zoobenthos'). Only few of the species that are abundant in the brackish Wadden Sea and Delta estuaries are found in the North Sea proper, mainly close to the coast (*Capitella capitata*, *Macoma balthica* and *Tellina tenuis*).

Different aspects of the diversity of the macrobenthos on the Dutch Shelf are represented by Hill's numbers. The values for  $Hill_0$  (figure 9), that is species density, or the number of species per unit surface area, show a distinct increase towards the northern part of the Dutch sector. Minimum values are recorded in the Voordelta and in the Southern Bight. Relatively high species density is found north of the Frisian Wadden islands, at the Oyster Ground and at the Dogger Bank, where 22 to 64 species were present in one sample. The high values at the shallow sandy Dogger Bank suggest that  $Hill_0$  bears little relation with grain-size or depth. Heip *et al.* (1992) showed on the basis of 200 stations sampled in the southern, central and northern North Sea that species density indeed follows a latitudinal gradient with increasing values in northerly direction.

Figure 10 shows the distribution of values for  $Hill_2$ , which is a measure for the degree of numerical dominance by one or a few species. Low values for  $Hill_2$  denote high dominance. A relatively high degree of dominance can be observed north of some Wadden islands, at the Frisian Front area and in the western part of the Oyster Ground. A comparison of figures 9 and 10 shows that species richness ( $Hill_0$ ) and dominance ( $Hill_2$ ) do not show a consistent relation. High species richness is sometimes combined with high dominance (Frisian Front) and in other places with low dominance. Similar conclusions were drawn by Duineveld *et al.* (1990) on the basis of the results of the NSBS survey, which covered a somewhat larger area than the present one.

At this stage no satisfactory explanation other than some theoretical and speculative consideration can be given for the diversity pattern. This consideration pertains, for instance, to the variations in abiotic



parameters. The dynamic conditions (temperature, tidal amplitude, bed perturbation) in the southern North Sea will favour adaptive species with great reproductive potential while the more stable conditions, for example north of the Dogger Bank, allow more sensitive species to invade the community as well. Other explanations refer to the temperature ranges in the area, which prevent cold-water species to survive in the southern North Sea but do not hamper the southern species to spread northwards. Another factor affecting the structure of the community is food availability. The amount of food determines the biomass and abundance of macrofauna and indirectly the maximum number of species in a unit surface area (Künitzer *et al.*, 1992; Heip & Craeymeersch, 1994). Clearly more fundamental and experimental research on larval recruitment is needed to be able to verify which factors are most important in determining the degree of diversity.

### **Meiobenthos**

A total of 15 meiobenthic taxa were identified in 734 samples. The major part of the total densities consists of the taxa Nematoda, Copepoda, Gastrotricha and Turbellaria. Highest numbers of taxa ( $Hill_0$ ) are found in the sandy areas of the Southern Bight and north of Rottum (figure 11). The lowest diversity in taxon numbers is found in the Frisian Front area and in parts of the Voordelta.

Increasing Hill diversities ( $1^\infty$ ), consequently giving more attention to the distribution of the individuals over the taxa, show that the most diverse areas are found in the Southern Bight, in the southern Voordelta and in the coarse Pleistocene sands north of Texel and Rottum (for  $Hill_2$ , see figure 12). Coarser sandy habitats are inhabited by a diverse (taxon-based) meiobenthic community with relative low densities, whereas the muddy areas with high total densities are dominated by only a few taxa, mainly Nematoda.

Figure 13

TWINSPAN-generated dichotomy of the macrobenthos samples of the Dutch Continental Shelf, based on density data. Indicator species (see text) and number of samples are mentioned at each division.

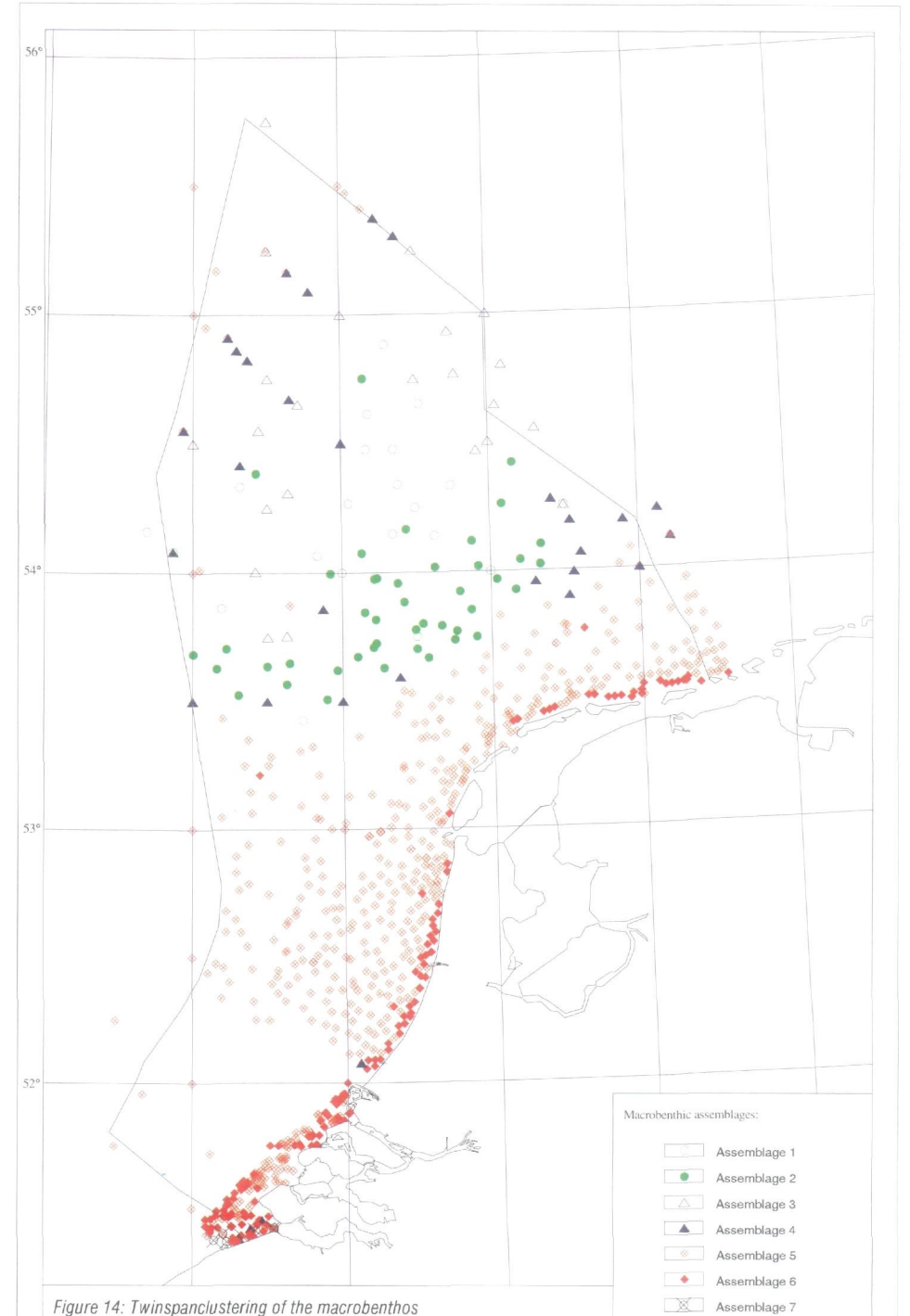
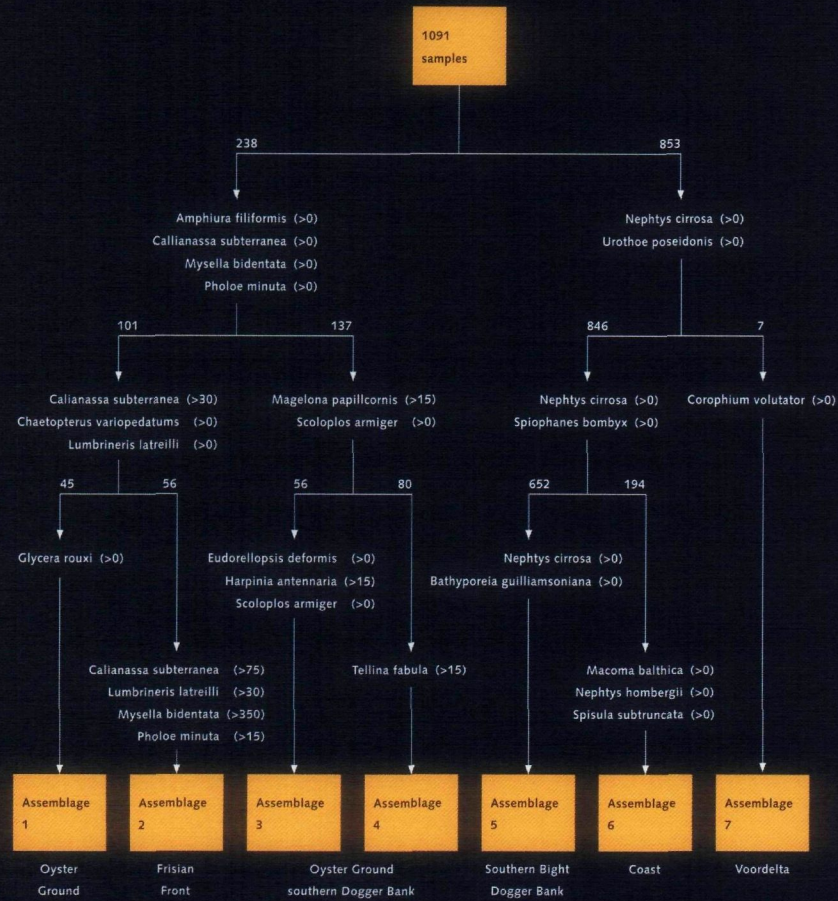


Figure 14: Twinspanclustering of the macrobenthos

## Assemblages of the zoobenthos

Assemblages were identified by means of the TWINSpan program (Hill, 1979), which produces repeated divisions of the stations into subgroups, each of which is accompanied by a set of characteristic species occurring solely or predominantly in that subgroup. Such indicator species may also be further characterized by their density. For example the indicator species *C. subterranea* (>75) (figure 13) means that *C. subterranea* occurs with densities of over 75 individuals per m<sup>2</sup> predominantly in the accompanying subgroup (assemblage 2).

## Assemblages of the macrobenthos

The input for TWINSpan consisted of the abundance data from 448 species spread over 1091 samples. At the first division level the studied area is split roughly at the 30 m isobath into a northern group of muddy and a southern group of sandy stations (see figure 13). The close relation between species occurrence and sediment type is illustrated by the fact that some northern stations with a sandy bottom (Dogger Bank, south-east of the Cleaver Bank) are put in the southern station group. At the second division level, seven stations in the Voordelta are split off the southern stations and the northern group is divided into two groups with different quantities of mud in the sediment. Finally at the third division level, station groups comprising the Frisian Front area and the coastal area are distinguished, adding up to a total of seven groups or assemblages that largely correspond to various subareas of the Dutch Continental Shelf (figure 14). The 'indicator' species belonging to the seven assemblages and their abundances are presented in Table 4. Because the seven assemblages differ in terms of sediment composition, depth and macrobenthic fauna, they can be described accordingly (see also Table 5).

Table 4 The abundance (mean and standard deviation) of the TWINSpan-indicator species per assemblage.

Assemblage	Oyster Ground		Frisian Front		Oyster ground southern Dogger Bank				Southern Bight		Coast		Voordelta	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Macrobenthos species (ind./m <sup>2</sup> )	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.
<i>Amphiura filiformis</i>	483	445	1048	750	922	490	560	738	11	9	–	–	–	–
<i>Bathyporeia guilliamsoniana</i>	–	–	–	–	7	11	3	5	52	71	24	19	–	–
<i>Callianassa subterranea</i>	88	47	156	77	42	32	42	31	9	21	–	–	–	–
<i>Chaetopterus variopedatus</i>	71	81	42	42	6	9	8	10	7	6	–	–	–	–
<i>Corophium volutator</i>	–	–	–	–	–	–	–	–	15	–	–	–	191	324
<i>Eudorellopsis deformis</i>	3	–	59	–	51	52	5	7	9	5	–	–	–	–
<i>Glycera rouxii</i>	312	295	35	28	8	6	3	–	3	–	–	–	–	–
<i>Harpinia antennaria</i>	39	24	62	45	65	39	22	24	1	1	–	–	–	–
<i>Lumbrineris latreilli</i>	42	46	124	83	17	–	31	60	4	4	1	0	–	–
<i>Macoma balthica</i>	–	–	–	–	–	–	–	–	59	95	225	375	74	–
<i>Magelona papillicornis</i>	6	7	19	6	86	33	256	377	399	1128	530	1653	–	–
<i>Mysella bidentata</i>	83	80	574	514	536	329	482	565	29	31	100	130	–	–
<i>Nephtys cirrosa</i>	15	–	32	13	8	10	37	8	86	62	61	41	–	–
<i>Nephtys hombergii</i>	24	9	27	21	31	16	72	27	28	30	78	62	29	–
<i>Pholoe minuta</i>	21	7	87	93	117	73	99	96	10	13	19	18	–	–
<i>Scoloplos armiger</i>	5	–	54	33	52	43	10	13	65	118	82	110	15	–
<i>Spiophanes bombyx</i>	37	11	184	702	52	48	984	1134	721	2360	428	1984	–	–
<i>Spisula subtruncata</i>	–	–	–	–	3	1	2	–	454	1205	768	1239	–	–
<i>Tellina fabula</i>	4	–	59	44	9	12	96	153	79	113	145	171	–	–
<i>Urothoe poseidonis</i>	–	–	15	–	27	–	13	24	231	359	391	530	–	–

Table 5

Abiotic and biotic parameters (mean value and standard deviation) per assemblage.

Assemblage	Oyster Ground		Frisian Front		Oyster ground southern Dogger Bank				Southern Bight Dogger Bank		Coast		Voordelta	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Number of locations	45	56	57	80	652	194	7							
Abiotic parameters	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.
Depth (m)	47.1	4.6	39.9	4.1	41.1	6.1	31.2	9.5	22.6	9.0	12.0	4.5	15.2	8.9
Median grain size ( $\mu\text{m}$ )	104.8	20.7	127.0	19.7	143.2	43.2	153.4	31.0	272.6	68.9	196.7	54.8	209.6	103.1
Silt content (%)	15.6	5.2	17.0	6.3	7.8	3.2	9.2	6.1	1.5	2.1	7.2	12.0	35.2	27.8
Macrobenthos	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.
Density (ind./m <sup>2</sup> )	1437	572	3114	1952	2508	960	3079	2832	1965	2942	2556	3458	281	390
Biomass (g AFDW/m <sup>2</sup> )	22.7	10.0	33.3	20.0	12.9	4.3	23.6	13.5	13.6	20.0	40.8	52.7	2.6	4.0
Hill <sub>0</sub>	29.8	12.1	24.1	4.5	34.3	13.8	25.5	12.8	16.2	7.7	14.3	7.3	3.1	2.4
Hill <sub>-1</sub>	14.5	6.5	8.4	3.8	11.0	4.5	10.1	5.7	7.8	3.7	6.3	3.1	1.9	0.8
Hill <sub>-2</sub>	8.9	5.1	5.3	3.1	6.1	3.1	6.6	4.4	5.5	2.8	4.4	2.3	1.7	0.7
Hill <sub>-∞</sub>	4.0	2.0	2.9	1.4	3.1	1.3	3.4	2.0	3.1	1.4	2.6	1.1	1.6	0.8

**Assemblage 1** The first assemblage is found in the deepest area (mean depth: 47 m), situated at the Oyster Ground with very fine sand and a high mud content (on average 15.6%). Compared to the rest of the area the average density in this area is very low (mean: 1437 ind./m<sup>2</sup>) and the diversity relatively high (Hill<sub>0</sub>: 29.8). The polychaete *Glycera rouxii* is the characteristic species of this assemblage.

**Assemblage 2** The second assemblage includes the main part of the Frisian Front area and is characterized by the highest mud content (mean: 17%) of all assemblages. The average density is the highest (3114 ind./m<sup>2</sup>) in the Dutch part of the North Sea and the mean biomass is also high (33.3 g AFDW/m<sup>2</sup>). The diversity is relatively high (Hill<sub>0</sub>: 24.1), with a high dominance of a few species (Hill<sub>2</sub>: 5.3). The polychaetes *Pholoe minuta* and *Lumbrineris latreilli*, the mollusc *Mysella bidentata* and the crustacean *Callianassa subterranea* are 'indicator' species for this assemblage.

**Assemblage 3** The stations of this assemblage are found at the Oyster Ground and in parts of the Dogger Bank, and have sediments of muddy very fine sand. The diversity is the highest of the whole Dutch Continental Shelf (Hill<sub>0</sub>: 34.3) and the average biomass found is relatively low (12.9 g AFDW/m<sup>2</sup>). The macrobenthos is characterized by the crustacean *Harpinia antennaria* and *Eudorellopsis deformis*, and the polychaete *Scoloplos armiger*.

**Assemblage 4** This assemblage contains the shallow locations south of the Dogger Bank and in the south-eastern part of the Oyster Ground, between the 30 m and 40 m isobaths. The mean density, biomass and diversity are intermediate in this area (3079 ind./m<sup>2</sup>, 23.6 g AFDW/m<sup>2</sup> and Hill<sub>0</sub>: 25.5). The bivalve *Tellina fabula* is the 'indicator' species for the macrobenthos.

**Assemblage 5** This cluster includes more than half of all stations sampled (652 samples) and is found in the sandy area with the lowest mud content (1.5%). The assemblage is situated in the Southern Bight and north of the Dutch Wadden islands down to about 20 m of depth. The mean biomass (13.6 g AFDW/m<sup>2</sup>), the mean density (1965 ind./m<sup>2</sup>) and the diversity are low. The macrobenthic fauna is characterized by the polychaete *Nephtys cirrosa* and the amphipod *Bathyporeia guilliamsoniana*.

**Assemblage 6** This coastal assemblage is formed by 194 locations and runs from the Voordelta to the Wadden islands. In this area a sediment of muddy fine sand is found. The mean biomass is the highest (40.8 g AFDW/m<sup>2</sup>) of all assemblages. Except for 7 stations in the Voordelta (assemblage 7) the average number of macrobenthic species (Hill<sub>0</sub>: 14.3) is the lowest of the entire Dutch Continental Shelf. The bivalves *Spisula subtruncata* and *Macoma balthica* and the polychaete *Nephtys hombergii* are 'indicator' species for the macrobenthos in this area.

**Assemblage 7** The 7 stations comprising this assemblage are situated in the shallow area of the Voordelta. The sediment at these stations is one of fine sand (median grain size: 209.6 µm) with a very high mud content (mean: 35.2%). This assemblage differs from all others in terms of total density (281 ind./m<sup>2</sup>), biomass (2.6 g AFDW/m<sup>2</sup>) and diversity. For all these parameters the lowest values are found at these stations. The macrofauna is characterized by the crustacean *Corophium volutator*.

The outcome of the TWINSPAN analysis agrees well with classification schemes proposed on the basis of the individual surveys. The analysis of successive surveys in the Voordelta also showed the stations to differ from the surrounding area (Seip & Brand, 1987) and mentioned *Corophium volutator* as 'indicator' species of this area (cf. figure 13). Likewise the results of the MILZON-BENTHOS and the EXP\*BMN programs lead roughly to the same classification (Holtmann & Groenewold, 1992; 1994; Duineveld & Belgers, 1994). The Dogger Bank is the only area not included in the above-mentioned classification since the only substantial dataset for this area is part of an unpublished study completed in 1986/87 (Heyman, unpubl.). The Dogger Bank macrofauna has been the subject of an intensive German study by Kröncke (1990) who, by comparing current data with those from the period 1951-1952 (Ursin, 1960), concluded that the fauna has undergone a distinct change in composition. She attributed this change to increasing eutrophication and pollution of the North Sea in the intervening period.

