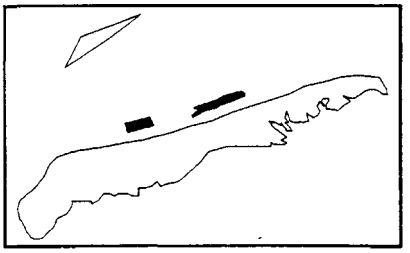
RISK ANALYSIS OF COASTAL NOURISHMENT TECHNIQUES (RIACON)

The effects on Benthic Fauna of Shoreface-Nourishment off the Island of Terschelling, The Netherlands
Report 4: Post- Nourishment survey, April 1994

RIACON-NL-04



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ABSTRACT

In the Marine Science and Technology Programme (MAST-2) of the Commission of the European Communities a research programme RIACON (Risk Analysis of Coastal Nourishment Techniques) was started in 1994 to evaluate the risks of shoreface nourishment and subaqueous sand extraction for the benthic community in marine coastal waters. In the Netherlands the RIACON project concentrates on a nourishment site off the coast of the island of Terschelling.
This report gives the results of a macrofauna survey made in April 1994, 6 months after the completion of the nourishment. The benthic community is described in terms of species diversity, numerical density of species and biomass of major taxa. Both the nourishment and an adjacent reference area were investigated. Statistical comparisons with pre-nourishment data are made. In the nourished area a significant decrease in number of species, total density and biomass occurred. In the nourished area the community structure, described using TWINSPAN cluster analysis, changed from a relative rich community towards a community with relative low numbers of species and low densities. In the reference area no significant changes were found except for a decrease in mollusc density and biomass.

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1. INTRODUCTION

The coastline of The Netherlands is constantly moving because of coastal accretion and erosion. Sand nourishments are used to prevent coastal erosion and have been carried out along the Dutch coast since the 1970's. Sand nourishment activities on the beaches, however, can interfere with recreational interest as the spring and summer offer the most suitable conditions for sand nourishment. To keep the disruption of recreational activities to a minimum, an alternative would be to replenish the sand on the sea floor immediately in front of the beach, below the low water mark (Van Heuvel & Hillen, 1991).
In the framework of the Commission of the European Communities program MAST (Marine Science & Technology) a program was started in 1993 to evaluate new replenishment techniques, with a particular emphasis on those applied to the shoreface. This program is called NOURTEC (Innovative Nourishment Techniques Evaluation). To study the response of the benthic community to subaqueous sand extraction and shoreface nourishment the RIACON (Risk Analysis of Coastal Nourishment Techniques) program was initiated in 1994. In The Netherlands the investigations are carried out at the study site of the NOURTEC program north off the island of Terschelling (Figure 1).
Large scale nourishments will confront the benthic community with environmental changes including increasing sedimentation rates and changes in sediment structure. Benthic macrofauna is able to survive a sudden coverage with sediment to a certain amount. This ability, however, varies from species to species, being dependent on the type of material, the thickness and the deposition velocity (Bijkerk, 1988).
The actual nourishment has taken place between April and November 1993. The new sand layer is expected to be recolonised by benthic macrofauna. Recolonisation after the sand supply can take place along three ways (Tydeman, 1994): 1) survival of locally present individuals, by crawling up through the newly supplied sand layer; 2) import of individuals from the borrow area, which have managed to survive the suction, transport and deposition of the sand; 3) immigration of individuals from nearby area's.
This report describes the situation of the benthic macrofauna in April 1994, six months after completion of the nourishment. To determine the effect of the nourishment comparisons were made between the nourishment area and a reference area. The results were also compared with results from a macrobenthic survey carried out at the reference and nourishment sites in March 1993, prior to the nourishment (Van Dalfsen and Pinkham, 1994).