In addition to the surveys listed in Chapter 3 there are a few studies dealing with the macrobenthos on the Dutch Continental Shelf that were not used for the purpose of this atlas because of their limited geographical or taxonomic scope. Eisma (1966), who undertook an intensive investigation of the distribution of mollusc species in the Dutch coastal area, found the occurrence of the mollusc species to be significantly correlated with the distance from the coast and with sediment parameters. This indicates that the processes occurring in the coastal waters are one of the factors determining the distribution of molluscs along the Dutch coast.

Creutzberg *et al.* (1984) described a benthic zoning at the boundary between sandy and silty sediment (the Frisian Front area). They reported a mean biomass of 13 g AFDW/m<sup>2</sup>, which is less than half the biomass found in the Frisian Front assemblage distinguished here (33 g AFDW/m<sup>2</sup>). In 1981 De Wilde *et al.* (1984) studied the macrobenthic community of the Oyster Ground and found a mean biomass of 35 g AFDW/m<sup>2</sup> at the Frisian Front area.

The classification of macrobenthic communities proposed for the entire North Sea by Künitzer *et al.* (1992) on the basis of the ICES-NSBS survey is not entirely comparable to the present result because of the much coarser sampling grid used and the larger area covered by the ICES survey. The high number of samples (i.e. 1091) used in this atlas provides a much higher degree of detail on the geographical limits of the assemblages. Nevertheless, Künitzer *et al.* (1992) also found a faunistic break at the 30 m depth contour, with a shallow coarse-sand assemblage in the south (atlas-assemblage 5) and a muddy fine sand assemblage in the north (atlas-assemblages 1 and 2). As a result of the difference in scale, Künitzer *et al.* (1992) do not distinguish assemblage 2 covering the Frisian Front nor the one comprising the coastal area (atlas-assemblage 6). The Frisian Front and the coastal area are, however, two important assemblages in the Dutch sector of the North Sea because of their characteristic fauna as well as the high average biomass and abundance.

Figure 15

TWINSPAN-generated dichotomy of the meiobenthos samples of the Dutch Continental Shelf, based on density data. Indicator species (see text) and number of samples are mentioned at each division.

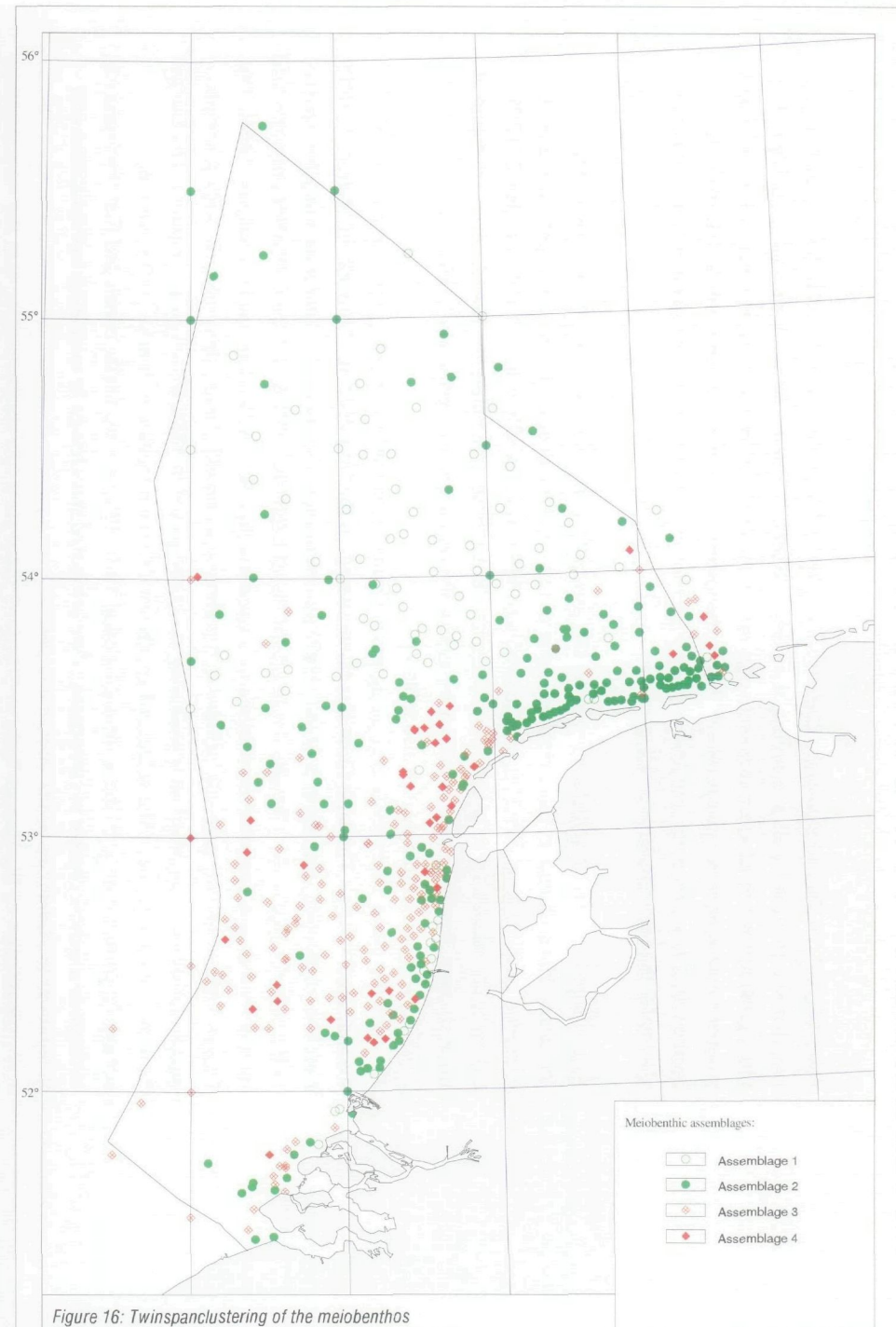
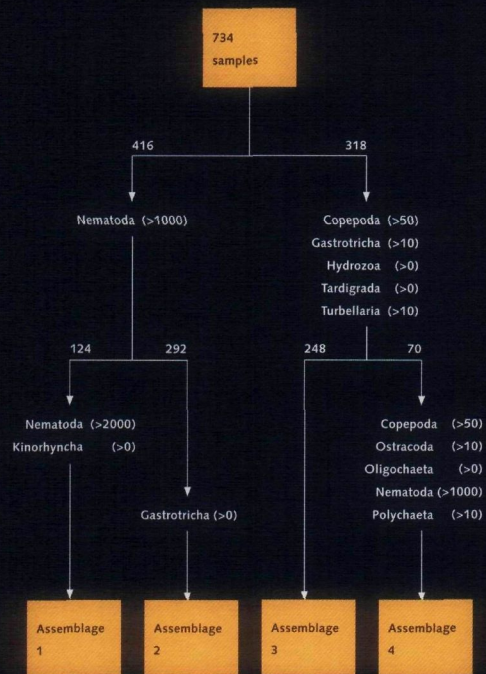


Figure 16: Twinspanclustering of the meiobenthos



## Assemblages of the meiobenthos

The combined meiobenthic data (taxon densities) of all stations on the Continental Shelf were used in order to determine assemblages. This resulted in the formation of 4 assemblages or clusters (figure 15). One assemblage is situated in the deeper muddy areas of the Oyster Ground and the (western) Frisian Front area, as well as in the muddy near-coastal area (figure 16). Another assemblage is found all over the Dutch sector, but mainly north of 53°N, surrounding the first assemblage. A third assemblage lies south of 54°N, but especially west of the Dutch coast. The last assemblage is found offshore off Hoek van Holland, Texel/Vlieland and Borkum, in the coarsest sediments and in coarse relict Pleistocene sand. The characteristics of the four assemblages are given below.

The 'indicator' taxa belonging to the four assemblages and their abundance are presented in table 6. Because the four assemblages differ in terms of sediment composition, depth and meiobenthic fauna, they can be described accordingly (see also table 7).

**Assemblage 1** This assemblage comprises the muddiest areas with very fine sand, namely the Oyster Ground, the Frisian Front area and some areas near the coast, which are influenced by fine particles from river outflows. On average the silt content reaches 10%. The diversity of the meiobenthos is low. Total densities are high (mean: 4000 ind./10 cm<sup>2</sup>), but most of the meiobenthos consists of nematodes. Only larger burrowing copepods are found in this area and kinorhynchans and priapulids are, except for absence in the coastal area, almost restricted to this assemblage. Most other taxa are scarce or absent.

**Assemblage 2** This assemblage is found mostly surrounding the first assemblage, in areas with fine sand and high mud contents of on average of 4%. The diversity in this area is low, but the numbers are, in comparison to the first assemblage, slightly better distributed over the taxa present. Densities are intermediate (app. 1500 ind./10 cm<sup>2</sup>), again mostly existing of nematodes. Copepods occur in low densities, while gastrotrichs, turbellarians and tardigrades are more common than in the muddiest areas.

**Assemblage 3** This assemblage contains areas with grain sizes that permit interstitial life, provided that they are not filled with mud (on average only 1.3%). Most taxa are found in this area, except for kinorhynchans and priapulids. Interstitial copepods are found in high numbers, the majority belonging to the exclusively interstitial families Leptastacidae and Paramesochridae.

Table 6 The abundance (mean and standard deviation) of the TWINSPAN-indicator taxa per assemblage.

Assemblage	1		2		3		4	
	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.
Meiobenthos taxa (ind./m <sup>2</sup> )								
Copepoda	48.8	60.9	19.8	21.5	114.9	117.1	332.8	206.7
Leptastacidae	2.1	10.5	0.6	4.9	10.5	26.3	29.8	52.6
Paramesochridae	3.1	24.0	0.3	4.1	15.2	50.8	73.1	73.1
Gastrotricha	0.8	3.0	0.3	1.0	4.4	5.7	12.4	11.9
Hydrozoa	0.1	0.3	0.3	1.0	4.4	5.7	12.4	11.9
Kinorhyncha	5.7	9.3	0.1	0.6	0.0	0.3	0.6	2.5
Nematoda	3940.2	2760.8	1486.8	1090.2	686.2	437.4	1343.3	889.6
Oligochaeta	0.3	1.4	0.5	3.1	1.1	3.6	5.7	6.7
Ostracoda	2.9	4.8	0.7	1.4	2.8	6.3	25.7	37.1
Polychaeta	4.5	7.1	5.0	13.8	5.1	9.1	14.6	14.9
Priapulida	0.3	0.7	0.0	0.1	–	–	–	–
Tardigrada	3.0	19.3	9.4	83.5	15.3	26.8	39.8	54.4
Turbellaria	9.8	23.8	21.6	34.9	27.6	38.7	24.8	

Table 7 Abiotic and biotic parameters (mean value and standard deviation) per assemblage.

Assemblage	1		2		3		4	
Number of locations	124		292		248		70	
Abiotic parameters	mean	st.d.	mean	st.d.	mean	st.d.	mean	st.d.
Depth (m)	34.9	12.4	23.2	11.3	22.6	9.3	27.0	8.1
Median grain size ( $\mu\text{m}$ )	151.9	55.1	210.5	57.2	280.6	58.5	358.8	73.4
Silt content (%)	2.9	7.3	4.2	6.9	1.3	1.6	1.2	1.0
Meiobenthos								
Density (incl. 10 cm <sup>2</sup> )	4016.9	2768.1	1568.4	1110.1	951.3	463.9	1933.4	980.4
Hill <sub>0</sub>	5.6	1.7	5.7	1.4	7.9	1.6	9.6	1.2
Hill <sub>1</sub>	1.2	0.1	1.4	0.3	2.5	0.8	2.9	0.8
Hill <sub>2</sub>	1.1	0.1	1.2	0.2	1.9	0.7	2.1	0.6
Hill <sub>∞</sub>	1.0	0.0	1.1	0.1	1.5	0.4	1.6	0.3

**Assemblage 4** The stations belonging to this assemblage are all found in coarse sand. The interstices are ideal for interstitial life, and the mud content is low. Except for Kinorhyncha and Priapulida all taxa are encountered in these areas. Total densities are intermediate (1900 ind./10 cm<sup>2</sup>), with high densities of (interstitial) copepods, gastrotrichs, tardigrades and highest numbers of the other taxa. The (taxon-) diversity consequently is the highest of the Dutch Continental Shelf.

As a result of TWINSPAN all stations have been awarded a score according to their meiofauna composition. Rank-correlating these scores with the median grain size and with the mud content found on these stations, shows that both parameters seem to influence the composition. The strength of these correlations shows that only part of the observed variation in meiobenthic taxon composition on the Dutch Continental Shelf can be explained by the sedimental composition. Food availability, competition, predation and disturbing factors all more or less contribute to the presence or absence of species and thus to the formation of assemblages. Moreover, the taxa are a collection of several species, each with its own preferences. Especially in very divers taxa like the nematodes, copepods, turbellarians, ostracods and polychaetes, this may strongly obscure any correlation between the observed patterns and environmental aspects.

Identification of nematodes in the Dutch Continental Shelf area into feeding-types (Huys & De Smet, 1992), showed that near to the coast non-selective deposit feeders dominate. Selective deposit feeders are found in highest densities far offshore. Epigrowth feeders dominate in the coarser sediments in the southernmost part of the Dutch sector, whereas the predators and omnivores reach highest abundances in the muddy northern stations.

The ICES study of the meiobenthos of the entire North Sea (Huys *et al.*, 1992) resulted in the formation of five assemblages based on copepod species composition. Three of these assemblages were found in the Dutch sector. The first assemblage was found in the Southern Bight, roughly coinciding with assemblage 3 (except for the stations north of the Wadden islands) in this study. The majority of the copepods in this assemblage were interstitial (Parmesochridae, Leptastacidae, small Ameiridae, vermiform Diosaccidae and Ectinosomatidae). In the north (Oyster Ground, Frisian Front, part of the Dogger Bank), a quantitatively and qualitatively impoverished assemblage was found, with non-interstitial copepods. Amongst them were large Diosaccidae, Ameiridae and Ectinosomatidae. Between the Wadden islands and the 30 m isobath, a mixture of small interstitial (Leptastacidae, some Ectinosomatidae and Ameiridae) and large burrowers (Ectinosomatidae and some Ameiridae) was found.

Taking this information into account, it is likely that assemblage 1 can be split into a coastal part (assemblage 1A), with nematodes as non-selective deposit-feeders, and a northern part (assemblage 1B), with predatory or omnivorous nematodes. Copepod species of the near-coastal muddy area have not been identified. Assemblage 2 will probably contain many selective deposit feeding nematodes in the area south of the 30 m isobath, whereas northward the predatory and omnivorous species will dominate. Assemblage 3 contains in this context mostly small copepods, as can also be seen in the distribution of the copepod families (chapter 4), together with non-selective and epigrowth feeding nematodes. Finally, assemblage 4 will probably contain only small or interstitial copepods and nematodes as epigrowth feeders moving around in the interstitial spaces.

On the Dutch Continental Shelf not only a variety of current velocities, median grain sizes and mud contents are found, also the meiobenthos in this area shows a various composition, with several hundreds of nematode and copepod species. As new copepod (Huys *et al.*, 1992) and nematode species (Vincx, 1986) are still found in this area, our estimates of diversity will probably keep increasing.

## References

- Adema, J.P.H.M., F. Creutzberg & G.J. van Noort, 1982. Notes on the occurrence of some poorly known Decapoda (Crustacea) in the Southern North Sea. *Zool. Bijdragen, Leiden*. **28**: 32 pp.
- Anonymous, 1986. Fifth report of the Benthos Ecology Working Group. *ICES 1986/C: 27*.
- Anonymous, 1992. Milieuzonering van het NCP op basis van ecosysteem kenmerken. Referentiedocument van het WSP-Noordzee 1991-1995. *Rijkswaterstaat Directie Noordzee, Rijswijk, rapport NZ-N-90.07*, 37 pp.
- Anonymous, 1995. Naamlijst van Zee- en Zoetwaterdieren van Nederland en omstreken met IAWM-codes. Toelichting bij het computerbestand. *Rijksinstituut voor Kust en Zee, Den Haag, rapport RIKZ-95.031*, 77 pp.
- Bachelet, G. & M. Cornet, 1981. Some data of the life history of *Abra alba* (Mollusca, Bivalvia) in the southern part of the Bay of Biscay. *Ann. Inst. Oceanogr. Paris* **57**: 111-123.
- Baptist, H.J.M. & P.A. Wolf, 1993. Atlas van de vogels van het Nederlands Continentaal Plat. *Dienst Getijdewateren, Middelburg, DGW-93.013*, 168 pp.
- Barnes, R.S.K., P. Calow & P.J.W. Olive (eds.), 1993. The invertebrates, a new syntheses. *Blackwell Scientific Publications, Oxford*, 488 pp.
- Bartsch, I., 1988. Halacarida. In: Higgins, R.P. & H. Thiel (eds.) Introduction to the study of meiofauna. *The Smithsonian Institution Press, Washington D.C.*, pp. 417-422.
- Beare, D.J. & P.G. Moore, 1994. Observations on the biology of a rare British marine amphipod: *Monoculodes gibbosus* (Crustacea: Amphipoda: Oedicerotidae). *J. mar. biol. Ass. U.K.* **74**: 193-201.
- Bell, S.S., 1979. Short- and long-term variation in a high marsh meiofauna community. *Estuar. coast. mar. Sci.* **9**: 331-350.
- Bergman, M.J.N. & G.C.A. Duineveld, 1990. Verspreiding van OBM-gevoelige macrobenthossoorten in de Noordzee. *Netherlands Institute for Sea Research, NIOZ-rapport 1990-7*, 29 pp.
- Bergman, M.J.N., M. Fonds, W. Lewis, P. van der Puyl, A. Stam & D. den Uyl, 1990. Direct effects of beamtrawl fishing on benthic fauna in the North Sea - a pilot study. *BEON, The Netherlands, BEON-rapport 8*, pp. 33-57.
- Bergman, M.J.N. & J.W. Van Santbrink, 1994. A new benthos dredge ('triple-D') for quantitative sampling of infauna species of low abundance. *Neth. J. Sea Res.* **33**: 129-133.
- Bergmans, M., 1981. A demographic study of the life cycle of *Tisbe furcata* (Baird, 1837) (Copepoda: Harpacticoida). *J. mar. biol. Ass. U.K.* **61**: 691-705.
- Beukema, J.J., 1979. Biomass and species richness of the macrobenthic animals living on a tidal flat area in the Dutch Wadden Sea. *Neth. J. Sea Res.* **13**: 203-223.
- Beukema, J.J., 1991. Changes in composition of bottom fauna of a tidal-flat area during a period of eutrophication. *Mar. Biol.* **111**: 293-301.
- Beukema, J.J. & G.C. Cadée, 1986. Zoobenthos responses to eutrophication of the Dutch Wadden Sea. *Ophelia* **26**: 55-64.
- Beukema, J.J. & G.C. Cadée, 1991. Growth rates of the bivalve *Macoma balthica* in the Wadden Sea during a period of eutrophication: relationships with concentrations of pelagic diatoms and flagellates. *Mar. Ecol. Prog. Ser.* **68**: 249-256.
- Beukema, J.J. & K. Essink, 1986. Common patterns in the fluctuations of macrozoobenthic species living at different places on tidal flats in the Wadden Sea. *Hydrobiologia* **142**: 199-207.
- Boon, J.P., M.B. van Zantvoort, M.J.M.A. Govaert & J.C. Duinker, 1985. Organochlorines in benthic polychaetes (*Nephtys* spp.) and sediment from the southern North Sea. Identification of individual PCB components. *Neth. J. Sea Res.* **19**: 93-109.
- Bosselmann, A., 1991. Recruitment and postlarval growth of some macrozoobenthos species in the German Bight. *Meeresforsch.* **33**: 141-158.
- Brafield, A.E. & G.E. Newell, 1961. The behaviour of *Macoma balthica* (L.). *J. mar. biol. Ass. U.K.* **41**: 81-87.
- Buchanan, J.B., 1963. The bottom fauna communities and their sediment relationships off the coast of Northumberland. *Oikos* **14**: 154-175.
- Buchanan, J.B., 1964. A comparative study of some features of the biology of *Amphiura filiformis* and *Amphiura chiajei* (Ophiuroidea) considered in relation to their distribution. *J. mar. biol. Ass. U.K.* **44**: 565-576.
- Buhr, K.J., 1976. Suspension feeder and assimilation efficiency in *Janice conchilega* (Polychaeta). *Mar. Biol.* **38**: 373-383.