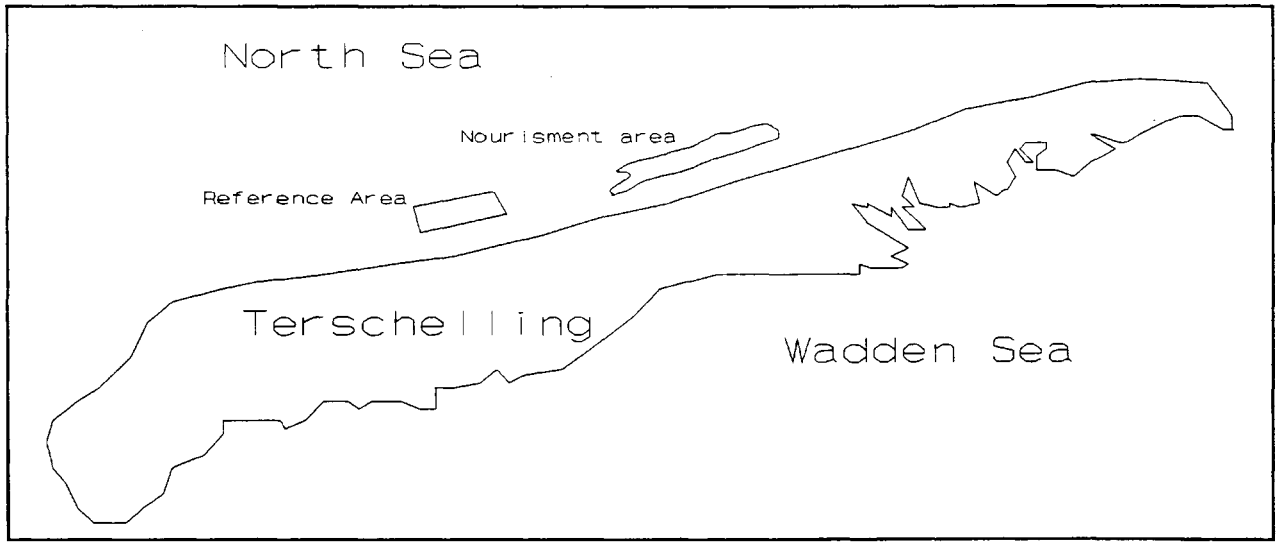


Figure 1. Location of the nourishment area and the reference area off Terschelling.

2. MATERIAL AND METHODS

2.1 Sampling

In the study area off Terschelling, the nearshore zone is characterized by 2 or 3 shore parallel breaker bars. Northwest of the area a large sandwave field is present (Biegel, 1994). Before the nourishment in 1993 the nourishment area showed three geomorphological strata, *viz.* stratum Trough, stratum North (north of the trough) and stratum South (south of the trough). The strata followed the seabed morphology showing a outer and a middle breaker bar and a through in between. The nourishment consists of filling up the trough (Figure 2).
In the vicinity of the nourishment area a reference area was chosen with a similar morphology and depth structure as the nourishment area. Here also a North stratum and a Trough stratum were distinguished. The southern sandbar was relatively small and has therefore not been taken into account as a stratum.
Following a "stratified random sampling"- approach, a total of 90 stations were selected. The positions of the 90 stations are shown in Appendix 1 and listed in Appendix 2. At each station one sample was taken with a Reineck boxcorer (0.06 m^2). All stations were sampled in April 1994. After taking a small sub-sample for sediment analysis, each sample was washed over a 1 mm mesh sieve on board the ship and preserved with 4% formalin in sea water. Within one to three days of sampling, the samples were frozen at -24°C to reduce biomass changes (Salonen & Sarvala,1985).