- Buhr, K.J. & J.E. Winter, 1977. Distribution and maintenance of a *Lanice conchilega* association in the Weser estuary (FRG), with special reference to the suspension feeding behaviour of *Lanice conchilega*. In: Keegan, B.F., P.O. Ceidigh & P.J.S. Boaden (eds.), *Biology of benthic organisms. Proc. 11th Europ. Mar. Symp. Biol.*, Pergamon Press, Oxford, pp. 101-113.
- Calloway, C.B., 1988. Priapulida. In: Higgins, R.P. & H. Thiel (eds.) *Introduction to the study of meiofauna. The Smithsonian Institution Press, Washington D.C.*, pp. 322-327.
- Camphuysen, C.J. & M.F. Leopold, 1994. Atlas of seabirds in the southern North Sea. *Netherlands Institute for Sea Research, NIOZ report 1994-8*, 126 pp.
- Cannon, L.R.G. & A. Faubel, 1988. Turbellaria. In: Higgins, R.P. & H. Thiel (eds.) *Introduction to the study of meiofauna. The Smithsonian Institution Press, Washington D.C.*, pp. 273-282.
- Castel, J., 1979. Adaptation and reproductive cycle of the harpacticoid copepod *Amonardia normani* (Brady, 1872) in semi-enclosed lagoons of Arcachon Bay, France. In: Naylor, E. & R.G. Hartnoll (eds.) *Cyclic phenomena in marine plants and animals. Proc. 13th Europ. Mar. Biol. Symp.*, Pergamon Press, Oxford, pp. 131-138.
- Cattijssse, A., J. Mees & O. Hamerlynck, 1993. The hyperbenthic Amphipoda and Isopoda of the Voordelta and the Westerschelde estuary. *Cah. Biol. Mar.* **34**: 187-200.
- Christie, G., 1985. A comparative study of the reproductive cycles of three Northumberland populations of *Chaetozone setosa* (Polychaeta: Cirratulidae). *J. mar. biol. Ass. U.K.* **65**: 239-254.
- Clark, R.B., 1962. Observations on the food of Nephthys. *Limnol. Oceanogr.* **7**: 380-385.
- Clausen, C., 1971. Interstitial Cnidaria: present status of their systematics and ecology. In: Hulings, N.C. (ed.), *Proceedings of the first International Conference of Meiofauna. Smithsonian. Contrib. Zool.* **76**: 1-8.
- Coull, B.C. & S.S. Bell, 1979. Perspectives of marine meiofaunal ecology. In: R.J. Livingston (ed.) *Ecological processes in coastal and marine systems. Plenum Publishing Corp., New York*, pp. 189-216.
- Coull, B.C. & G.T. Chandler, 1992. Pollution and meiofauna: field, laboratory, and mesocosm studies. *Oceanogr. mar. Biol. Ann. Rev.* **30**: 191-271.
- Coull, B.C. & J.B.J. Wells, 1983. Refuges from fish predation: experiments with phytal meiofauna from the New Zealand rocky intertidal. *Ecology* **64**: 1599-1609.
- Craeymeersch, J.A., O. Hamerlynck, K. Hostens, A. Vanreusel & M. Vincx, 1990. De ekologische ontwikkeling van de Voordelta. Deelrapport 1. De huidige ekologische situatie van de Voordelta. *Delta Instituut voor Hydrobiologisch Onderzoek, Nederland*, 92 pp.
- Cressie, N.A.C., 1993. *Statistics for spatial data (revised ed.)*. Wiley, New York, 900 pp.
- Creutzberg, F., P. Wapenaar, G. Duineveld & N. Lopez Lopez, 1984. Distribution and density of benthic fauna in the southern North Sea in relation to bottom characteristics and hydrographic conditions. *Rapp. P.-v. Réun. Cons. int. Explor. Mer* **183**: 101-110.
- Curtis, M.A., 1977. Life cycles and population dynamics of marine benthic polychaetes from the Disko Bay area of West Greenland. *Ophelia* **16**: 9-58.
- Daan, R. & M. Mulder, 1994. Long-term effects of OBM cutting discharges in the sandy erosion area of the Dutch Continental Shelf. *Netherlands Institute for Sea Research, NIOZ-rapport 1994-10*, 26 pp.
- Daan, R., W.E. Lewis & M. Mulder, 1990. Biological effects of discharged oil-contaminated drill cuttings in the North Sea. *Netherlands Institute for Sea Research, NIOZ-rapport 1990-5*, 79 pp.
- Daan, R., W.E. Lewis & M. Mulder, 1991. Biological effects of washed OBM drill cuttings discharged on the Dutch Continental Shelf. *Netherlands Institute for Sea Research, NIOZ-rapport 1991-8*, 33 pp.
- Davis, F.M., 1925. Quantitative studies on the fauna of the sea bottom. *M.A.F. Fish. Invest. Series II VII*: 1-50.
- De Gee, A., M.A. Baars, H.W. van der Veer, 1991. De ecologie van het Friese Front. Waarnemingen aan een biologisch-rijke zone in de Noordzee, gelegen tussen de zuidelijke Bocht en de Oestergronden. *Netherlands Institute for Sea Research, NIOZ-rapport 1991-2*, 96 pp.
- De Gee, A. & H. Ridderinkhof, 1991. Hydrografie en Geomorfologie. In: De Gee, A., M.A. Baars & H.W. van der Veer (eds.) *De ecologie van het Friese Front. Waarnemingen aan een biologisch-rijke zone in de Noordzee, gelegen tussen de Zuidelijke Bocht en de Oestergronden. Netherlands Institute for Sea Research, NIOZ-rapport 1991-2*, pp. 15-20.
- De Groot, S.J. & H.J. Lindeboom (eds.), 1994. Environmental impact of bottom gears on benthic fauna in relation to natural resources management and the protection of the North Sea. *Netherlands Institute for Sea Research, NIOZ-rapport 1994-11*, 257 pp.
- De Ridder, C. & J.M. Lawrence, 1982. Food and feeding mechanisms: Echinoidea. In: M. Jangoux, M. & J.M. Lawrence (eds.) *Echinoderm nutrition. A.A. Bakema, Amsterdam*, pp. 57-115.
- De Ridder, C., M. Jangoux & L. de Vos, 1987. Frontal ambulacral and peribuccal areas of the spatangoid echinoid *Echinocardium cordatum* (Echinodermata): a functional entity in feeding mechanism. *Mar. Biol.* **94**: 613-624.
- De Wilde, P.A.W.J., M.I. Jenness & G.C.A. Duineveld, 1992. Introduction into the ecosystem of the North Sea: Hydrography, biota, and food web relationships. *Neth. J. aquat. Ecol.* **26**: 7-18.
- Duineveld, G.C.A., 1992. The macrobenthic fauna in the Dutch Sector of the North Sea in 1991. *Netherlands Institute for Sea Research, NIOZ-rapport 1992-6*, 19 pp.
- Duineveld, G.C.A. & J.J.M. Belgers, 1993. The macrobenthic fauna in the Dutch sector of the North Sea in 1992. *Netherlands Institute for Sea Research, NIOZ-rapport 1993-11*, 38 pp.
- Duineveld, G.C.A. & J.J.M. Belgers, 1994. The macrobenthic fauna in the Dutch sector of the North Sea in 1993 and a comparison with previous data.

- Netherlands Institute for Sea Research, NIOZ-rapport 1994-12, 103 pp.
- Duineveld, G.C.A. & M.I. Jenness, 1984. Differences in growth rates of the sea urchin *Echinocardium cordatum* as estimated by the parameter  $\omega$  of the Bertalanffy equation applied to skeletal rings. *Mar. Ecol. Prog. Ser.* **19**: 65-72.
- Duineveld, G.C.A., A. Künitzer, U. Niermann, P.A.W.J. de Wilde & J.S. Gray, 1991. The macrobenthos of the North Sea. *Neth. J. Sea Res.* **28**: 53-65.
- Duineveld, G.C.A., P.A.W.J. de Wilde & A. Kok, 1990. A synopsis of the macrobenthic assemblages and benthic activity in the Dutch sector of the North Sea. *Neth. J. Sea Res.* **26**: 125-138.
- Eisma, D., 1966. The distribution of benthic marine molluscs off the main Dutch coast. *Neth. J. Sea Res.* **3**: 107-163.
- Eleftheriou, A. & D.J. Basford, 1989. The macrobenthic infauna of the offshore northern North Sea. *J. mar. biol. Ass. U.K.* **69**: 123-143.
- Enequist, P., 1949. Studies on the soft-bottom amphipods of the Skagerak. *Zool. Bijdr. Uppsala* **26**: 297-492.
- Entrop, B., 1976. Schelpen vinden en herkennen. *Thieme & Cie, Zutphen*, 324 pp.
- Erséus, C., 1988. Oligochaeta. In: Higgins, R.P. & H. Thiel (eds.) Introduction to the study of meiofauna. *The Smithsonian Institution Press, Washington D.C.*, pp. 349-354.
- Everaarts, J.M., E. Otter & C.V. Fischer, 1990. Cadmium and polychlorinated biphenyls: different distribution pattern in North Sea benthic biota. *Neth. J. Sea Res.* **26**: 75-82.
- Fager, E.W., 1964. Marine Sediments: Effects of a tube-building polychaete. *Science* **143**: 356-359.
- Fallesen, G. & H.M. Jørgensen, 1991. Distribution of *Nephtys hombergii* and *N. ciliata* (Polychaeta: Nephtyidae) in Århus Bay, Denmark, with emphasis on the effect of severe oxygen deficiency. *Ophelia Suppl.* **5**: 443-450.
- Fauchald, K. & P.A. Jumars, 1979. The diet of worms: A study of polychaete feeding guilds. *Oceanogr. mar. Biol. Ann. Rev.* **17**: 193-284.
- Fincham, A.A., 1971. Ecology and population studies of some intertidal and sublittoral sand-dwelling amphipods. *J. mar. biol. Ass. U.K.* **51**: 471-488.
- Fish, J.D. & S. Fish, 1989. A student's guide to the seashore. *Unwin Hyman, London*, 473 pp.
- Footo, K.G. & G. Stefánsson, 1993. Definition of the problem of estimating fish abundance over an area from acoustic line-transect measurements of density. *ICES J. mar. Sci.* **50**: 369-381
- Ford, E., 1923. Animal communities of the level sea-bottom in the waters adjacent to Plymouth. *J. mar. biol. Ass. U.K.* **13**: 164-224.
- Gage, J.D., 1990. Skeletal growth bands in brittle stars: Microstructure and significance as age markers. *J. mar. biol. Ass. U.K.* **70**: 209-224.
- Gee, J.M. 1989. An ecological and economic review of meiofauna as food for fish. *Zool. J. Linn. Soc.* **96**: 243-261.
- Gentil, F., J.C. Dauvin & F. Ménard, 1990. Reproductive biology of the polychaete *Owenia fusiformis* Delle Chiaje in the Bay of Seine (eastern English Channel). *J. exp. mar. Biol. Ecol.* **142**: 13-23.
- Giere, O., 1975. Population structure, food relations and ecological role of marine oligochaetes, with special reference to meiobenthic species. *Mar. Biol.* **31**: 139-156.
- Giere, O., 1980. The impact of oil and oil dispersants on the marine oligochaete *Marionina subterranea*. *Cah. Biol. Mar.* **21**: 51-60.
- Giere, O., 1993. Meiobenthology. The microscopic fauna in aquatic sediments. *Springer-Verlag, Berlin*, 328 pp.
- Giere, O. & O. Pfannkuche, 1982. Biology and ecology of marine oligochaetes. *Oceanogr. mar. Biol. Ann. Rev.* **20**: 173-308.
- Gosselck, F. & F. Georgi, 1984. Benthic recolonization of the Lübeck Bight (Western Baltic) in 1980/81. *Limnologia* **15**: 407-414.
- Grassle, J.F. & J.P. Grassle, 1974. Opportunistic life histories and genetic systems in marine benthic polychaetes. *J. mar. Res.* **32**: 253-284.
- Grimaldi de Zio, S., M. D'Addabo Gallo & R.M. De Lucia, 1983. Marine tardigrades ecology. *Oealia* **IX**: 15-31.
- Groenewold, A. & Y. van Scheppingen, 1988. De ruimtelijke verspreiding van het benthos in de zuidelijke Noordzee. *Rijkswaterstaat Directie Noordzee/Dienst Getijdewateren, MILZON-BENTHOS Rapport 88-02*, 19 pp.
- Groenewold, A. & Y. van Scheppingen, 1989. De ruimtelijke verspreiding van het benthos in de zuidelijke Noordzee. Voorjaar 1988. *Rijkswaterstaat Directie Noordzee/Dienst Getijdewateren, MILZON-BENTHOS Rapport 89-05*, 27 pp.
- Groenewold, A. & Y. van Scheppingen, 1990. De ruimtelijke verspreiding van het benthos in de zuidelijke Noordzee. De noord-Nederlandse kustzone 1989. *Rijkswaterstaat Directie Noordzee/Dienst Getijdewateren, MILZON-BENTHOS Rapport 90-01*, 27 pp.
- Hagmeier, A., 1925. Vorläufiger Bericht über die vorbereitenden Untersuchungen der Bodenfauna der Deutschen Bucht mit dem Petersen-Bodengreifer. *Ber. dt. wiss. Kommn. Meeresforsch.* **1**: 247-272.
- Hartmann-Schröder, G., 1971. Annelida, Borstenwürmer, Polychaeta. (Die Tierwelt Deutschlands 58), *Gustav Fischer Verlag, Jena.*, 594 pp.
- Hayward, P.J. & J.S. Ryland, 1990. The marine fauna of the British Isles and North-West Europe. *Clarendon Press, Oxford*, 996 pp.
- Heip, C., D. Basford, J.A. Craeymeersch, J.-M. Dewarumez, J. Dörjes, P. de Wilde, G. Duineveld, A. Eleftheriou, P.M.J. Herman, U. Niermann, P. Kingston, A. Künitzer, E. Rachor, H. Rumohr, K. Soetaert & T. Soltwedel, 1992. Trends in biomass, density and diversity of North Sea macrofauna. *ICES J. mar. Sci.* **49**: 13-21.
- Heip, C., T. Brey, F. Creutzberg, J. Dittmer, J. Dörjes, G. Duineveld, P. Kingston, H. Mair, E. Rachor, H. Rumohr, L. Thielemans & C. Vanosmael, 1985a. Report on an intercalibration exercise on sampling methods for macrobenthos. *ICES C.M. 1985/L:19*, 4 pp.
- Heip, C. & J.A. Craeymeersch, 1995. Benthic community structures in the North Sea.

- Helgoländer Meeresunters.* **49**: 313-328.
- Heip, C., R. Herman, G. Bisschop, J.C.R. Govaere, M. Holvoet, D. Van Damme, C. Vanosmael, K.R. Willems & L.A.P. De Coninck, 1979. Benthic studies of the Southern Bight of the North Sea and its adjacent continental estuaries. Progress report I. *ICES C.M. L*:9, pp. 133-163.
- Heip, C., R. Herman & J. Craeymeersch, 1986. Diversiteit, densiteit en biomassa van het macrobenthos in de Westerschelde: 1978-1985. *Rijksuniversiteit Gent, Instituut voor Dierkunde, Sektie Mariene Biologie*.
- Heip, C., R. Herman & M. Vincx, 1983. Subtidal meiofauna of the North Sea: a review. *Biol. Jb. Dodonea* **51**: 116-170.
- Heip, C., N. Smol & V. Absillus, 1978. Influence of temperature on the reproductive potential of *Oncholaimus oxyuris* (Nematoda). *Mar. Biol.* **45**: 255-260.
- Heip, C., M. Vincx & G. Vranken, 1985b. The ecology of marine nematodes. *Oceanogr. mar. Biol. Ann. Rev.* **23**: 399-489.
- Heip, C., R.M. Warwick, M.R. Carr, P.M.J. Herman, R. Huys, N. Smol, K. Van Holsbeke, 1988. Analysis of the community attributes of the benthic meiofauna of the Frierfjord/Langesundfjord. *Mar. Ecol. Prog. Ser.* **46**: 171-180.
- Hermans, C.O., 1969. The systematic position of the Archiannelida. *Syst. Zool.* **18** (1): 85-102.
- Hicks, G.R.F., 1979. Pattern and strategy in the reproductive cycles of benthic harpacticoid copepods. In: Naylor, E. & R.G. Hartnoll (eds.) *Cyclic phenomena in marine plants and animals. Proc. 13th Europ. Mar. Biol. Symp., Pergamon Press, Oxford*, pp. 139-147.
- Hicks, G.R.F. & B.C. Coull, 1983. The ecology of marine meiobenthic harpacticoid copepods. *Oceanogr. mar. Biol. Ann. Rev.* **21**: 67-175.
- Higgins, R.P., 1964. A method for meiobenthic invertebrate collection. *Am. Zool.* **4**: 291.
- Higgins, R.P., 1971. A historical overview of kinorhynch research. In: Hulings, N.C. (ed.), *Proceedings of the first International Conference of Meiofauna. Smithsonian. Contrib. Zool.* **76**: 25-31.
- Higgins, R.P., 1974. Kinoryncha. In: Giese, A.C. & J.C. Pearse (eds.). *Reproduction of Marine Invertebrates vol. 1. Acoelomate and Pseudocoelomate Metazoans. Academic press, New York*, pp. 507-518.
- Higgins, R.P., 1988. Kinorhyncha. In: Higgins, R.P. & H. Thiel (eds.) *Introduction to the study of meiofauna. The Smithsonian Institution Press, Washington D.C.*, pp. 328-331.
- Hill, M.O., 1973. Diversity and evenness: A unifying notation and its consequences. *Ecology* **54**: 427-432.
- Hill, M.O., 1979. TWINSPAN: A FORTRAN program for arranging Multivariate data in an Ordered Two-Way Table by Classification of the Individuals and Attributes. *Ecology and Systematics, Cornell University. Ithaca*, 90 pp.
- Hily, C., 1987. Spatio-temporal variability of *Chaetozone setosa* (Malmgren) populations on an organic gradient in the Bay of Brest, France. *J. exp. mar. Biol. Ecol.* **112**: 201-216.
- Holthe, T., 1986. Polychaeta Terebellomorpha. Marine invertebrates of Scandinavia, No. 7. *Norwegian University Press, Oslo*, 194 pp.
- Holtmann, S.E. & A. Groenewold, 1992. Distribution of the zoobenthos on the Dutch Continental Shelf: The Oyster Ground, Frisian Front, Vlieland Ground and Terschelling Bank (1991). *Netherlands Institute for Sea Research, NIOZ-rapport 1992-8, Netherlands Institute of Ecology, NIOO-CEMO rapporten en verslagen 1992-6*, 129 pp.
- Holtmann, S.E. & A. Groenewold, 1994. Distribution of the zoobenthos on the Dutch Continental Shelf: The Western Frisian Front, Brown Bank and Broad Fourteens (1992/1993). *Netherlands Institute for Sea Research, NIOZ-rapport 1994-1, Netherlands Institute of Ecology, NIOO-CEMO rapporten en verslagen 1994-1*, 136 pp.
- Holtmann, S.E., Y.C.M. van Scheppingen & A. Groenewold, 1990. Biomonitoring van het zoöbenthos in de zuidelijke Noordzee, voorjaar 1990. *Deelrapport monitoring MILZON-BENTHOS. Rijkswaterstaat Directie Noordzee, MILZON-BENTHOS rapport 90*, 15 pp.
- Hummon, W.D., 1971. The marine and brackish-water Gastrotricha in perspective. In: Hulings, N.C. (ed.), *Proceedings of the first International Conference of Meiofauna. Smithsonian. Contrib. Zool.* **76**: 21-23.
- Huys, R., 1984. Samenstelling en fluctuaties van het meiobenthos in een sublittoraal zandig station van de Noordzee. *Licentiaatsverhandeling Rijks Universiteit Gent, Belgium*, 377 pp.
- Huys, R. & G. De Smet, 1992. Het meiobenthos van het Nederlands Continentaal Plat. Voorjaar 1991. *Rapportage in het kader van het Biologisch Monitoring Project, NIOO, Yerseke*, 57 pp.
- Huys, R. & G. De Smet, 1993. Het meiobenthos van het Nederlands Continentaal Plat. Voorjaar 1992. *Rapportage in het kader van het Biologisch Monitoring Project, NIOO, Yerseke*, 94 pp.
- Huys, R., C.H.R. Heip, P.M.J. Herman & K. Soetaert, 1992. The meiobenthos of the North Sea: density, biomass trends and distribution of copepod communities. *ICES J. mar. Sci.* **49**: 23-44.
- Huys, R., A. Vanreusel & C. Heip, 1986. The meiobenthos of the Voordelta. *Final report project BOVO, Rijkswaterstaat Directie Noordzee*, 88 pp.
- Irlinger, J.P., F. Gentil & V. Quintino, 1991. Reproductive biology of the polychaete *Pectinaria koreni* (Malmgren) in the Bay of Seine (English Channel). *Ophelia Suppl.* **5**: 343-350.
- Jansson, B.O., 1967. The significance of grain size and pore water content for the interstitial fauna of sandy beaches. *Oikos* **18**: 311-322.
- Jensen, P., 1987. Feeding ecology of free-living aquatic nematodes. *Mar. Ecol. Prog. Ser.* **35**: 187-196.
- Jones, N. S., 1976. British Cumaceans. (Synopses of British Fauna (New Series) No. 7). *Academic Press, London*, 63 pp.
- Josefson, A.B., 1990. Increase of benthic biomass in the Skagerrak-Kattegat during the 1970s and 1980s - effects of organic enrichment. *Mar. Ecol. Prog. Ser.* **66**: 117-130.
- Juario, J.V., 1975. Nematode species