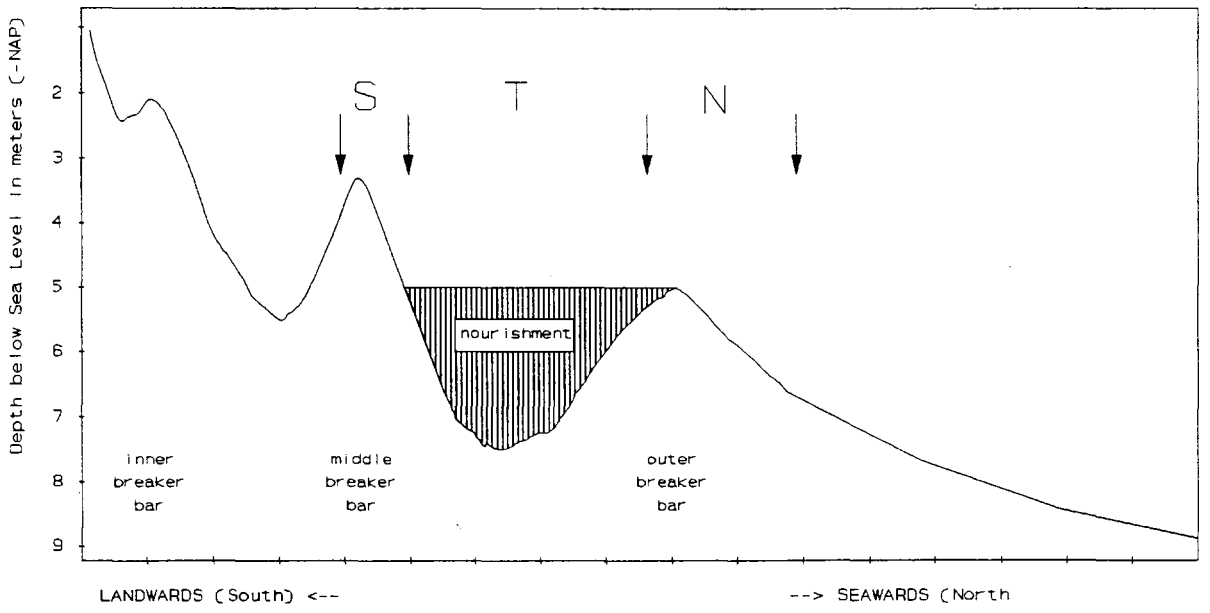


Figure 2. Schematic bottom profile at the nourishment area off Terschelling with the location of the strata: North (N), Trough (T) and South (S).

2.2 Sample treatment

The sediment samples were analyzed for mud content (< 53 μm), $CaCO_3$ and organic matter. Before sorting, the macrofauna samples were thawed and rinsed with tap water using a 0.5 mm mesh sieve. The samples were then sorted with the aid of a lowpower stereomicroscope. Density (ind/m²) was recorded at species level for as much as possible, or otherwise at a higher taxonomic level. Bivalves were separated into length classes of 0.5 cm. For *Macoma balthica* year classes (1992 - 1987+) have been distinguished. In all other species no discrimination was made between juveniles and adults .
Biomass in terms of ashfree dry weight (AFDW in g/m²) was determined for all worms, molluscs and echinoderms. Crustaceans were excluded from biomass determination. Biomass was measured separately for *Nephthys* species and for *Magelona papillicornis*. For all remaining worms (polychaetes, nemertini) a combined biomass was determined. For the bivalves a biomass determination was made per species, regardless year class or length class, except for *Macoma balthica* (per year class) and for *Spisula substruncata* (per length class). Except for *Montecuta ferruginosa* and for all other species smaller then 5 mm, biomass was determined without shell. For echinoderms, only complete individuals were used for determination of biomass. The AFDW was determined directly by drying the organisms at 65°C, for 65 hours. The animals were then incinerated at 570°C for 2 hours.

2.3 Data analysis

To see how the benthic fauna on the stations was distributed throughout the different strata sampled (North, Trough & South), density, biomass, species diversity and evenness were calculated per stratum. The diversity of the macrobenthic fauna is expressed by the Shannon-Wiener index H' and the distribution of the numbers of individuals among the species by Heip's index E(H) of evenness (Heip, 1974).

$$H' = -\sum_{i=1}^{S} p_i \, (\ln p_i) \qquad \text{with } p_i = n_i / N$$

N = Total number of individuals
n_i = number of individuals of species i
S = total number of species

$$E(H) = \frac{N_1 - 1}{N_0 - 1}$$

$N_1 = e^{H'}$
N_0 = total number of species
H' = Shannon- Wiener index

Furthermore, a cluster analysis on all data was done using TWINSPAN (HILL, 1979) to get information about the benthic community structure. The TWINSPAN analyses were performed on density data as well as on presence/absence of species, using the combined dataset of the nourishment and the reference area. To be able to compare with the T0 survey, the same cut-levels have been used (0, 10, 50, 150 ind/m²).