- composition and seasonal fluctuation of a sublittoral meiofaunacommunity on the German Bight. *Veröff. Inst. Meeresforsch. Bremerh.* **15**: 283-337.
- Keyser, D., 1988. Ostracoda. In: Higgins, R.P. & H. Thiel (eds.) Introduction to the study of meiofauna. *The Smithsonian Institution Press, Washington D.C.*, pp. 370-376.
- Kirkegaard, J.B., 1978. Settling, growth and life span of some common polychaetes from Danish waters. *Meddr. Danm. Fisk. - og Havunders* **7**: 447-496.
- Klein, R. & R. Witbaard, 1993. The appearance of scars on the shell of *Arctica islandica* L. (Mollusca, Bivalvia) and their relation to the bottom trawl fishery. *Netherlands Institute for Sea Research, NIOZ-rapport 1993-12*, 19 pp.
- Klijn, R.J., T.W. Boon, H.J.L. Heessen & J.R.G. Hislop, 1993. Atlas of North Sea fishes. International Council for the Exploration of the Sea, *ICES Cooperative research report 194*, 268 pp.
- Kröncke, I., 1987. Lead and cadmium content in selected macrofauna species from the Dogger Bank and the eastern North Sea. *Helgoländer Meeresunters.* **41**: 465-475.
- Kröncke, I., 1990. Macrofauna standing stock of the Dogger Bank. A comparison: II. 1951-1952 versus 1985-1987. Are changes in the community of the northeastern part of the Dogger Bank due to environmental changes? *Neth. J. Sea Res.* **25**: 189-198.
- Kröncke, I., G.C.A. Duineveld, S. Raak, E. Rachor & R. Daan, 1992. Effects of a former discharge of drill cuttings on the macrofauna community. *Mar. Ecol. Prog. Ser.* **91**: 277-287.
- Künitzer, A., G.C.A. Duineveld, D. Basford, J.M. Dewarumez, J. Dörjes, A. Eleftheriou, C. Heip P.M.J. Herman, P. Kingston, U. Niermann, H. Rumohr & P.A.W.J. de Wilde, 1992. The benthic infauna of the North Sea: Species distribution and assemblages. *ICES J. mar. Sci.* **49**: 127-143.
- Lang, K., 1939. Über die Entwicklung von *Priapulus caudatus* Lam. *Kungl. fysiografiska Sällsk. Lund Förhandl.* **9**: 80-87.
- Langston, W.J. & Mingjiang Zhou, 1987. Cadmium accumulation, distribution and elimination in the bivalve *Macoma balthica*: neither metallothionein nor metallothionein-like proteins are involved. *Mar. environ. Res.* **21**: 225-237.
- Lasserre, P., 1971. Oligochaeta from the marine meiobenthos: taxonomy and ecology. In: Hulings, N.C. (ed.), Proceedings of the first International Conference of Meiofauna. *Smithson. Contrib. Zool.* **76**: 71-86.
- Leaver, M.J., D.J. Murison, J.M. Davies & D. Raffaelli, 1987. Experimental studies of the effects of drilling discharges. *Phil. Trans. R. Soc. Lond. B.* **316**: 625-640.
- Lincoln, R.J., 1979. British marine amphipods: Gammaridea. *British Museum (Natural History), London*, 657 pp.
- Lutze, J., 1938. Über Systematik, Entwicklung und Ökologie von Callianassa. *Helgoländer wiss. Meeresunters.* **1**: 162-171.
- Marcotte, B.M., 1977. An introduction to the architecture and kinematics of harpacticoid (Copepoda) *Tisbe furcata* (Baird, 1837). *Mikrofauna Meeresboden* **61**: 183-196.
- Marcotte, B.M., 1983. The imperatives of copepod diversity: perception, cognition, competition and predation. In: Schram, F.R. (ed.) Crustacean phylogeny. *Balkema, Rotterdam*, pp. 47-72.
- Marcotte, B.M., 1986. Hermeneutics and copepod behavioural ecology: sciences of interpretation. In: Proceedings of the Second International Conference on Copepoda, Ottawa, 1984, *Syllogeus* **58**: 147-149.
- Matheron, G., 1963. Principles of geostatistics. *Economic Geology* **58**: 1246-1266.
- Mathivat-Lallier, M.H. & C. Cazaux, 1991. Life-history of *Nephtys hombergii* in Arcachon Bay. *Estuar. coast. Shelf Sci.* **32**: 1-9.
- McIntyre, A.D., 1969. Ecology of marine meiobenthos. *Biol. Rev.* **44**: 245-290.
- Mortensen, Th., 1927. Handbook of the Echinoderms of the British Isles. *Oxford University Press: Oxford*, 471 pp.
- Mulder, M., W.E. Lewis & M.A. van Arkel, 1988. Biological effects of the discharges of contaminated drill-cuttings and water-based drilling fluids in the North Sea. *Netherlands Institute for Sea Research, NIOZ-rapport 1988-3*, 126 pp.
- Mulder, J.P.M., T. Louters, F.P. Hallie, R. Postma, J.A. Craeymeersch & O. Hamerlynck, 1991. Integrated coastal research in the SW Netherlands. In: Proceedings of the 22nd Coastal Engineering Conference 'High tech in the lowlands', 2-6 July 1990, Delft, The Netherlands. *Am. Soc. civ. Eng.* **3**: 2984-2997.
- Newell, I.M., 1971. Problems in the study of subtidal Halacaridae (Acari). In: Hulings, N.C. (ed.), Proceedings of the first International Conference of Meiofauna. *Smithson. Contrib. Zool.* **76**: 102-107.
- Nicolaisen, W. & E. Kanneworff, 1969. On the burrowing and feeding habits of the amphipods *Bathyporeia pilosa* Lindström and *Bathyporeia sarsi* Watkin. *Ophelia* **6**: 231-250.
- Noodt, W., 1971. Ecology of copepods. In: Hulings, N.C. (ed.), Proceedings of the first International Conference of Meiofauna. *Smithson. Contrib. Zool.* **76**: 97-102.
- Nott, P.L., 1980. Reproduction in *Abra alba* (Wood) and *Abra tenuis* (Montagu) (Tellinacea: Scrobiculariidae). *J. mar. biol. Ass. U.K.* **60**: 465-479.
- O'Connor, B., T. Bowmer & A. Grehan, 1983. Long-term assessment of the population dynamics of *Amphiura filiformis* (Echinodermata: Ophiuroidea) in Galway Bay (west coast of Ireland). *Mar. Biol.* **75**: 279-286.
- O'Foighil, D., D. McGrath, M.E. Conneely, B.F. Keegan & M. Costelloe, 1984. Population dynamics and reproduction of *Mysella bidentata* (Bivalvia: Galeommatacea) in Galway Bay, Irish west coast. *Mar. Biol.* **81**: 283-291.
- Ockelmann, K.W. & K. Muus, 1978. The biology, ecology and behaviour of the bivalve *Mysella bidentata* (Montagu). *Ophelia* **17**: 1-93.
- Olive, P.J.W. & P.J. Morgan, 1991. The reproductive cycles of four British intertidal *Nephtys* species in relation to their geographical distribution (Polychaeta: Nephtyidae). *Ophelia Suppl.* **5**: 351-361.



- Perkins, 1958. The food relationships of the microbenthos, with particular reference to that found at Whitstable, Kent. *Ann. Mag. nat. Hist.* **1**: 64-77.
- Petersen, C.G.J., 1914. Valuation of the sea. II. The animal communities of the sea bottom and their importance for marine zoogeography. *Rep. Dan. biol. Stn.* **21**: 1-44.
- Petitgas, P., 1993. Geostatistics for fish stock assessments: a review and an acoustic application. *ICES J. mar. Sci.* **50**: 285-298.
- Petkovski, T.K., 1964. Zur Kenntnis der Harpacticidae Portugals (Crustacea, Copepoda). *Lunds-Univ. Arsskr., N.F. Afd. 2*, **59**: 1-22.
- Pfannkuche, O. & H. Thiel, 1987. Meiobenthic stocks and benthic activity on the NE-Svalbard shelf and in the Nansen Basin. *Polar Biol.* **7**: 253-266.
- Platt, H.M. & R.M. Warwick, 1983. Free-living marine nematodes. Part I British enoplids. Pictorial key to world genera and notes for the identification of British species. *Cambridge University Press, Cambridge*, 307 pp.
- Platt, H.M. & R.M. Warwick, 1988. Free-living marine nematodes. Part II British chromadorids. Pictorial key to world general and notes for the identification of British species. *Brill, Backhuys, Leiden*, 502 pp.
- Popham, M.L., 1940. The mantle cavity of some the Erycinidae, Montacutidae and Galeommatidae with special reference to the ciliary mechanisms. *J. mar. biol. Ass. U.K.* **24**: 549-587.
- Postma, H., 1982. Jan Verwey, 1899-1981. *Neth. J. Sea Res.* **15**: 131-140.
- Rainer, S.F., 1991. The genus *Nephtys* (Polychaeta: Phyllodocida) of northern Europe: a review of species, including the description of *N. pulchra* sp.n. and a key to the Nephtyidae. *Helgoländer wiss. Meeresunters.* **45**: 65-96.
- Rees, C.B., 1940. A preliminary study of the ecology of a mud-flat. *J. mar. biol. Ass. U.K.* **24**: 185-199.
- Rees, H.L. & P.J. Dare, 1993. Sources of mortality and associated life-cycle traits of selected benthic species: a review. *MAFF Directorate of Fisheries Research, Fisheries Research Data Report No. 33*, 36 pp.
- Remane, A., 1933. Verteilung und Organisation der benthischen Mikrofauna der Kieler Bucht. *Wiss. Meeresunters. Kiel* **21**: 161-221.
- Renaud-Mornant, J., 1988. Tardigrada. In: Higgins, R.P. & H. Thiel (eds.) Introduction to the study of meiofauna. *The Smithsonian Institution Press, Washington D.C.*, pp. 357-364.
- Renaud-Mornant, J. & L.W. Pollock, 1971. A review of the systematics and ecology of marine Tardigrada. In: Hulings, N.C. (ed.) Proceedings of the first International Conference of Meiofauna. *Smithson. Contrib. Zool.* **76**: 109-118.
- Rhoads, D.C., 1973. The influence of deposit-feeding benthos on water turbidity and nutrient recycling. *Am. J. Sci.* **273**: 1-22.
- Ripley, B.D., 1981. Spatial statistics. *Wiley, New York*, 252 pp.
- Riemann, F., 1988. Nematoda. In: Higgins, R.P. & H. Thiel (eds.) Introduction to the study of meiofauna. *The Smithsonian Institution Press, Washington D.C.*, pp. 291-301.
- Romeyn, K. & L.A. Bouwman, 1983. Food selection and consumption by estuarine nematodes. *Hydrobiol. Bull.* **17**: 103-109.
- Rowden, A.A. & M.B. Jones, 1994. A contribution to the biology of the burrowing mud shrimp, *Callinassa subterranea* (Decapoda: Thalassinidae). *J. mar. biol. Ass. U.K.* **74**: 623-635.
- Salzwedel, H., 1979. Reproduction, growth, mortality and variations in abundance and biomass of *Tellina fabula* (Bivalvia) in the German Bight in 1975/76. *Veröff. Inst. Meeresforsch. Bremerh.* **18**: 111-202.
- Seip, P.A. & R. Brand, 1987. Inventarisatie van macrozoöbenthos in de Voordelta. *Netherlands Institute for Sea Research, NIOZ-rapport 1987-1*, 38 pp.
- Shannon, C.E. & W. Weaver, 1949. The mathematical theory of communication. *Univ. of Illinois Press, Urbana*.
- Simard, Y., P. Legendre, G. Lavoie & D. Marcotte, 1992. Mapping, estimating biomass, and optimizing sampling programs for spatially autocorrelated data: case study of the northern shrimp (*Pandalus borealis*). *Can. J. Fish. aquatic Sci.* **49**: 32-45.
- Simpson, E.H., 1949. Measurements of diversity. *Nature* **163**: 688-688.
- Sips, H.J.J., 1988. Oecologisch profiel van zandzagers (*Nephtys*; Polychaeta). *Bureau Waardenburg, 1988 Nota*, 17 pp.
- Sopott, B., 1973. Jahreszeitliche Verteilung und Lebenszyklen der Proseriata (Turbellaria) eines Sandstrandes der Nordseeinsel Sylt. *Mikrofauna Meeresboden* **15**: 253-258.
- Southward, E.C., 1972. Keys for the identification of Echinodermata of the British Isles. *Marine Biological Association, Echinoderm Survey*, 24 pp.
- Stone, C.J., A. Webb, C. Barton, N. Radcliff, T.C. Reed, M.L. Tasker, C.J. Camphuysen & M.W. Pienkowski, 1995. An atlas of seabird distribution in northwest European waters. *Joint Nature Conservation Committee, Peterborough*, 326 pp.
- Swedmark, B., 1959. On the biology of sexual reproduction of the interstitial fauna of marine sands. In: *Proc. 15th int. Congr. Zool. London*, 327-329.
- Swedmark, B., 1964. The interstitial fauna of marine sand. *Biol. Rev.* **39**: 1-42.
- Swedmark, B. & G. Teissier, 1950. Développement d'un Hydrozoaire aberrant *Halammohydra schulzei* Remane. *C. R. Acad. Sci.* **231**: 173-174.
- Swedmark, B. & G. Teissier, 1957. Organisation et développement des *Halammohydra* (Hydrozoaires). *C. R. Acad. Sci.* **244**: 501-504.
- Szefer, P. & K. Szefer, 1990. Metals in molluscs and associated bottom sediments of the southern Baltic. *Helgoländer wiss. Meeresunters.* **44**: 411-424.
- Teare, M., 1978. Post-embryonic development of *Tachidius discipes* Giesbrecht, 1881 (Copepoda, Harpacticoida). *Cah. Biol. mar.* **XIX**: 343-353.
- Tebble, N., 1966. British bivalve seashells. *British Museum (Natural History), London*, 212 pp.
- Théel, H., 1906. Northern and arctic invertebrates in the collection of the Swedish State Museum (Rijksmuseum). II. Priapulids, Echiurids etc. *Kungl. svenska Vet.-Akad. Handl.* **40**: 1-28.

- Thiel, H., 1988. Cnidaria. In: Higgins, R.P. & H. Thiel (eds.) Introduction to the study of meiofauna. *The Smithsonian Institution Press, Washington D.C.*, pp. 266-272.
- Ursin, E., 1960. A quantitative investigation of the echinoderm fauna of the central North Sea. *Meddr. Danm. Fisk. -og Havunders.(N.S.)* **2**: 1-204.
- Van der Land, J., 1970. Systematics, zoogeography and ecology of the Priapulida. *Zool. Verh., Leiden* **112**: 1-118.
- Van der Meer, J. & M.F. Leopold, 1995. Assessing the population size of the European storm petrel (*Hydrobates pelagicus*) using spatial autocorrelation between counts from segments of criss-cross ship transects. *ICES J. mar. Sci.* **52**: 809-818.
- Van Scheppingen, Y.C.M. & Groenewold, 1990. De ruimtelijke verspreiding van het benthos in de zuidelijke Noordzee. De Noord-Nederlandse kustzone, overzicht 1988 - 1989. *Rijkswaterstaat Directie Noordzee, MILZON-BENTHOS rapport nr. 90-03*, 27 pp.
- Vanreusel, A., R. Huys, G. Desmet & C. Heip, 1986. Het meiobenthos van de Voordelta. September-November 1984, April-Mei 1985, September 1985. Eindverslag 1986. *Rijksuniversiteit Gent*.
- Vincx, M., 1986. Free-living marine nematodes from the Southern Bight of the North Sea. *Ph.D. Thesis, State Univ. Gent*, 618 pp.
- Vrancken, G., D. Van Brussel, R. Vanderhaeghen & C. Heip, 1984. In: Persoone, G., E. Jaspers & C. Claus (eds.) Ecotoxicological testing for the marine environment. *State Univ. Ghent and Inst. Mar. Scient. Res., Bredene, Belgium*, pp. 271-291.
- Walcott, C., 1911. Cambrian geology and paleontology. II. 5. Middle cambrian annelids. *Smithson. misc. Coll.* **57**: 109-134.
- Warner, G., 1982. Food and feeding mechanisms: Ophiuroidea. In: Jangoux, M. & J.M. Lawrence (eds.) Echinoderm nutrition. *A.A. Bakema, Amsterdam*, pp. 161-181.
- Warwick, R.M. & J.B. Buchanan, 1970. The meiofauna off the coast of Northumberland. I. The structure of the nematode population. *J. mar. biol. Ass. U.K.* **50**: 129-146.
- Watkin, E.E., 1939a. The swimming and burrowing habits of some species of the amphipod genus Bathyporeia. *J. mar. biol. Ass. U.K.* **23**: 457-465.
- Watkin, E.E., 1939b. The pelagic phase in the life history of the amphipod genus Bathyporeia. *J. mar. biol. Ass. U.K.* **23**: 467-481.
- Welleman, H., 1989. Literatuurstudie naar de effecten van de bodemvisserij op de bodem en het bodemleven. *Rijksinstituut voor Visserij, MO 89-201*, 58 pp.
- Wells, J.B.J., 1986. Copepoda: marine-interstitial Harpacticoida. In: Botosaneanu (ed.) Stygofauna Mundi. A faunistic, distributional, and ecological synthesis of the world fauna inhabiting subterranean waters (including the marine interstitial). *Brill, Backhuys, Leiden*, pp. 356-381.
- Wells, J.B.J., 1988. Copepoda. In: Higgins, R.P. & H. Thiel (eds.) Introduction to the study of meiofauna. *The Smithsonian Institution Press, Washington D.C.*, pp. 380-388.
- Westheide, W., 1971. Interstitial Polychaeta (excluding Archannelida). In: Hulings, N.C. (ed.), Proceedings of the first International Conference of Meiofauna. *Smithson. Contrib. Zool.* **76**: 57-70.
- Westheide, W., 1984. The concept of reproduction in polychaetes with small body size: adaptations in interstitial species. In: Fischer, A. & H.-D. Pfannestiel (eds.) Polychaete reproduction. *Fortschritte der Zoologie* **29**: 265-287.
- Westheide, W., 1988. Polychaeta. In: Higgins, R.P. & H. Thiel (eds.) Introduction to the study of meiofauna. *The Smithsonian Institution Press, Washington D.C.*, pp. 332-344.
- Wieser, W., 1953. Die Beziehung zwischen Mundhöhlengestalt, Ernährungsweise und Vorkommen bei freilebenden marinen Nematoden. *Ark. Zool.* **4**: 439-484.
- Wieser, W., 1959. The effect of grain size on the distribution of small invertebrates inhabiting the beaches of Puget Sound. *Limnol. Oceanogr.* **4**: 181-194.
- Willems, K.A., M. Vincx, D. Claeys, C. Vanosmael & C. Heip, 1982. Meiobenthos of a sublittoral sandbank in the Southern Bight of the North Sea. *J. mar. biol. Ass. U.K.* **62**: 535-548.
- Wilson, E.O., 1992. The diversity of life. *Penguin, London*. 406 pp.
- Witbaard, R., 1989. De verspreiding van een aantal macrobenthos soorten in de Noordzee. *Netherlands Institute for Sea Research, NIOZ-rapport 1989-1*, 99 pp.
- Witbaard, R. & G.C.A. Duineveld, 1989. Some aspects of the biology and ecology of the burrowing shrimp *Callianassa subterranea* (Montagu) (Thalassinidae) from the southern North Sea. *Sarsia* **74**: 209-219.
- Wolff, W.J., 1973. The estuary as a habitat an analysis of data on the soft-bottom macrofauna of the estuarine area of the rivers Rhine, Meuse, and Scheldt. *Zool. Verh., Leiden* **126**, 242 pp.
- Woodley, J.D., 1975. The behaviour of some amphipod brittle-stars. *J. exp. mar. Biol. Ecol.* **18**: 29-46.
- Ziegelmeier, E., 1957. Die Muscheln (Bivalvia) der deutschen Meeresgebiete. *Helgoländer wiss. Meeresunters.* **6**: 1-64.
- Ziegelmeier, E., 1966. Die Schnecken (Gastropoda Prosobranchia) der deutschen Meeresgebiete und brackigen Küstengewässer. *Helgoländer wiss. Meeresunters.* **13**: 1-62.
- Ziegelmeier, E., 1978. Macrobenthos investigations in the eastern part of the German Bight from 1950 to 1974. *Rapp. P.-v. Réun. Cons. int. Explor. Mer* **172**: 432-444.
- Zwarts, L. & A. Blomert, 1992. Why knot *Calidris canutus* take medium-sized *Macoma baltica* when six prey species are available. *Mar. Ecol. Prog. Ser.* **83**: 113-128.
- Zwarts, L., A. Blomert & J.H. Wanink, 1992. Annual and seasonal variation in the food supply harvestable by knot *Calidris canutus* staging in the Wadden Sea in late summer. *Mar. Ecol. Prog. Ser.* **83**: 129-139.

# Register

Only the scientific names and the synonyms of the species/taxa presented in this atlas are given here.

- Abra alba* 29  
*Ameiridae* 195  
*Ameirina* 195  
*Amphiura filiformis* 159  
*Anaitides groenlandica* 57  
*Anaitides mucosa* 59  
*Anchorabolidae* 195  
*Angulus fabulus* 51  
*Angulus tenuis* 53  
*Archiannelida* 187  
*Arctica islandica* 31  
*Aricidea minuta* 61  
*Atylus falcatus* 127  
*Atylus swammerdami* 129
- Bathyporeia elegans* 131  
*Bathyporeia guillamsoniana* 133  
*Bathyporeia tenuipes* 135
- Calianassa stebbingi* 137  
*Calianassa subterranea* 137  
*Canthocamptidae* 195, 203  
*Canthocamptinae* 195  
*Capitella capitata* 63  
*Chaetopterus variopedatus* 65  
*Chaetozone setosa* 67  
*Chamelea gallina* 33  
*Chamelea striatula* 33  
*Copepoda* 193  
*Cylindropsyllidae* 201  
*Cyprina islandica* 31
- Diastylus bradyi* 139  
*Diosaccidae* 197  
*Donax vittatus* 35
- Echinocardium cordatum* 161  
*Echinocyamus pusillus* 163  
*Echinoderida* 179  
*Ectinosomatidae* 199
- Eteone longa* 69  
*Eumida sanguinea* 71  
*Eunereis longissima* 99  
*Euspira nitida* 37  
*Euspira poliana* 37
- Fabulina fabula* 51
- Gastrotricha* 177  
*Gattyana cirrosa* 73  
*Glycera rouxii* 75  
*Goniada maculata* 77
- Halacarida* 205  
*Harmothoe glabra* 79  
*Harmothoe longisetis* 79  
*Harmothoe lunulata* 81  
*Harpacticidae* 195  
*Harpactinae* 195  
*Harpinia antennaria* 141  
*Hippomedon denticulatus* 143  
*Hydrozoa* 171
- Kinorhyncha* 179
- Lagis koreni* 83  
*Lanice conchilega* 85  
*Leptastacidae* 201  
*Lumbrineris latreilli* 87  
*Lunatia alderi* 37  
*Lunatia intermedia* 37  
*Lunatia poliana* 37
- Macoma balthica* 39  
*Magelona mirabilis* 89  
*Magelona papillicornis* 89  
*Megaluropus agilis* 145  
*Montacuta ferruginosa* 41  
*Mysella bidentata* 43
- Natica alderi* 37  
*Natica poliana* 37  
*Nematoda* 175  
*Nephtys caeca* 91  
*Nephtys cirrosa* 93  
*Nephtys hombergii* 95  
*Nephtys longosetosa* 97  
*Nereis longissima* 99  
*Netrine cirratulus* 111  
*Notomastus latericeus* 101  
*Nototropis swammerdami* 129  
*Nucula nitida* 45  
*Nucula nitidosa* 45  
*Nucula turgida* 45
- Oligochaeta* 183  
*Ophelia borealis* 103  
*Ophelia limacina* 103  
*Ophioglypha albida* 165  
*Ophiura albida* 165  
*Ophiura ciliata* 167  
*Ophiura lacertosa* 167  
*Ophiura ophiura* 167  
*Ophiura texturata* 167  
*Ostracoda* 191  
*Owenia fusiformis* 105
- Paramesochridae* 203  
*Pectinaria koreni* 83  
*Perioculodes longimanus* 147  
*Pholoe inornata* 107  
*Pholoe minuta* 107  
*Pholoe synophthalmica* 107  
*Phyllodoce groenlandica* 57  
*Phyllodoce mucosa* 59  
*Polychaeta* 185  
*Pontocratus altamarinus* 149  
*Priapulida* 181  
*Pseudocuma longicornis* 151
- Scolelepis bonnieri* 109  
*Scolelepis squamata* 111  
*Scoloplos armiger* 113  
*Sigalion mathildae* 115  
*Spio filicornis* 117  
*Spiophanes bombyx* 119  
*Spisula elliptica* 47  
*Spisula subtruncata* 49  
*Stenheliinae* 195  
*Sthenelais limicola* 121  
*Syndosmya alba* 29
- Tardigrada* 189  
*Tellimyia ferruginosa* 41  
*Tellina fabula* 51  
*Tellina tenuis* 53  
*Travisia forbesii* 123  
*Turbellaria* 173
- Urothoe brevicornis* 153  
*Urothoe poseidonis* 155
- Venus gallina* 33  
*Venus striatula* 33

# Appendices

## Appendix I

List of all species collected at the Dutch Continental Shelf, including the number of stations on which they were encountered.

Latin name	Higher taxonomic level	Number of stations	Latin name	Higher taxonomic level	Number of stations
<i>Abludomelita obtusata</i>	Arthropoda	12	<i>Anaitides groenlandica</i>	Annelida	131
<i>Abra alba</i>	Mollusca	85	<i>Anaitides lineata</i>	Annelida	2
<i>Abra nitida</i>	Mollusca	21	<i>Anaitides maculata</i>	Annelida	1
<i>Abra prismatica</i>	Mollusca	31	<i>Anaitides mucosa</i>	Annelida	90
<i>Acanthocardia echinata</i>	Mollusca	4	<i>Anaitides subulifera</i>	Annelida	51
<i>Acidostoma obesum</i>	Arthropoda	8	<i>Anobothrus gracilis</i>	Annelida	5
<i>Acidostoma sarsi</i>	Arthropoda	1	<i>Antinoella sarsi</i>	Annelida	2
<i>Acrocrida brachiata</i>	Echinodermata	21	<i>Aonides paucibranchiata</i>	Annelida	37
<i>Acteon tornatilis</i>	Mollusca	2	<i>Aora typica</i>	Arthropoda	1
<i>Actinonema celtica</i>	Nematoda	1	<i>Apherusa clevei</i>	Arthropoda	5
<i>Aglaophamus malmgreni</i>	Annelida	1	<i>Apherusa jurinei</i>	Arthropoda	1
<i>Alteutha interrupta</i>	Arthropoda	2	<i>Apherusa ovalipes</i>	Arthropoda	7
<i>Ameira brevipes</i>	Arthropoda	4	<i>Aphrodita aculeata</i>	Annelida	13
<i>Ameira longipes</i>	Arthropoda	2	<i>Apodopsyllus listensis</i>	Arthropoda	5
<i>Ameira parvula</i>	Arthropoda	11	<i>Apodopsyllus littoralis</i>	Arthropoda	1
<i>Ameira pusilla</i>	Arthropoda	1	<i>Apodopsyllus spinipes</i>	Arthropoda	14
<i>Ameira tenella</i>	Arthropoda	3	<i>Aponema torosa</i>	Nematoda	1
<i>Ameiopsis brevicornis</i>	Arthropoda	11	<i>Aporrhais pespelecani</i>	Mollusca	1
<i>Ameiopsis mixta</i>	Arthropoda	2	<i>Arctica islandica</i>	Mollusca	24
<i>Ampelisca brevicornis</i>	Arthropoda	44	<i>Arenicola marina</i>	Annelida	1
<i>Ampelisca diadema</i>	Arthropoda	2	<i>Arenocaris bifida</i>	Arthropoda	32
<i>Ampelisca gibba</i>	Arthropoda	1	<i>Arenocaris reducta</i>	Arthropoda	1
<i>Ampelisca macrocephala</i>	Arthropoda	3	<i>Arenosetella germanica</i>	Arthropoda	17
<i>Ampelisca spinipes</i>	Arthropoda	2	<i>Arenosetella tenuissima</i>	Arthropoda	10
<i>Ampelisca tenuicornis</i>	Arthropoda	40	<i>Argissa hamatipes</i>	Arthropoda	58
<i>Ampharete acutifrons</i>	Annelida	2	<i>Aricidea catherinae</i>	Annelida	1
<i>Ampharete finmarchica</i>	Annelida	1	<i>Aricidea cerrutii</i>	Annelida	1
<i>Amphiascoides subdebilis</i>	Arthropoda	2	<i>Aricidea minuta</i>	Annelida	111
<i>Amphictene auricoma</i>	Annelida	43	<i>Ascolaimus elongatus</i>	Nematoda	14
<i>Amphilochus neapolitanus</i>	Arthropoda	2	<i>Asellopsis hispida</i>	Arthropoda	2
<i>Amphimonhystera anechma</i> *	Nematoda	1	<i>Asellopsis intermedia</i>	Arthropoda	6
<i>Amphiura filiformis</i>	Echinodermata	125	<i>Asterias rubens</i>	Echinodermata	20

Latin name	Higher taxonomic level	Number of stations
<i>Astropecten irregularis</i>	Echinodermata	10
<i>Atylus falcatus</i>	Arthropoda	92
<i>Atylus swammerdami</i>	Arthropoda	76
<i>Axionice maculata</i>	Annelida	1
<i>Axonolaimus helgolandicus</i>	Nematoda	12
<i>Axonolaimus orcombensis</i>	Nematoda	5
<i>Bathylaimus capacosus</i>	Nematoda	7
<i>Bathylaimus parafilicaudatus</i>	Nematoda	6
<i>Bathylaimus stenolaimus</i>	Nematoda	1
<i>Bathyporeia elegans</i>	Arthropoda	411
<i>Bathyporeia guilliamsoniana</i>	Arthropoda	281
<i>Bathyporeia pelagica</i>	Arthropoda	11
<i>Bathyporeia pilosa</i>	Arthropoda	4
<i>Bathyporeia sarsi</i>	Arthropoda	5
<i>Bathyporeia tenuipes</i>	Arthropoda	45
<i>Bodotria arenosa</i>	Arthropoda	2
<i>Bodotria scorpoides</i>	Arthropoda	1
<i>Bolbolaimus dentatus</i>	Nematoda	6
<i>Bolbolaimus riemanni</i>	Nematoda	3
<i>Boreopontia heipi</i>	Arthropoda	12
<i>Bradya scotti</i>	Arthropoda	7
<i>Bradya typica</i>	Arthropoda	10
<i>Branchiostoma lanceolatum</i>	Chordata	24
<i>Brissopsis lyrifera</i>	Echinodermata	3
<i>Buccinum undatum</i>	Mollusca	2
<i>Bulbamphiascus imus</i>	Arthropoda	9
<i>Callianassa subterranea</i>	Arthropoda	115
<i>Callianassa tyrrhena</i>	Arthropoda	5
<i>Calomicrolaimus honestus</i>	Nematoda	7
<i>Calomicrolaimus parahonestus</i>	Nematoda	13
<i>Camacolaimus longicauda</i>	Nematoda	1
<i>Camacolaimus tardus</i>	Nematoda	8
<i>Canuella perplexa</i>	Arthropoda	10
<i>Capitella capitata</i>	Annelida	109
<i>Carcinus maenas</i>	Arthropoda	4
<i>Ceramonema carinatum</i>	Nematoda	1
<i>Ceramonema yunfengi</i>	Nematoda	1
<i>Cerastoderma edule</i>	Mollusca	4
<i>Chaetoderma nitidulum</i>	Mollusca	6
<i>Chaetonema riemanni</i>	Nematoda	5
<i>Chaetopterus variopedatus</i>	Annelida	58
<i>Chaetozone setosa</i>	Annelida	254
<i>Chamelea striatula</i>	Mollusca	61
<i>Cheirocratus intermedius</i>	Arthropoda	1
<i>Chone infundibuliformis</i>	Annelida	1
<i>Chromadorella salicaniensis</i>	Nematoda	6
<i>Chromadorita nana</i>	Nematoda	1
<i>Chromadorita obligua</i>	Nematoda	4
<i>Chromaspirina chabaudi</i>	Nematoda	1

Latin name	Higher taxonomic level	Number of stations
<i>Chromaspirina inglisi</i>	Nematoda	1
<i>Chromaspirina multipapillata</i>	Nematoda	1
<i>Chromaspirina parapontica</i>	Nematoda	4
<i>Chromaspirina pellita</i>	Nematoda	2
<i>Chromaspirina renaudae</i>	Nematoda	3
<i>Cirolana borealis</i>	Arthropoda	3
<i>Cirolana cranchii</i>	Arthropoda	1
<i>Clausinella fasciata</i>	Mollusca	3
<i>Cletodes limicola</i>	Arthropoda	2
<i>Cletodes longicaudatus</i>	Arthropoda	4
<i>Cletodes tenuipes</i>	Arthropoda	1
<i>Cochlodesma praetenuae</i>	Mollusca	6
<i>Comesa warwicki</i>	Nematoda	1
<i>Corbula gibba</i>	Mollusca	40
<i>Corophium acherusicum</i>	Arthropoda	2
<i>Corophium affine</i>	Arthropoda	3
<i>Corophium crassicorne</i>	Arthropoda	2
<i>Corophium insidiosum</i>	Arthropoda	1
<i>Corophium volutator</i>	Arthropoda	6
<i>Corystes cassivelaunus</i>	Arthropoda	33
<i>Crangon allmanni</i>	Arthropoda	2
<i>Crangon crangon</i>	Arthropoda	92
<i>Cucumaria elongata</i>	Echinodermata	3
<i>Cumopsis goodsiri</i>	Arthropoda	1
<i>Cyartonema germanicum</i>	Nematoda	2
<i>Cylichna cylindracea</i>	Mollusca	49
<i>Cylindropsyllus laevis</i>	Arthropoda	5
<i>Cylindropsyllus remanei</i>	Arthropoda	12
<i>Dactylopedella flava</i>	Arthropoda	1
<i>Dactylopusia vulgaris</i>	Arthropoda	3
<i>Danielssenia typica</i>	Arthropoda	2
<i>Daptonema elegans</i>	Nematoda	1
<i>Daptonema fistulatum</i>	Nematoda	5
<i>Daptonema flagellicauda</i>	Nematoda	1
<i>Daptonema gelana</i>	Nematoda	1
<i>Daptonema hirsutum</i>	Nematoda	2
<i>Daptonema kornoeense</i>	Nematoda	8
<i>Daptonema nanum</i>	Nematoda	4
<i>Daptonema normanicum</i>	Nematoda	6
<i>Daptonema proprium</i>	Nematoda	6
<i>Daptonema riemanni</i>	Nematoda	7
<i>Daptonema stylosum</i>	Nematoda	13
<i>Daptonema svalbardense</i>	Nematoda	7
<i>Daptonema tenuispiculum</i>	Nematoda	5
<i>Daptonema trichinus</i>	Nematoda	5
<i>Daptonema xyaliforme</i>	Nematoda	10
<i>Dasynemoides albaensis</i>	Nematoda	5
<i>Desmodora cephalata</i>	Nematoda	1
<i>Desmodora schulzi</i>	Nematoda	2