Differences between the 5 strata were tested for significance by a analysis of variance (ANOVA) using a 95 percent LSD Multiple Range Test. The results of the T0 (April '93) and T1 (April '94) survey were compared, using the Mann-Whitney U-test to test for statistical differences in abiotic parameters, species composition, abundance and biomass.

3. RESULTS

At the nourishment area about 2.5 million m^3 of sand have been dumped between May 1993 and November 1993. The sand was dumped in the trough between the two outer breakerbars at a depth between NAP -5 m and NAP -8 m (Figure 3). The surface level of the former trough was raised to about 1 m above the crest of the outer breaker bar. (Biegel, 1994)

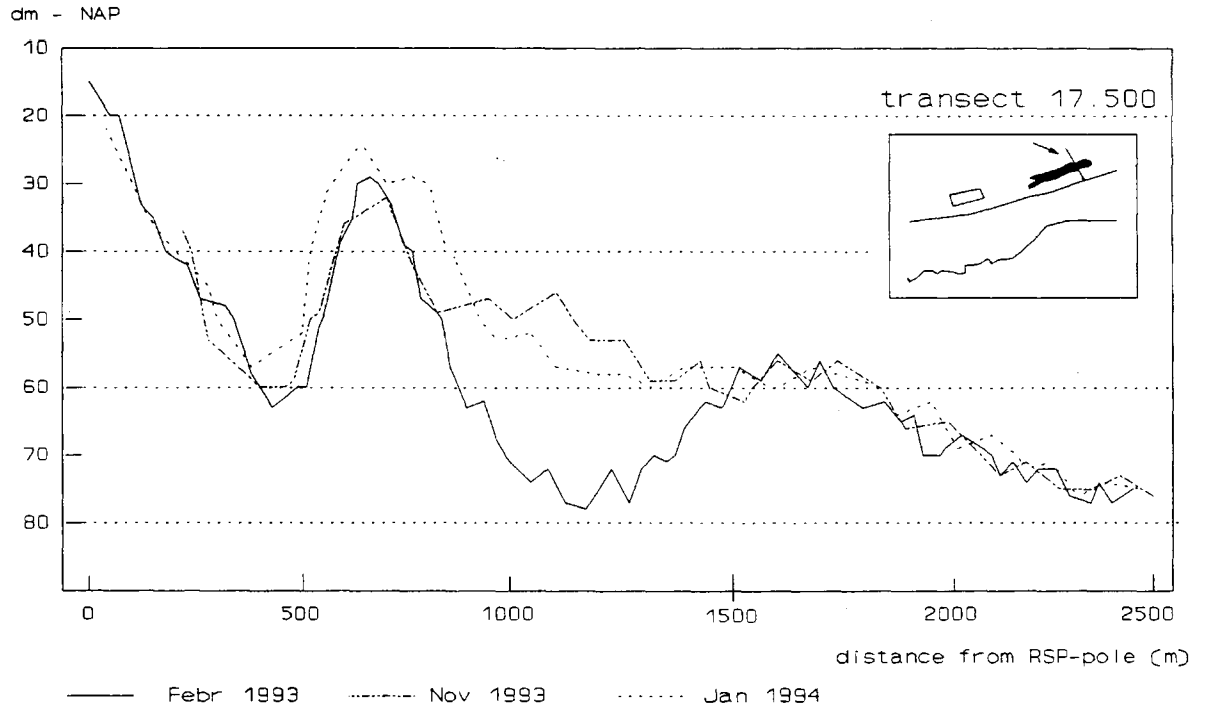


Figure 3. Cross profile at transect 17.500 (nourishment site).

3.1 Environmental parameters

3.1.1 Depth

In the trough a sand layer with a maximum of 3 meters has been supplied, creating a almost flat surface at a depth of NAP -5 m. (Biegel, 1994). The average depth in the Trough stratum of the nourishment area decreased significantly with 1.4 m after the nourishment (Table 1). Also a significant reduction of the depth occurred in the North stratum of the nourishment area and in the Trough stratum of the reference area, but these reductions were smaller.

Table 1: Average depth (in m -NAP) per station in the T1 survey and T0 survey for the different strata; 95 % confidence interval (95%) and number of stations (n). N = nourishment area; R = reference area. Significant differences between the T0 and T1 surveys are indicated: * = $P<0.05$; ** = $P<0.01$ (Mann Whitney U test).

Stratum	n	m -NAP T1	95 % T1	m -NAP T0
North N	20	5.81	5.52 - 6.10	6.27*
Trough N	20	4.93	4.64 - 5.22	6.32*
South N	10	3.90	3.49 - 4.31	3.89
North R	20	5.57	5.28 - 5.85	5.45
Trough R	20	5.11	4.82 - 5.40	5.98*

3.1.2 Sediment

The results of the sediment analyses are given in Appendix 3. On all stations the percentage of mud (< 53 μm) was low (< 1%). The highest percentage of mud was found in the North strata of both the nourishment- and the reference area (Table 2).
Only in the North stratum of the nourishment area there has been a significant increase of the average mud content since the T0 survey. The average percentage of mud in the South stratum of the nourishment area and in both the Trough strata changed very little.
The $CaCO_3$ content has increased significantly in all strata since the T0 survey. The highest values in $CaCO_3$ content were found in the Trough and the South strata of the nourishment area.
The organic matter content in the nourishment area and in the reference area was very low (< 0.15 %) and has decreased significantly in all the strata in the period between March 1993 and April 1994.

Table 2. Results of the sediment analysis per stratum; N = nourishment area; R = reference area. Significant differences between the T0 and T1 surveys are indicated: * = P<0.05; ** = P<0.01 (Mann Whitney U test).

Table 2a: Average percentage of mud (< 53 μm) (%) per station in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	% mud T1	95% T1			% mud T0
North N	20	0.90	0.63	-	1.17	0.45**
Trough N	20	0.61	0.34	-	0.89	0.71
South N	10	0.47	0.08	-	0.86	1.21
North R	20	0.92	0.65	-	1.20	0.42
Trough R	20	0.35	0.08	-	0.62	0.39

Table 2b: Average percentage of $CaCO_3$ (%) per station in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	% $CaCO_3$ T1	95% T1			% $CaCO_3$ T0
North N	20	4.81	3.50	-	6.11	3.08**
Trough N	20	6.40	5.10	-	7.70	2.40**
South N	10	5.91	4.07	-	7.75	0.79**
North R	20	4.69	3.38	-	5.99	1.60**
Trough R	20	4.15	2.84	-	5.45	1.96**

Table 2c: Average percentage of organic matter (%) per station in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	% org.mat T1	95% T1			% org.mat T0
North N	20	0.50	0.30	-	0.70	2.91**
Trough N	20	0.89	0.69	-	1.09	2.18**
South N	10	0.41	0.13	-	0.69	3.30**
North R	20	0.15	-0.05	-	0.34	3.19**
Trough R	20	0.70	0.50	-	0.90	3.42**

3.2 Species composition and diversity

From the 90 samples that were analyzed a total of 40 species has been identified. Appendix 4 gives a list of the identified species. The following groups of macrobenthos have been found:

-Nemertinae (not analyzed to species level)
-Mollusca (10 species)
-Polychaeta (14 species)
-Crustacea (14 species)
-Echinodermata (1 species)

The most abundant species (present in >70 % of all samples) were the polychaete *Nephtys hombergii* and the crustaceans *Urothoe poseidonis, Pontocratus altamarinus* and *Bathyporeia elegans*.