Latin name	Higher taxonomic level	Number of stations
<i>Desmolaimus zeelandicus</i>	Nematoda	1
<i>Devonia perrieri</i>	Mollusca	2
<i>Diarthrodella secunda</i>	Arthropoda	5
<i>Diastylis bradyi</i>	Arthropoda	127
<i>Diastylis laevis</i>	Arthropoda	7
<i>Diastylis lucifera</i>	Arthropoda	5
<i>Diastylis rathkei</i>	Arthropoda	22
<i>Diastylis rugosa</i>	Arthropoda	11
<i>Dichromadora cephalata</i>	Nematoda	2
<i>Dichromadora cucullata</i>	Nematoda	11
<i>Dichromadora hyalocheile</i>	Nematoda	1
<i>Diplocirrus glaucus</i>	Annelida	53
<i>Diplopeltula ostrita</i>	Nematoda	1
<i>Donax vittatus</i>	Mollusca	47
<i>Dorylaimopsis punctata</i>	Nematoda	1
<i>Dosinia exoleta</i>	Mollusca	13
<i>Dosinia lupinus</i>	Mollusca	35
<i>Dracognomus tinae</i>	Nematoda	1
<i>Dyopedos monacanthus</i>	Arthropoda	1
<i>Ebalia cranchii</i>	Arthropoda	4
<i>Echinocardium cordatum</i>	Echinodermata	349
<i>Echinocardium flavescens</i>	Echinodermata	12
<i>Echinocyamus pusillus</i>	Echinodermata	73
<i>Echiurus echiurus</i>	Echiura	7
<i>Ectinosoma dentatum</i>	Arthropoda	1
<i>Ectinosoma melaniceps</i>	Arthropoda	10
<i>Ectinosoma normani</i>	Arthropoda	3
<i>Ectinosoma tenuipes</i>	Arthropoda	3
<i>Eleutherolaimus stenosoma</i>	Nematoda	1
<i>Enhydrosoma buchholtzi</i>	Arthropoda	1
<i>Enipo kinbergi</i>	Annelida	7
<i>Enoploides spiculohamatus</i>	Nematoda	11
<i>Enoplolaimus longicaudatus</i>	Nematoda	1
<i>Enoplolaimus propinguus</i>	Nematoda	10
<i>Ensis arcuatus</i>	Mollusca	12
<i>Ensis arcuatus var. directus</i>	Mollusca	29
<i>Ensis ensis</i>	Mollusca	12
<i>Ensis siliqua</i>	Mollusca	4
<i>Epacanthion galeatum</i>	Nematoda	3
<i>Epsilonema pustulatum</i>	Nematoda	1
<i>Esola bulligera</i>	Arthropoda	3
<i>Eteone flava</i>	Annelida	12
<i>Eteone foliosa</i>	Annelida	15
<i>Eteone longa</i>	Annelida	150
<i>Eudorella emarginata</i>	Arthropoda	6
<i>Eudorella truncatula</i>	Arthropoda	44
<i>Eudorellopsis deformis</i>	Arthropoda	27
<i>Eumida punctifera</i>	Annelida	2
<i>Eumida sanguinea</i>	Annelida	78

Latin name	Higher taxonomic level	Number of stations
<i>Eumorpholaimus sabulicolus</i>	Nematoda	3
<i>Eunoe nodosa</i>	Annelida	1
<i>Eurydice pulchra</i>	Arthropoda	2
<i>Eurydice spinigera</i>	Arthropoda	1
<i>Eusyllis blomstrandii</i>	Annelida	3
<i>Evansula pygmaea</i>	Arthropoda	27
<i>Exogone dispar</i>	Annelida	1
<i>Exogone hebes</i>	Annelida	15
<i>Exogone naidina</i>	Annelida	13
<i>Exogone verugera</i>	Annelida	1
<i>Gafrarium minutum</i>	Mollusca	1
<i>Galathea intermedia</i>	Arthropoda	1
<i>Gammanema conicauda</i>	Nematoda	1
<i>Gammaropsis maculata</i>	Arthropoda	2
<i>Gammaropsis nitida</i>	Arthropoda	2
<i>Gammarus crinicornis</i>	Arthropoda	6
<i>Gari fervensis</i>	Mollusca	12
<i>Gastrosaccus sanctus</i>	Arthropoda	1
<i>Gastrosaccus spinifer</i>	Arthropoda	124
<i>Gattyana cirrosa</i>	Annelida	57
<i>Gerlachius novusetosus</i>	Nematoda	1
<i>Glycera alba</i>	Annelida	21
<i>Glycera lapidum</i>	Annelida	23
<i>Glycera rouxi</i>	Annelida	33
<i>Glycinde nordmanni</i>	Annelida	37
<i>Golfingia elongata</i>	Sipunculida	2
<i>Golfingia procera</i>	Sipunculida	2
<i>Golfingia vulgaris</i>	Sipunculida	2
<i>Goniada maculata</i>	Annelida	151
<i>Goniadella bobretzkii</i>	Annelida	5
<i>Gonionchus longicaudatus</i>	Nematoda	9
<i>Gonionchus villosus</i>	Nematoda	3
<i>Goodallia triangularis</i>	Mollusca	3
<i>Gyptis capensis</i>	Annelida	55
<i>Gyptis helgolandicus</i>	Annelida	2
<i>Halalaimus capitulatus</i>	Nematoda	1
<i>Halectinosoma curticorne</i>	Arthropoda	3
<i>Halectinosoma distinctum</i>	Arthropoda	2
<i>Halectinosoma gothiceps</i>	Arthropoda	5
<i>Halectinosoma herdmani</i>	Arthropoda	21
<i>Halectinosoma propinquum</i>	Arthropoda	12
<i>Halectinosoma sarsi</i>	Arthropoda	9
<i>Haloschizopera bulbifera</i>	Arthropoda	3
<i>Haloschizopera pygmaea</i>	Arthropoda	1
<i>Harmothoe antilopes</i>	Annelida	2
<i>Harmothoe impar</i>	Annelida	2
<i>Harmothoe longisetis</i>	Annelida	121
<i>Harmothoe lunulata</i>	Annelida	73
<i>Harpacticus obscurus</i>	Arthropoda	2

Latin name	Higher taxonomic level	Number of stations
<i>Harpinia antennaria</i>	Arthropoda	83
<i>Harpinia crenulata</i>	Arthropoda	4
<i>Harpinia laevis</i>	Arthropoda	1
<i>Harpinia pectinata</i>	Arthropoda	10
<i>Haustorius arenarius</i>	Arthropoda	1
<i>Hemilamprops rosea</i>	Arthropoda	1
<i>Hesionura augeneri</i>	Annelida	12
<i>Hesionura elongata</i>	Annelida	1
<i>Heterolaophonte hamondi</i>	Arthropoda	2
<i>Heterolaophonte stroemi</i>	Arthropoda	1
<i>Heteromastus filiformis</i>	Annelida	29
<i>Heteromysis formosa</i>	Arthropoda	1
<i>Heteropsyllus curticaudatus</i>	Arthropoda	2
<i>Heteropsyllus major</i>	Arthropoda	3
<i>Hiatella arctica</i>	Mollusca	2
<i>Hippomedon denticulatus</i>	Arthropoda	60
<i>Hyalia vitrea</i>	Mollusca	7
<i>Hypereteone lactea</i>	Annelida	21
<i>Hypodontolaimus setosus</i>	Nematoda	3
<i>Idotea linearis</i>	Arthropoda	1
<i>Idotea neglecta</i>	Arthropoda	1
<i>Idyanthe pusilla</i>	Arthropoda	1
<i>Interleptomesochra eulittoralis</i>	Arthropoda	14
<i>Interleptomesochra tenuicornis</i>	Arthropoda	3
<i>Intermedopsyllus intermedius</i>	Arthropoda	19
<i>Ione thoracica</i>	Arthropoda	10
<i>Iphinoe trispinosa</i>	Arthropoda	58
<i>Ixonema powelli</i>	Nematoda	1
<i>Karkinochromadora lorenzeni</i>	Nematoda	2
<i>Kellia suborbicularis</i>	Mollusca	3
<i>Kliopsyllus coelebs</i>	Arthropoda	6
<i>Kliopsyllus constrictus</i>	Arthropoda	25
<i>Kliopsyllus holsaticus</i>	Arthropoda	20
<i>Kliopsyllus paraholsaticus</i>	Arthropoda	19
<i>Kliopsyllus perharidiensis</i>	Arthropoda	5
<i>Kliopsyllus similis</i>	Arthropoda	2
<i>Labidoplax buski</i>	Echinodermata	1
<i>Lagis koreni</i>	Annelida	97
<i>Lamprops fasciata</i>	Arthropoda	74
<i>Lanice conchilega</i>	Annelida	257
<i>Laonice cirrata</i>	Annelida	3
<i>Laophonte cornuta</i>	Arthropoda	3
<i>Laophonte elongata</i>	Arthropoda	2
<i>Laophonte inopinata</i>	Arthropoda	3
<i>Laophonte inornata</i>	Arthropoda	2
<i>Laophonte longicaudata</i>	Arthropoda	2
<i>Laophonte thoracica</i>	Arthropoda	3
<i>Latronema orcinum</i>	Nematoda	1
<i>Lepidepecreum longicorne</i>	Arthropoda	1

Latin name	Higher taxonomic level	Number of stations
<i>Leptastacus kwintei</i>	Arthropoda	9
<i>Leptastacus laticaudatus</i>	Arthropoda	34
<i>Leptolaimus ampullaceus</i>	Nematoda	2
<i>Leptolaimus elegans</i>	Nematoda	1
<i>Leptolaimus luridus</i>	Nematoda	1
<i>Leptolaimus venustus</i>	Nematoda	1
<i>Lepton squamosum</i>	Mollusca	10
<i>Leptonemella aphanothecae</i>	Nematoda	4
<i>Leptopontia curvicauda</i>	Arthropoda	20
<i>Leptopsyllus elongatus</i>	Arthropoda	3
<i>Leptosynapta inhaerens</i>	Echinodermata	14
<i>Leucothoe incisa</i>	Arthropoda	22
<i>Leucothoe lilljeborgi</i>	Arthropoda	17
<i>Leucothoe procera</i>	Arthropoda	3
<i>Leucothoe richiardii</i>	Arthropoda	1
<i>Leucothoe spinicarpa</i>	Arthropoda	3
<i>Levinsenia gracilis</i>	Annelida	21
<i>Linhystera problematica</i>	Nematoda	1
<i>Liocarcinus holsatus</i>	Arthropoda	14
<i>Liocarcinus marmoreus</i>	Arthropoda	1
<i>Liocarcinus pusillus</i>	Arthropoda	47
<i>Longipedia helgolandica</i>	Arthropoda	10
<i>Longipedia minor</i>	Arthropoda	12
<i>Longipedia scotti</i>	Arthropoda	2
<i>Lophogaster typicus</i>	Arthropoda	1
<i>Loripes lucinalis</i>	Mollusca	1
<i>Lucinoma borealis</i>	Mollusca	6
<i>Lumbrineris hibernica</i>	Annelida	5
<i>Lumbrineris latreilli</i>	Annelida	61
<i>Lunatia alderi</i>	Mollusca	201
<i>Lunatia catena</i>	Mollusca	4
<i>Lutraria lutraria</i>	Mollusca	1
<i>Lysilla loveni</i>	Annelida	6
<i>Macoma balthica</i>	Mollusca	115
<i>Mactra stultorum</i>	Mollusca	24
<i>Maerella tenuimana</i>	Arthropoda	2
<i>Magelona alleni</i>	Annelida	21
<i>Magelona papillicornis</i>	Annelida	454
<i>Maryllynia complexa</i>	Nematoda	1
<i>Mediomastus fragilis</i>	Annelida	7
<i>Megaluropus agilis</i>	Arthropoda	173
<i>Melanella alba</i>	Mollusca	5
<i>Mesacanthion africanthiforme</i>	Nematoda	4
<i>Mesacanthion diplochma</i>	Nematoda	3
<i>Metachromadora quadribulba</i>	Nematoda	1
<i>Metacyclopina brevisetosa</i>	Arthropoda	14
<i>Metadesmolaimus aduncus</i>	Nematoda	9
<i>Metadesmolaimus gaelicus</i>	Nematoda	1
<i>Metadesmolaimus heteroclitus</i>	Nematoda	1

Latin name	Higher taxonomic level	Number of stations	Latin name	Higher taxonomic level	Number of stations
<i>Metadesmolaimus pandus</i>	Nematoda	4	<i>Notomastus latericeus</i>	Annelida	67
<i>Metadesmolaimus varians</i>	Nematoda	4	<i>Nucella lapillus</i>	Mollusca	1
<i>Metalinhomoeus biformis</i>	Nematoda	3	<i>Nucula nitidosa</i>	Mollusca	49
<i>Metoncholaimus scanicus</i>	Nematoda	1	<i>Nuculoma tenuis</i>	Mollusca	33
<i>Metopa alderi</i>	Arthropoda	1	<i>Nudora gouboultae</i>	Nematoda	2
<i>Metopa borealis</i>	Arthropoda	2	<i>Odontophora exharena</i>	Nematoda	4
<i>Microarthridion littorale</i>	Arthropoda	11	<i>Odontophora ornata</i>	Nematoda	5
<i>Microlaimus acinaces</i>	Nematoda	7	<i>Odontophora phalarata</i>	Nematoda	1
<i>Microlaimus conothelis</i>	Nematoda	2	<i>Odontophora rectangula</i>	Nematoda	10
<i>Microlaimus conspicuus</i>	Nematoda	1	<i>Oenopota turricula</i>	Mollusca	2
<i>Microlaimus marinus</i>	Nematoda	14	<i>Oncholaimellus calvadosicus</i>	Nematoda	5
<i>Microlaimus ostracion</i>	Nematoda	10	<i>Oncholaimus oxyuris</i>	Nematoda	2
<i>Microphthalmus szcelkowi</i>	Annelida	2	<i>Onyx perfectus</i>	Nematoda	14
<i>Microprotopus maculatus</i>	Arthropoda	10	<i>Ophelia borealis</i>	Annelida	97
<i>Microsetella norvegica</i>	Arthropoda	2	<i>Ophelia limacina</i>	Annelida	16
<i>Minuspio cirrifera</i>	Annelida	11	<i>Ophelia rathkei</i>	Annelida	1
<i>Modiolus barbatus</i>	Mollusca	2	<i>Ophelina acuminata</i>	Annelida	25
<i>Moerella pygmaea</i>	Mollusca	12	<i>Ophiodromus flexuosus</i>	Annelida	55
<i>Montacuta ferruginosa</i>	Mollusca	183	<i>Ophiothrix fragilis</i>	Echinodermata	1
<i>Molgolaimus turgofrons</i>	Nematoda	1	<i>Ophiura affinis</i>	Echinodermata	6
<i>Monoculodes carinatus</i>	Arthropoda	1	<i>Ophiura albida</i>	Echinodermata	90
<i>Monoposthia mirabilis</i>	Nematoda	7	<i>Ophiura texturata</i>	Echinodermata	84
<i>Musculus discors</i>	Mollusca	1	<i>Opisa eschrichtii</i>	Arthropoda	1
<i>Musculus niger</i>	Mollusca	1	<i>Opisthodontia pterochaeta</i>	Annelida	2
<i>Mya arenaria</i>	Mollusca	6	<i>Orbinia sertulata</i>	Annelida	6
<i>Mya truncata</i>	Mollusca	4	<i>Orchomene humilis</i>	Arthropoda	10
<i>Myriochele oculata</i>	Annelida	2	<i>Orchomene nana</i>	Arthropoda	12
<i>Mysella bidentata</i>	Mollusca	181	<i>Owenia fusiformis</i>	Annelida	64
<i>Mysia undata</i>	Mollusca	13	<i>Pagurus bernhardus</i>	Arthropoda	7
<i>Mysta picta</i>	Annelida	1	<i>Paracanthonchus longicaudatus</i>	Nematoda	1
<i>Mystides southerni</i>	Annelida	2	<i>Paracanthonchus longus</i>	Nematoda	3
<i>Mytilus edulis</i>	Mollusca	2	<i>Paracanthonchus thaumasius</i>	Nematoda	14
<i>Nannolaimoides decoratus</i>	Nematoda	1	<i>Paracyatholaimus pentodon</i>	Nematoda	12
<i>Neochromadora munita</i>	Nematoda	7	<i>Paralaophonte brevirostris</i>	Arthropoda	2
<i>Neochromadora paratecta</i>	Nematoda	1	<i>Paralaophonte macera</i>	Arthropoda	1
<i>Neochromadora poecilosoma</i>	Nematoda	1	<i>Paraleptastacus espinulatus</i>	Arthropoda	41
<i>Neochromadora tecta</i>	Nematoda	2	<i>Paraleptastacus holsaticus</i>	Arthropoda	17
<i>Neochromadora trichophora</i>	Nematoda	4	<i>Paraleptastacus monensis</i>	Arthropoda	5
<i>Nephtys caeca</i>	Annelida	85	<i>Paraleptastacus spinicauda</i>	Arthropoda	13
<i>Nephtys cirrosa</i>	Annelida	477	<i>Paralinhomoeus lepturus</i>	Nematoda	4
<i>Nephtys hombergii</i>	Annelida	386	<i>Paralinhomoeus uniovarium</i>	Nematoda	1
<i>Nephtys incisa</i>	Annelida	8	<i>Paralongicyatholaimus macramphis</i>	Nematoda	5
<i>Nephtys longosetosa</i>	Annelida	85	<i>Paramesochra helgolandica</i>	Arthropoda	16
<i>Nereis longissima</i>	Annelida	104	<i>Paramesochra mielkei</i>	Arthropoda	19
<i>Nereis pelagica</i>	Annelida	1	<i>Paramesochra similis</i>	Arthropoda	3
<i>Nereis succinea</i>	Annelida	1	<i>Paramphascoides vararensis</i>	Arthropoda	3
<i>Nereis virens</i>	Annelida	5	<i>Paramphasopsis longirostris</i>	Arthropoda	20
<i>Normanella minuta</i>	Arthropoda	3	<i>Paramphilochoides odontonyx</i>	Arthropoda	2
<i>Normanella mucronata</i>	Arthropoda	2	<i>Paraonis fulgens</i>	Annelida	20