The North strata of the nourishment area and of the reference area had significantly higher numbers of species than the other strata (Table 3). The North strata also had the highest Shannon-Wiener index (Table 4) but only between the North- and the Trough strata of the nourishment area the difference is significant. The relative low evenness values of the North strata indicate a stronger numerically dominance by a few species as compared to the other strata (Table 5).
In the nourishment area the North stratum and the Trough stratum showed a significant decrease in the number of species per station from March 1993 till April 1994. The diversity index of the North stratum of the nourishment area decreased significantly as well. No significant changes occurred between the T0 and T1 survey's in the other strata. Only in the Trough stratum of the nourishment area the evenness value decreased significantly between the T0 and the T1 survey.

Table 3. Average number of species per station in the T1 survey and T0 survey for the different strata; 95 % confidence interval (95%) and number of stations (n). N = nourishment area; R = reference area. Significant differences between the T0 and T1 surveys are indicated: * = P<0.05; ** = P<0.01 (Mann Whitney U test).

Stratum	n	nr. species T1	95% T1	nr species T0
North N	20	10.1	9.2 - 11.0	12.5*
Trough N	20	6.0	5.1 - 6.9	9.3*
South N	10	6.7	5.4 - 8.0	7.2
North R	20	8.9	7.9 - 9.8	8.1
Trough R	20	7.1	6.2 - 8.0	7.5

Table 4 Average Shannon-Wiener index (H'index) per station in the T1 survey and T0 survey for the different strata; 95 % confidence interval (95%) and number of stations (n). N = nourishment area; R = reference area. Significant differences between the T0 and T1 surveys are indicated: * = P<0.05; ** = P<0.01 (Mann Whitney U test).

Stratum	n	H'index T1	95% T1	H' index T0[1]
North N	20	1.83	1.67 - 1.99	2.04*
Trough N	20	1.46	1.30 - 1.63	1.61
South N	10	1.58	1.35 - 1.81	1.49
North R	20	1.70	1.54 - 1.86	1.50
Trough R	20	1.66	1.49 - 1.82	1.68

[1] recalculated; In Van Dalfsen and Pinkham (1994), the Shannon-Wiener index H' was calculated using ^{2}log instead of ln.

Table 5. Average Heip's index of evenness E(H) per station in the T1 survey and T0 survey for the different strata; 95 % confidence interval (95%) and number of stations (n). N = nourishment area; R = reference area. Significant differences between the T0 and T1 surveys are indicated: * = P < 0.05; ** = P < 0.01 (Mann Whitney U test).

Stratum	n	E(H) T1	95% T1			E(H) T0
North N	20	0.61	0.53	-	0.69	0.62
Trough N	20	0.71	0.64	-	0.79	0.54**
South N	10	0.72	0.61	-	0.82	0.63
North R	20	0.63	0.56	-	0.71	0.57
Trough R	20	0.75	0.67	-	0.83	0.76

3.3 Density

For each station the abundance data per species are given in Appendix 5.
The average density per station in the total study area was 467 ind/m², ranging in the nourishment area from 134 to 1553 ind/m² (mean: 463 ind/m²) and ranging in the reference area from 134 to 1285 ind/m² (mean 472 ind/m²).

High macrofauna densities were found in the North strata of the nourishment area and of the reference area (Table 6). The densities here were significantly higher than in the Trough- or South strata. For all the major taxa, the Polychaeta, Crustacea and the Mollusca, the North strata had the highest densities (Table 7). The South stratum in the nourishment area had a relative low density of polycheates as compared to the other strata.

Table 6. Average total density (ind/m²) per station in the T1 survey and T0 survey for the different strata; 95 % confidence interval (95%) and number of stations (n). N = nourishment area; R = reference area. Significant differences between the T0 and T1 surveys are indicated: * = P < 0.05; ** = P < 0.01 (Mann Whitney U test).

stratum	n	ind/m² T1	95% T1			ind/m² T0
North N	20	608	489	-	727	763*
Trough N	20	397	278	-	516	712**
South N	10	304	135	-	473	392
North R	20	608	488	-	727	467
Trough R	20	337	217	-	456	321

When the March 1993 survey was compared with the April 1994 survey (after the nourishment), the decrease of the total density and of the density of molluscs in the Trough of the nourishment area was striking. The North stratum of the nourishment area also showed a significant decrease in total density which was also true for polycheates and the molluscs densities, but these changes were less dramatically. The density of the Crustacea in the reference area increased significantly in the period between March 1993 and April 1994. In the same period the density of crustaceans decreased in the Trough and in the South strata of the nourishment area although not significantly.

Table 7. Abundance analysis per stratum for the 3 major taxa; Polychaeta, Crustacea and Mollusca: N = nourishment area; R = reference area. Significant differences between the T0 and T1 surveys are indicated: * = $P<0.05$; ** = $P<0.01$ (Mann Whitney U test).

Table 7a. Average density (ind/m²) per station of Polychaeta in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	ind/m² T1	95% T1	ind/m² T0
North N	20	178	130 - 226	244*
Trough N	20	173	125 - 220	261
South N	10	92	24 - 160	91
North R	10	164	116 - 212	175
Trough R	20	103	55 - 151	112

Table 7b. Average density (ind/m²) per station of Crustacea in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	ind/m² T1	95% T1	ind/m² T0
North N	20	297	203 - 391	259
Trough N	20	173	79 - 267	320
South N	10	185	52 - 318	247
North R	20	375	282 - 469	196**
Trough R	20	182	88 - 276	117**

Table 7c. Average density (ind/m²) per station of Mollusca in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	ind/m² T1	95% T1	ind/m² T0
North N	20	88	69 - 107	229**
Trough N	20	24	5 - 44	116**
South N	10	24	-3 - 51	48
North R	20	57	37 - 76	89
Trough R	20	32	13 - 51	92**

3.4 Biomass

The biomass data per station are given in Appendix 6. The average biomass per station was 11.8 g/m² ranging from 0.3 g/m² to 58.9 g/m² in the nourishment area and ranging from 0.2 g/m² to 55.9 g/m² in the reference area.
The North stratum of the nourishment area could be clearly distinghuised from the other strata by its high total biomass value (Table 8). This was caused by the occurrence of (mostly large) echinoderms. The South stratum was marked, as with the total density, by a relative low value for total biomass.

Compared to the T0 survey the total biomass and the biomass of molluscs had significantly decreased in the Trough stratum of the nourishment area. A decrease in mollusc biomass also occurred in the Trough stratum of the reference area.

Table 8. Biomass analysis per stratum for the total measured biomass (Crustacea excluded) and for worms and molluscs separately: N = nourishment area; R = reference area. Significant differences between the T0 and T1 surveys are indicated: * = P<0.05; ** = P<0.01 (Mann Whitney U test).

Table 8a. Average total biomass (g/m²) per station (Crustacea excluded) in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	(g/m²) T1	95% T1			(g/m²) T0
North N	20	25.9986	20.9411	-	31.0560	17.5483
Trough N	20	8.2216	3.1641	-	13.2790	15.8415**
South N	10	3.2465	-3.9058	-	10.3988	4.0600
North R	20	10.7516	5.6942	-	15.8091	11.9579
Trough R	20	6.6716	1.6141	-	11.7290	11.9334

Table 8b. Average biomass (g/m²) per station of worms (Polychaeta and Nemertinae) in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	(g/m²) T1	95% T1			(g/m²) T0
North N	20	2.9338	2.0560	-	3.8117	3.1263
Trough N	20	3.4179	2.5401	-	4.2958	2.6479
South N	10	0.8055	-0.4360	-	2.0470	0.9526
North R	20	3.1629	2.2851	-	4.0408	3.0173
Trough R	20	2.1557	1.2779	-	3.0336	1.4846

Table 8c. Average biomass (g/m²) per station of Mollusca in the T1 survey and T0 survey; 95 % confidence interval (95%) and number of stations (n).