Latin name	Higher taxonomic level	Number of stations
<i>Parathemisto gaudichaudi</i>	Arthropoda	2
<i>Pariambus typicus</i>	Arthropoda	3
<i>Pectinaria belgica</i>	Annelida	1
<i>Periocolodes longimanus</i>	Arthropoda	136
<i>Petricola pholadiformis</i>	Mollusca	2
<i>Phaxas pellucidus</i>	Mollusca	58
<i>Philine catena</i>	Mollusca	3
<i>Philine scabra</i>	Mollusca	1
<i>Pholoe minuta</i>	Annelida	115
<i>Photis reinhardi</i>	Arthropoda	1
<i>Phoxichilidium femoratum</i>	Arthropoda	1
<i>Phoxocephalus holbolli</i>	Arthropoda	3
<i>Phtisica marina</i>	Arthropoda	1
<i>Phyllodoce laminosa</i>	Annelida	1
<i>Pinnotheres pisum</i>	Arthropoda	2
<i>Pirimela denticulata</i>	Arthropoda	1
<i>Pisione remota</i>	Annelida	8
<i>Pista cristata</i>	Annelida	2
<i>Pleurobranchus membranaceus</i>	Mollusca	1
<i>Poecilochaetus serpens</i>	Annelida	45
<i>Polycirrus medusa</i>	Annelida	9
<i>Polydora caulleryi</i>	Annelida	1
<i>Polydora flava</i>	Annelida	1
<i>Polydora guillei</i>	Annelida	10
<i>Polydora ligni</i>	Annelida	3
<i>Polyphysia crassa</i>	Annelida	5
<i>Polysigma fuscum</i>	Nematoda	1
<i>Pomponema astrodes</i>	Nematoda	1
<i>Pomponema clavicaudatum</i>	Nematoda	2
<i>Pomponema loticum</i>	Nematoda	5
<i>Pomponema multipapillatum</i>	Nematoda	1
<i>Pomponema sedecima</i>	Nematoda	1
<i>Pontocrates altamarinus</i>	Arthropoda	124
<i>Pontocrates arenarius</i>	Arthropoda	14
<i>Pontophilus bispinosus</i>	Arthropoda	1
<i>Pontophilus trispinosus</i>	Arthropoda	13
<i>Praxillura longissima</i>	Annelida	1
<i>Prionospio malmgreni</i>	Annelida	1
<i>Proameira echinipes</i>	Arthropoda	1
<i>Proameira hiddensoensis</i>	Arthropoda	8
<i>Proameira signata</i>	Arthropoda	1
<i>Proameira simplex</i>	Arthropoda	2
<i>Processa edulis</i>	Arthropoda	1
<i>Processa modica</i>	Arthropoda	3
<i>Processa nouveli</i>	Arthropoda	4
<i>Processa parva</i>	Arthropoda	1
<i>Prochromadorella attenuata</i>	Nematoda	8
<i>Prochromadorella ditlevseni</i>	Nematoda	1
<i>Prochromadorella longicaudata</i>	Nematoda	5

Latin name	Higher taxonomic level	Number of stations
<i>Protodorvillea kefersteini</i>	Annelida	2
<i>Protopsammotopa norvegica</i>	Arthropoda	14
<i>Psammis longisetosa</i>	Arthropoda	3
<i>Psammotopa phyllosetosa</i>	Arthropoda	23
<i>Pseudameira crassicornis</i>	Arthropoda	8
<i>Pseudameira mixta</i>	Arthropoda	4
<i>Pseudameira perplexa</i>	Arthropoda	3
<i>Pseudameira reflexa</i>	Arthropoda	3
<i>Pseudamphiascopsis herdmani</i>	Arthropoda	5
<i>Pseudobradya beduina</i>	Arthropoda	20
<i>Pseudobradya minor</i>	Arthropoda	9
<i>Pseudobradya pulchella</i>	Arthropoda	5
<i>Pseudocuma gilsoni</i>	Arthropoda	1
<i>Pseudocuma longicornis</i>	Arthropoda	211
<i>Pseudocuma similis</i>	Arthropoda	32
<i>Pseudolaophonte spinosa</i>	Arthropoda	1
<i>Pseudomesochra longifurcata</i>	Arthropoda	1
<i>Pseudonchus pachysetosus</i>	Nematoda	1
<i>Pseudonychocampus proximus</i>	Arthropoda	4
<i>Pseudopolydora pulchra</i>	Annelida	4
<i>Pseudosarsameira exilis</i>	Arthropoda	6
<i>Psyllocampus minutus</i>	Arthropoda	1
<i>Pteropsyllus consimilis</i>	Arthropoda	3
<i>Pygospio elegans</i>	Annelida	11
<i>Remanea arenicola</i>	Arthropoda	1
<i>Retusa obtusa</i>	Mollusca	1
<i>Rhabdocoma riemanni</i>	Nematoda	3
<i>Rhabdodemia major</i>	Nematoda	1
<i>Rhizothrix curvata</i>	Arthropoda	4
<i>Rhodine gracilior</i>	Annelida	1
<i>Rhynchonema lyngei</i>	Nematoda	8
<i>Rhynchonema megamphida</i>	Nematoda	1
<i>Richtersia deconincki</i>	Nematoda	4
<i>Richtersia inaequalis</i>	Nematoda	14
<i>Robertsonia tenuis</i>	Arthropoda	3
<i>Sabatieria celtica</i>	Nematoda	15
<i>Sabatieria longispinosa</i>	Nematoda	2
<i>Sabatieria punctata</i>	Nematoda	18
<i>Sabatieria strigosa</i>	Nematoda	1
<i>Sabellaria spinulosa</i>	Annelida	2
<i>Sarsameira parva</i>	Arthropoda	4
<i>Scalibregma inflatum</i>	Annelida	32
<i>Scaphander lignarius</i>	Mollusca	1
<i>Schistomysis kervillei</i>	Arthropoda	18
<i>Scolecopsis bonnierii</i>	Annelida	184
<i>Scolecopsis foliosa</i>	Annelida	8
<i>Scolecopsis squamata</i>	Annelida	82
<i>Scoloplos armiger</i>	Annelida	469
<i>Scopelocheirus hopei</i>	Arthropoda	2

Latin name	Higher taxonomic level	Number of stations
<i>Scottopsyllus minor</i>	Arthropoda	15
<i>Scrobicularia plana</i>	Mollusca	1
<i>Setosabatieria hilarula</i>	Nematoda	2
<i>Sicameira leptoderma</i>	Arthropoda	8
<i>Sigalion mathildae</i>	Annelida	87
<i>Sigmophoranema rufum</i>	Nematoda	5
<i>Siphonoecetes kroyeranus</i>	Arthropoda	12
<i>Siphonolaimus ewensis</i>	Nematoda	4
<i>Siriella clausii</i>	Arthropoda	2
<i>Solen marginatus</i>	Mollusca	1
<i>Southernia zosteriae</i>	Nematoda	4
<i>Sphaerodorum flavum</i>	Annelida	2
<i>Sphaerosyllis hystrix</i>	Annelida	2
<i>Spio armata</i>	Annelida	1
<i>Spio filicornis</i>	Annelida	331
<i>Spiophanes bombyx</i>	Annelida	514
<i>Spiophanes kroeyeri</i>	Annelida	14
<i>Spirinia laevioides</i>	Nematoda	1
<i>Spirinia laevis</i>	Nematoda	3
<i>Spirinia parasitifera</i>	Nematoda	10
<i>Spisula elliptica</i>	Mollusca	41
<i>Spisula solida</i>	Mollusca	3
<i>Spisula subtruncata</i>	Mollusca	111
<i>Stegocephaloides christianiensis</i>	Arthropoda	1
<i>Stenhelia aemula</i>	Arthropoda	7
<i>Stenhelia gibba</i>	Arthropoda	3
<i>Stenhelia normani</i>	Arthropoda	1
<i>Stenocaris kliei</i>	Arthropoda	7
<i>Stenocaris minor</i>	Arthropoda	8
<i>Stenocaris minuta</i>	Arthropoda	7
<i>Stenocopia longicaudata</i>	Arthropoda	2
<i>Stenothoe monoculoides</i>	Arthropoda	1
<i>Stephanolaimus bicoronatus</i>	Nematoda	4
<i>Stephanolaimus elegans</i>	Nematoda	6
<i>Stephanolaimus flevensis</i>	Nematoda	5
<i>Stephanolaimus gandavensis</i>	Nematoda	1
<i>Sthenelais boa</i>	Annelida	1
<i>Sthenelais limicola</i>	Annelida	72
<i>Streblospio shrubsolii</i>	Annelida	1
<i>Streptosyllis websteri</i>	Annelida	9
<i>Synchelidium haplocheles</i>	Arthropoda	10
<i>Synchelidium maculatum</i>	Arthropoda	26
<i>Synelmis klatti</i>	Annelida	57
<i>Synonchiella riemanni</i>	Nematoda	2
<i>Syrticola flandricus</i>	Arthropoda	10
<i>Tachidiella minuta</i>	Arthropoda	5
<i>Tachidius discipes</i>	Arthropoda	2
<i>Tellina fabula</i>	Mollusca	321
<i>Tellina tenuis</i>	Mollusca	86

Latin name	Higher taxonomic level	Number of stations
<i>Terebellides stroemi</i>	Annelida	4
<i>Terschellingia longicaudata</i>	Nematoda	1
<i>Tharyx marioni</i>	Annelida	9
<i>Theristus acer</i>	Nematoda	2
<i>Theristus interstitialis</i>	Nematoda	3
<i>Theristus macer</i>	Nematoda	1
<i>Theristus pertenuis</i>	Nematoda	2
<i>Thia scutellata</i>	Arthropoda	35
<i>Thompsonula hyaenae</i>	Arthropoda	6
<i>Thracia convexa</i>	Mollusca	10
<i>Thracia phaseolina</i>	Mollusca	28
<i>Thracia villosiuscula</i>	Mollusca	2
<i>Thyasira croulinensis</i>	Mollusca	1
<i>Thyasira flexuosa</i>	Mollusca	17
<i>Tisbe bulbisetosa</i>	Arthropoda	2
<i>Tisbe furcata</i>	Arthropoda	1
<i>Tisbe gracilis</i>	Arthropoda	1
<i>Travisia forbesii</i>	Annelida	55
<i>Trefusia litoralis</i>	Nematoda	1
<i>Trichotheristus mirabilis</i>	Nematoda	10
<i>Tridonta borealis</i>	Mollusca	2
<i>Tridonta montagui</i>	Mollusca	1
<i>Tryphosella sarsi</i>	Arthropoda	7
<i>Tubolaimoides tenuicaudatus</i>	Nematoda	10
<i>Turbonilla lactea</i>	Mollusca	1
<i>Turritella communis</i>	Mollusca	6
<i>Typhlamphiascus confusus</i>	Arthropoda	1
<i>Typosyllis armillaris</i>	Annelida	4
<i>Unciola planipes</i>	Arthropoda	4
<i>Upogebia deltaura</i>	Arthropoda	24
<i>Upogebia stellata</i>	Arthropoda	2
<i>Urothoe brevicornis</i>	Arthropoda	69
<i>Urothoe elegans</i>	Arthropoda	18
<i>Urothoe marina</i>	Arthropoda	1
<i>Urothoe poseidonis</i>	Arthropoda	383
<i>Urothoe pulchella</i>	Arthropoda	2
<i>Valvaelaimus maior</i>	Nematoda	6
<i>Viscosia franzii</i>	Nematoda	10
<i>Viscosia langrunensis</i>	Nematoda	7
<i>Viscosia separabilis</i>	Nematoda	2
<i>Viscosia viscosa</i>	Nematoda	5
<i>Vitreolina philippi</i>	Mollusca	5
<i>Westwoodilla caecula</i>	Arthropoda	9
<i>Xyala striata</i>	Nematoda	9
<i>Zosime major</i>	Arthropoda	1

## Appendix II

Systematics of the macrobenthic species presented in this atlas.

Phylum	Mollusca
Class	Gastropoda
Order	Mesogastropoda
Family	Naticidae
	<b>Lunatia alderi</b> (Forbes, 1838)
Class	Bivalvia
Order	Nuculoida
Family	Nuculidae
	<b>Nucula nitidosa</b> (Winckworth, 1930)
Order	Veneroida
Family	Montacutidae
	<b>Montacuta ferruginosa</b> (Montagu, 1808)
	<b>Mysella bidentata</b> (Montagu, 1803)
Family	Mactridae
	<b>Spisula elliptica</b> (Brown, 1827)
	<b>Spisula subtruncata</b> (da Costa, 1778)
Family	Tellinidae
	<b>Macoma balthica</b> (Linnaeus, 1758)
	<b>Tellina fabula</b> (Gmelin, 1791)
	<b>Tellina tenuis</b> (da Costa, 1778)
Family	Donacidae
	<b>Donax vittatus</b> (da Costa, 1778)
Family	Semelidae
	<b>Abra alba</b> (W. Wood, 1802)
Family	Arcticidae
	<b>Arctica islandica</b> (Linnaeus, 1767)
Family	Veneridae
	<b>Chamelea striatula</b> (da Costa, 1778)
Phylum	Annelida
Class	Polychaeta
Order	Errantia
Family	Polynoidae
	<b>Gattyana cirrosa</b> (Pallas, 1766)
	<b>Harmothoe longisetis</b> (Grube, 1863)
	<b>Harmothoe lunulata</b> (Delle Chiaje, 1841)
Family	Sigalionidae
	<b>Sigalion mathildae</b> (Audouin & Milne-Edwards, 1832)
	<b>Pholoe minuta</b> (Fabricius, 1780)
	<b>Sthenelais limicola</b> (Ehlers, 1864)
Family	Phyllodocidae
	<b>Eteone longe</b> (Fabricius, 1780)
	<b>Anaitides groenlandica</b> (Oersted, 1842)
	<b>Anaitides mucosa</b> (Oersted, 1843)
	<b>Eumida sanguinea</b> (Oersted, 1843)

Family	Nereidae
	<b>Nereis longissima</b> (Johnston, 1840)
Family	Nephtyidae
	<b>Nephtys caeca</b> (Fabricius, 1780)
	<b>Nephtys cirrosa</b> (Ehlers, 1868)
	<b>Nephtys hombergii</b> (Savigny, 1818)
	<b>Nephtys longosetosa</b> (Oersted, 1843)
Family	Glyceridae
	<b>Glycera rouxi</b> (Audouin & Milne-Edwards, 1833)
Family	Goniadidae
	<b>Goniada maculata</b> (Oersted, 1843)
Family	Lumbrineridae
	<b>Lumbrineris latreilli</b> (Audouin & Milne-Edwards, 1834)
Order	Sedentaria
Family	Orbinidae
	<b>Scoloplos armiger</b> (O.F. Müller, 1776)
Family	Paraonidae
	<b>Aricidea minuta</b> (Southward, 1956)
Family	Spionidae
	<b>Spio filicornis</b> (O.F. Müller, 1766)
	<b>Spiophanes bombyx</b> (Claparède, 1870)
	<b>Scolelepis bonnierii</b> (Mesnil, 1896)
	<b>Scolelepis squamata</b> (Müller, 1789)
Family	Magelonidae
	<b>Magelona papillicornis</b> (F. Müller, 1858)
Family	Chaetopteridae
	<b>Chaetopterus variopedatus</b> (Renier, 1804)
Family	Cirratulidae
	<b>Chaetozone setosa</b> (Malmgren, 1867)
Family	Opheliidae
	<b>Ophelia borealis</b> (Quatrefages, 1865)
	<b>Travisia forbesii</b> (Johnston, 1840)
Family	Capitellidae
	<b>Capitella capitata</b> (Fabricius, 1780)
	<b>Notomastus latericeus</b> (Sars, 1851)
Family	Oweniidae
	<b>Owenia fusiformis</b> (Delle Chiaje, 1841)
Family	Pectinariidae
	<b>Lagis koreni</b> (Malmgren, 1865)
Family	Terebellidae
	<b>Lanice conchilega</b> (Pallas, 1766)

Phylum	Arthropoda
Subphylum	Crustacea
Class	Malacostraca
Order	Amphipoda
Family	Lysianassidae
	<b>Hippomedon denticulatus</b> (Bate, 1857)
Family	Haustoriidae
	<b>Bathyporeia elegans</b> (Watkin, 1938)
	<b>Bathyporeia guilliamsoniana</b> (Bate, 1856)
	<b>Bathyporeia tenuipes</b> (Meinert, 1877)
	<b>Urothoe brevicornis</b> (Bate, 1862)
	<b>Urothoe poseidonis</b> (Reibisch, 1905)
Family	Oedicerotidae
	<b>Perioculodes longimanus</b>
	(Bate & Westwood, 1868)
	<b>Pontocrates altamarinus</b>
	(Bate & Westwood, 1862)
Family	Phoxocephalidae
	<b>Harpinia antennaria</b> (Meinert, 1890)
Family	Melphidippidae
	<b>Megaluropus agilis</b> (Hoek, 1889)
Family	Atylidae
	<b>Atylus falcatus</b> (Metzger, 1871)
	<b>Atylus swammerdami</b>
	(Milne-Edwards, 1830)
Order	Cumacea
Family	Pseudocumatidae
	<b>Pseudocuma longicornis</b> (Bate, 1858)
Family	Diastylidae
	<b>Diastylis bradyi</b> (Norman, 1879)
Superorder	Eucarida
Order	Decapoda
Family	Callianassidae
	<b>Callianassa subterranea</b>
	(Montagu, 1808)
Phylum	Echinodermata
Class	Ophiuroidea
Family	Amphiuridae
	<b>Amphiura filiformis</b> (O.F. Müller, 1776)
Family	Ophiolepidae
	<b>Ophiura albida</b> (Forbes, 1839)
	<b>Ophiura texturata</b> (Linnaeus, 1758)
Class	Echinoidea
Order	Clypeastroidae
Family	Fibularidae
	<b>Echinocyamus pusillus</b>
	(O.F. Müller, 1776)
Order	Spatangoidea
Family	Spatangidae
	<b>Echinocardium cordatum</b> (Pennant, 1777)

## Appendix III

Systematics of the meiobenthic taxa presented in this atlas.

Phylum	Cnidaria
Class	<b>Hydrozoa</b>
Phylum	Platyhelminthes
Class	<b>Turbellaria</b>
Phylum	<b>Nematoda</b>
Phylum	<b>Gastrotricha</b>
Phylum	<b>Kinorhyncha</b>
Phylum	<b>Priapulida</b>
Phylum	Annelida
Class	<b>Oligochaeta</b>
Class	<b>Polychaeta</b>
Order	<b>Archiannelida</b>
Phylum	<b>Tardigrada</b>
Phylum	Arthropoda
Subphylum	Crustacea
Class	Thecostraca
Subclass	<b>Ostracoda</b>
Subclass	<b>Copepoda</b>
Order	Harpacticoida
Family	<b>Ameiridae</b>
Family	<b>Diosaccidae</b>
Family	<b>Ectinosomatidae</b>
Family	<b>Leptastacidae</b>
Family	<b>Paramesochridae</b>
Subphylum	Chelicerata
Class	Arachnida
Order	Acari
Family	<b>Halacaridae</b>

#### Appendix IV

The average density (ind./m<sup>2</sup>) and biomass (g AFDW/m<sup>2</sup>) with their standard deviation and maximum values of the selected macrobenthos species found at the Dutch Continental Shelf. The presence of the species are given in number and percentage of stations.

Species	Presence on stations		Density (ind./m <sup>2</sup> )			Biomass (g AFDW/m <sup>2</sup> )		
	n	%	average	st.dev.	max.	average	st.dev.	max.
<i>Abra alba</i>	85	11	19.35	197.94	4623.0	0.037	0.344	7.962
<i>Amphiura filiformis</i>	125	17	101.55	343.13	3672.0	0.660	2.881	34.041
<i>Anaitides groenlandica</i>	131	17	4.74	17.61	221.0	0.115	0.509	5.989
<i>Anaitides mucosa</i>	90	12	10.24	61.41	971.0	0.003	0.031	0.703
<i>Arctica islandica</i>	24	3	0.25	2.21	46.0	0.002	0.040	1.060
<i>Aricidea minuta</i>	111	15	9.66	61.07	1471.0	0.002	0.008	0.100
<i>Atylus falcatus</i>	92	12	2.38	8.22	74.0	0.001	0.003	0.029
<i>Atylus swammerdami</i>	76	10	1.91	10.43	162.0	0.0004	0.002	0.028
<i>Bathyporeia elegans</i>	411	55	50.07	112.02	1515.0	0.015	0.033	0.379
<i>Bathyporeia guilliamsoniana</i>	281	38	21.30	55.01	577.0	0.017	0.046	0.506
<i>Bathyporeia tenuipes</i>	45	6	1.75	9.20	112.0	0.0004	0.003	0.036
<i>Callianassa subterranea</i>	115	15	13.13	42.87	395.0	0.410	1.538	18.772
<i>Capitella capitata</i>	109	15	10.63	50.76	677.0	0.002	0.015	0.309
<i>Chaetozone setosa</i>	254	34	14.35	42.22	571.0	0.010	0.032	0.363
<i>Chaetopterus variopedatus</i>	58	8	3.60	23.29	454.0	0.507	2.824	37.285
<i>Chamelea striatula</i>	61	8	1.22	5.43	79.0	0.093	0.804	15.667
<i>Diastylis bradyi</i>	127	17	3.78	13.10	191.0	0.001	0.007	0.132
<i>Donax vittatus</i>	47	6	2.41	19.07	424.0	0.010	0.790	14.501
<i>Echinocardium cordatum</i>	349	47	50.03	329.63	8282.0	3.504	8.453	93.379
<i>Echinocyamus pusillus</i>	73	10	3.78	24.00	541.0	0.003	0.015	0.169
<i>Eteone longa</i>	150	20	5.72	18.42	235.0	0.002	0.007	0.081
<i>Eumida sanguinea</i>	78	10	5.14	47.56	1192.0	0.002	0.012	0.234
<i>Gattyana cirrosa</i>	57	8	3.03	19.55	380.0	0.034	0.219	2.843
<i>Glycera rouxii</i>	33	4	0.77	22.62	73.0	0.035	0.321	5.066
<i>Goniada maculata</i>	151	20	4.88	21.16	410.0	0.015	0.067	0.829
<i>Harmothoe longisetis</i>	121	16	3.70	13.06	235.0	0.008	0.105	2.722
<i>Harmothoe lunulata</i>	73	10	2.20	9.87	117.0	0.011	0.096	1.978
<i>Harpinia antennaria</i>	83	11	6.30	23.45	205.0	0.002	0.006	0.061
<i>Hippomedon denticulatus</i>	60	8	1.33	8.98	205.0	0.001	0.006	0.121
<i>Lagis koreni</i>	97	13	9.96	75.50	1206.0	0.017	0.103	1.376
<i>Lanice conchilega</i>	257	34	63.67	279.72	3369.0	0.559	3.085	55.662
<i>Lumbrineris latreilli</i>	61	8	6.90	33.78	424.0	0.016	0.129	3.072
<i>Lunatia alderi</i>	201	27	8.27	25.88	382.0	0.139	0.931	16.200
<i>Macoma balthica</i>	115	15	35.95	165.16	2059.4	0.991	4.360	37.982
<i>Magelona papillicornis</i>	454	61	311.21	1120.18	12709.0	0.964	3.392	35.768
<i>Megaluropus agilis</i>	173	23	7.01	19.98	221.0	0.002	0.005	0.061
<i>Montacuta ferruginosa</i>	183	24	17.86	92.25	1383.0	0.013	0.071	1.162
<i>Mysella bidentata</i>	181	24	58.07	198.73	1873.0	0.013	0.050	0.696
<i>Nephtys ceaca</i>	85	11	1.86	6.87	73.0	0.252	1.242	16.146
<i>Nephtys cirrosa</i>	477	64	48.82	61.09	368.0	0.212	0.325	2.412

Species	Presence on stations		Density (ind./m <sup>2</sup> )			Biomass (g AFDW/m <sup>2</sup> )		
	n	%	average	st.dev.	max.	average	st.dev.	max.
<i>Nephtys hombergii</i>	386	52	29.18	47.36	294.0	0.859	1.463	11.243
<i>Nephtys longosetosa</i>	85	11	1.59	5.95	73.0	0.045	0.253	2.888
<i>Nereis longissima</i>	104	14	3.31	16.32	353.0	0.156	0.777	7.874
<i>Notomastus latericeus</i>	67	9	2.88	19.67	424.0	0.039	0.216	2.319
<i>Nucula nitidosa</i>	49	7	1.88	9.91	135.0	0.007	0.060	0.904
<i>Ophelia borealis</i>	97	13	4.51	20.82	279.0	0.057	0.730	18.821
<i>Ophiura albida</i>	90	12	3.10	18.14	395.0	0.012	0.104	1.721
<i>Ophiura texturata</i>	84	11	4.12	17.69	250.0	0.018	0.160	2.501
<i>Owenia fusiformis</i>	64	9	1.58	7.56	117.0	0.006	0.040	0.436
<i>Perioculodes longimanus</i>	136	18	3.95	12.52	118.0	0.001	0.003	0.021
<i>Pholoe minuta</i>	115	15	8.24	34.76	585.0	0.003	0.014	0.234
<i>Pontocrates altamarinus</i>	124	17	6.29	29.31	530.0	0.002	0.014	0.294
<i>Pseudocuma longicornis</i>	211	28	12.37	35.87	397.0	0.001	0.004	0.040
<i>Scolelepis bonnieri</i>	184	25	5.71	16.64	191.0	0.113	1.266	32.819
<i>Scolelepis squamata</i>	82	11	3.77	16.23	177.0	0.032	0.171	2.209
<i>Scoloplos armiger</i>	469	63	51.51	107.55	1103.0	0.151	0.323	3.482
<i>Sigalion mathildae</i>	87	12	2.59	9.70	118.0	0.038	0.209	2.749
<i>Spiophanes bombyx</i>	514	69	543.93	2376.70	31215.0	0.205	0.789	9.978
<i>Spio filicornis</i>	331	44	40.98	140.78	2221.0	0.016	0.058	0.682
<i>Spisula elliptica</i>	41	5	7.20	111.15	2765.0	0.306	4.081	83.055
<i>Spisula subtruncata</i>	111	15	77.71	451.49	5928.0	3.364	18.995	342.941
<i>Sthenelais limicola</i>	72	10	4.79	96.95	2648.0	0.010	0.067	0.965
<i>Tellina fabula</i>	321	43	52.33	118.92	1059.0	0.740	1.933	17.584
<i>Tellina tenuis</i>	86	11	4.40	27.78	559.0	0.115	0.648	10.719
<i>Travisia forbesii</i>	55	7	1.86	9.28	147.0	0.014	0.090	1.116
<i>Urothoe brevicornis</i>	69	9	4.60	21.54	235.0	0.003	0.015	0.156
<i>Urothoe poseidonis</i>	383	51	149.59	354.43	4428.0	0.051	0.114	0.866

## Appendix V

Average values of the median grain size ( $\mu\text{m}$ ) and silt content (%) with their standard deviation, minimum and maximum values of the selected macrobenthos species found at the Dutch Continental Shelf. The presence of the species is given in number and percentage of stations.

Species	Presence on stations		Median grain size ( $\mu\text{m}$ )				Silt content (%)			
	n	%	average	st.dev.	min.	max.	average	st.dev.	min.	max.
<i>Abra alba</i>	85	11	205.5	76.3	87.0	450.0	8.9	7.7	0.1	28.5
<i>Amphiura filiformis</i>	125	17	147.5	49.4	86.7	360.0	11.1	7.4	0.4	35.3
<i>Anaitides groenlandica</i>	131	17	237.1	81.7	87.0	581.3	4.0	6.1	0.0	33.3
<i>Anaitides mucosa</i>	90	12	208.3	78.3	98.8	581.3	4.2	7.0	0.0	49.7
<i>Arctica islandica</i>	24	3	149.2	72.8	86.7	360.0	8.0	6.4	0.2	23.3
<i>Aricidea minuta</i>	111	15	285.4	50.6	152.4	450.0	1.6	2.0	0.0	18.4
<i>Atylus falcatus</i>	92	12	249.4	84.6	129.4	581.3	1.9	3.5	0.0	24.0
<i>Atylus swammerdami</i>	76	10	244.0	77.0	91.6	450.0	2.2	2.8	0.1	14.0
<i>Bathyporeia elegans</i>	411	55	242.5	66.9	87.0	581.3	1.8	2.3	0.0	24.2
<i>Bathyporeia guilliamsoniana</i>	281	38	248.9	61.1	108.4	450.0	1.6	1.8	0.0	16.5
<i>Bathyporeia tenuipes</i>	45	6	174.2	61.1	87.0	360.0	6.0	4.6	0.1	20.3
<i>Callianassa subterranea</i>	115	15	141.9	45.8	86.7	326.0	9.8	7.5	1.1	35.3
<i>Capitella capitata</i>	109	15	226.2	69.1	111.1	450.0	4.4	7.1	0.0	49.7
<i>Chaetozone setosa</i>	254	34	221.3	70.5	86.7	409.1	3.6	5.1	0.0	27.6
<i>Chaetopterus variopedatus</i>	58	8	122.1	25.5	86.7	197.8	13.3	8.1	2.7	35.3
<i>Chamelea striatula</i>	61	8	180.5	82.6	87.0	450.0	6.6	6.7	0.1	26.0
<i>Diastylis bradyi</i>	127	17	218.2	82.2	86.7	581.3	4.2	6.5	0.0	37.6
<i>Donax vittatus</i>	47	6	225.3	43.8	140.7	326.0	1.7	2.2	0.1	14.2
<i>Echinocardium cordatum</i>	349	47	227.2	73.6	86.7	459.0	3.3	5.0	0.1	27.6
<i>Echinocyamus pusillus</i>	73	10	282.2	77.0	87.0	571.8	2.1	2.9	0.1	20.3
<i>Eteone longa</i>	150	20	258.8	70.0	87.0	450.0	2.1	3.3	0.0	20.3
<i>Eumida sanguinea</i>	78	10	229.6	68.0	123.3	450.0	2.4	2.1	0.1	10.3
<i>Gattyana cirrosa</i>	57	8	132.1	36.3	86.7	245.0	14.2	7.3	1.5	35.3
<i>Glycera rouxi</i>	33	4	126.5	48.6	88.0	360.0	14.7	7.6	0.9	35.3
<i>Goniada maculata</i>	151	20	204.6	82.5	86.7	571.8	5.8	6.4	0.1	24.2
<i>Harmothoe longisetis</i>	121	16	250.5	80.7	87.0	420.4	5.1	7.0	0.1	37.6
<i>Harmothoe lunulata</i>	73	10	210.2	78.8	86.7	418.0	5.6	5.9	0.2	24.2
<i>Harpinia antennaria</i>	83	11	133.8	33.9	87.0	280.0	11.8	6.4	1.7	26.8
<i>Hippomedon denticulatus</i>	60	8	228.3	74.5	91.6	418.0	3.6	3.6	0.1	16.3
<i>Lagis koreni</i>	97	13	192.0	59.3	86.7	387.4	6.5	7.7	0.0	35.3
<i>Lanice conchilega</i>	257	34	227.7	70.3	93.6	459.0	3.3	4.9	0.0	35.3
<i>Lumbrineris latreilli</i>	61	8	145.4	65.1	88.0	418.0	14.4	7.9	0.5	35.3
<i>Lunatia alderi</i>	201	27	225.5	78.0	87.0	571.8	4.6	6.3	0.0	35.9
<i>Macoma balthica</i>	115	15	200.2	63.5	80.8	446.6	7.2	12.4	0.0	90.9
<i>Magelona papillicornis</i>	454	61	235.9	70.6	93.6	571.8	2.6	3.6	0.0	27.0
<i>Megaluropus agilis</i>	173	23	274.7	63.7	131.5	581.3	1.6	2.0	0.0	16.5
<i>Montacuta ferruginosa</i>	183	24	208.5	66.7	87.0	450.0	4.3	5.6	0.0	27.6
<i>Mysella bidentata</i>	181	24	179.4	73.2	86.7	450.0	8.6	7.9	0.1	35.9
<i>Nephtys ceaca</i>	85	11	259.9	68.6	131.5	420.7	2.2	3.0	0.1	16.4
<i>Nephtys cirrosa</i>	477	64	261.8	74.8	87.0	581.3	2.3	4.1	0.0	28.5

Species	Presence on stations		Median grain size ( $\mu\text{m}$ )				Silt content (%)			
	n	%	average	st.dev.	min.	max.	average	st.dev.	min.	max.
<i>Nephtys hombergii</i>	386	52	188.5	57.1	86.7	450.0	6.4	8.9	0.0	58.3
<i>Nephtys longosetosa</i>	85	11	283.0	79.0	87.0	455.9	2.1	3.6	0.0	20.3
<i>Nereis longissima</i>	104	14	212.9	88.8	87.0	450.0	8.2	9.2	0.0	49.7
<i>Notomastus latericeus</i>	67	9	153.6	73.6	86.7	418.0	11.3	7.9	0.4	35.3
<i>Nucula nitidosa</i>	49	7	144.1	34.4	87.0	196.6	9.9	7.4	1.1	35.3
<i>Ophelia borealis</i>	97	13	299.6	86.3	131.5	581.3	1.0	1.4	0.0	8.4
<i>Ophiura albida</i>	90	12	219.8	88.4	87.0	459.0	5.0	6.2	0.1	23.7
<i>Ophiura texturata</i>	84	11	193.8	54.7	96.8	384.3	5.3	6.3	0.3	25.0
<i>Owenia fusiformis</i>	64	9	157.4	64.7	88.0	450.0	10.0	8.4	0.1	35.3
<i>Pericolodetes longimanus</i>	136	18	210.8	68.6	89.0	459.0	3.9	4.6	0.1	24.2
<i>Pholoe minuta</i>	115	15	164.5	63.4	89.0	395.5	10.3	7.7	0.1	35.3
<i>Pontocrates altamarinus</i>	124	17	245.8	66.6	118.4	481.5	1.8	1.9	0.0	11.7
<i>Pseudocuma longicornis</i>	211	28	254.5	67.7	97.5	455.9	2.2	2.7	0.0	16.7
<i>Scolecopsis bonnieri</i>	184	25	263.5	70.2	87.0	459.0	1.8	2.9	0.0	24.2
<i>Scolecopsis squamata</i>	82	11	265.4	64.3	158.9	450.0	1.2	1.0	0.0	5.1
<i>Scoloplos armiger</i>	469	63	241.6	76.1	87.0	507.0	2.8	4.9	0.0	49.7
<i>Sigalion mathildae</i>	87	12	187.9	39.5	87.0	276.5	3.9	4.3	0.1	24.1
<i>Spiophanes bombyx</i>	514	69	235.1	75.2	86.7	571.8	3.4	5.2	0.0	35.3
<i>Spio filicornis</i>	331	44	243.0	83.0	86.7	581.3	2.6	4.8	0.0	49.7
<i>Spisula elliptica</i>	41	5	286.8	79.7	160.0	459.0	1.5	1.5	0.0	5.8
<i>Spisula subtruncata</i>	111	15	209.3	73.5	107.4	581.3	5.8	7.5	0.1	37.6
<i>Sthenelais limicola</i>	72	10	172.5	59.0	87.0	306.2	7.9	6.7	0.1	26.0
<i>Tellina fabula</i>	321	43	218.6	60.4	87.0	571.8	3.2	4.3	0.0	24.0
<i>Tellina tenuis</i>	86	11	234.1	70.7	114.2	437.2	2.4	4.9	0.0	24.2
<i>Travisia forbesii</i>	55	7	302.7	41.5	238.2	425.8	0.8	0.7	0.0	3.9
<i>Urothoe brevicornis</i>	69	9	276.7	54.0	97.5	450.0	1.9	2.5	0.0	15.6
<i>Urothoe poseidonis</i>	382	51	239.3	63.8	115.9	491.9	1.9	2.6	0.0	23.7




## Appendix VI

The average density (ind./10 cm<sup>2</sup>), with standard deviation and maximum values, and the average values of the median grain size (µm) and silt content (%), with standard deviation and minimum and maximum values, of the selected meiobenthic taxa found at the Dutch Continental Shelf. The presence of the taxa is given in number and percentage of stations (N=530, except N Archiannelida=476, N Copepoda families=83). Values have been calculated from the station averages (not sample values).

Taxon	Presence on stations		Density (ind./10 cm <sup>2</sup> )			Median grain size (µm)				Silt content			
	n	%	average	st.dev.	max.	average	st.dev.	min.	max.	average	st.dev.	min.	max.
Archiannelida	119	25	1.0	2.4	15	320.0	66.1	173	581	1.6	3.5	0.0	35.6
Copepoda	529	100	85.2	130.1	1098	240.7	83.0	87	581	4.4	6.6	0.0	45.1
Gastrotricha	447	84	52.1	97.6	1559	256.5	77.8	87	581	2.9	4.9	0.0	45.1
Halacarida	109	21	0.7	3.6	64	273.4	107.7	87	572	5.2	8.6	0.0	45.1
Hydrozoa	212	40	2.5	5.5	58	286.1	75.6	87	581	2.1	4.1	0.0	35.6
Kinorhyncha	85	16	1.1	4.8	57	167.6	89.1	88	572	11.5	7.8	0.4	35.3
Nematoda	530	100	1517.2	1430.7	9540	240.6	83.0	87	581	4.4	6.6	0.0	45.1
Oligochaeta	145	27	1.2	4.0	48	301.3	86.8	87	581	2.7	5.6	0.0	35.9
Ostracoda	279	53	4.0	13.2	212	255.5	97.5	89	581	4.5	6.7	0.0	45.1
Polychaeta	450	85	6.9	12.9	206	243.7	86.2	87	581	4.4	6.8	0.0	45.1
Priapulida	21	4	0.1	0.3	3	135.2	55.5	89	343	14.7	8.5	1.3	35.3
Tardigrada	312	59	12.1	41.9	748	272.3	78.5	95	581	2.6	3.8	0.0	37.6
Turbellaria	523	99	23.5	26.1	234	241.8	82.8	87	581	4.3	6.6	0.0	45.1
Ameiridae	43	52	3.4	8.8	71	221.8	102.1	87	450	5.8	8.8	0.4	45.1
Diosaccidae	50	60	4.4	7.7	38	234.4	97.9	88	450	4.1	4.9	0.4	20.1
Ectinosomatidae	64	77	7.5	12.5	76	226.7	85.9	87	450	4.1	5.7	0.4	23.3
Leptastacidae	43	52	18.2	32.1	148	263.7	71.6	113	450	2.0	3.2	0.4	20.1
Paramesochridae	35	42	26.0	63.7	418	264.3	70.7	113	450	1.9	3.4	0.4	20.1





This atlas describes the occurrence and distribution of animals that live in the sediments of the southern North Sea. These tiny animals, molluscs, worms, shrimps, sea urchins and their likes, are called the zoobenthos. The atlas serves two purposes. First, it is a reference for later studies. Second, it is, hopefully, a stimulus for further ecological study.

Of course, much was known about the zoobenthos before this atlas appeared. We just mention the benthos survey performed under the International Council for the Exploration of the Sea (ICES) in the whole North Sea. However, the surveys on which this atlas is based are unique due to a combination of a large area covered and a high sampling intensity.

Knowledge of the animal distribution of our seas has always been far behind our knowledge of terrestrial ecosystems. Nevertheless, the appearance of this zoobenthos atlas follows only shortly after the atlas of North Sea fishes and a variety of atlases of seabirds in the North Sea. So, if it is true what the Senegalese conservationist Baba Dioum has said – “In the end, we will only conserve what we love, we will love only what we understand, we will understand only what we are taught.” – then we may hope that all these atlases will contribute to the protection of our own grey sea with its hidden beauty.



Ministry of Transport, Public Works and  
Water Management  
North Sea Directorate (RWS-DNZ)



Netherlands Institute for Sea Research  
(NIOZ)



Netherlands Institute of Ecology -  
Centre for Estuarine and Coastal Ecology  
(NIOO-CEMO)