Stratum	n	(g/m²) T1	95% T1			(g/m²) T0
North N	20	6.5058	4.4050	-	8.6067	11.9678
Trough N	20	2.3998	0.2990	-	4.5007	10.7146**
South N	10	2.4410	-0.5301	-	5.4121	2.8909
North R	20	5.9693	3.8684	-	8.0701	7.4585
Trough R	20	4.5158	2.4150	-	6.6167	10.4488*

3.5 Community structure

Using the TWINSPAN classification on species abundance four clusters were generated (Appendix 7 and 8). The first division, dividing clusters 1 and 2 from clusters 3 and 4, separates the stations in both North strata from the stations in the Trough and South strata. This division is mainly based on the presence or absence of *Bathyporeia guilliamsonia, Echinocardium cordatum, Tellina fabula, Macoma baltica, and Lanice concilega* and density differences in *Urothoe poseidonis* and *Bathyporeia elegans*.

The clusters 1 and 2 have stations at greater depth and can be described as having the highest number of species, total density and biomass. They are characterised by relative high numbers and biomass of bivalves comparing to cluster 3 and 4 (Table 9).
Cluster 1 is found mainly in the North stratum of the nourishment area. It is characterised by the highest values for total density and biomass and also the highest, although still low, values for organic matter and mud content. Cluster 2 is formed primarily by the deeper stations at the reference area.
Cluster 3 can be described as having the highest evenness index and the lowest crustacean density. It is formed by stations distributed over the South and the Trough strata in the nourishment and in the reference area.
Cluster 4 has the lowest diversity index and polychaete density. As in cluster 3, the stations are distributed over both areas.

Table 9. Averages (avg) and standard deviations (st.d) of abiotic and benthos parameters for the TWINSPAN clusters generated using density data of the T1 survey (April 1994).

nr. stations	cluster 1 (n=21)		cluster 2 (n=15)		cluster 3 (n=34)		cluster 4 (n=20)	
	avg	st.d	avg	st.d	avg	st.d	avg	st.d
Abiotic parameters								
mud (< 53 µm) (%)	1.13	0.96	0.62	0.42	0.56	0.5	0.41	0.14
Org. material (%)	0.06	0.03	0.04	0.01	0.03	0.02	0.03	0.01
Depth (m -NAP)	5.80	0.70	5.72	0.66	4.78	0.58	4.63	0.74
Macrobenthos								
nr. species	9.2	2.7	10.0	1.6	6.8	1.7	5.9	1.9
H'-index	1.68	0.39	1.87	0.31	1.67	0.31	1.39	0.36
Heips- index	0.59	0.21	0.65	0.18	0.78	0.1	0.67	0.15
Total density n/m²	654	323	571	292	318	163	379	245
Polychaeta n/m²	177	117	164	78	143	76	106	152
Crustacea n/m²	346	281	321	263	128	97	250	132
Mollusca n/m²	92	62	63	39	25	17	18	28
Total biomass g/m²	23.8132	17.9654	16.5859	12.2385	5.4567	3.3489	3.8238	5.2209
Worms g/m²	3.1467	1.5899	3.1494	2.1151	2.9366	2.4820	1.3617	1.0459
Mollusca g/m²	7.4709	5.6020	6.7097	4.3054	2.5201	2.2671	2.4622	5.0350

When the community structure of the T1 survey was compared with the T0 survey, a shift of the stations in the Trough stratum of the nourishment area became visible.
In the T0 survey, the stations in the Trough stratum of the nourishment area corresponded well with the stations in the North stratum (having higher average densities and numbers of species of benthic fauna) (Van Dalfsen and Pinkham, 1994). The stations of the South stratum were clearly separated from the other stations in a well defined cluster (with lower average densities and numbers of species).
In the T1 survey, after the nourishment, the stations in the Trough stratum were not any longer grouped together with those of the North stratum, but showed more resemblance to the stations in the South stratum.
In the reference area the community structure in the North stratum and Trough stratum had not changed much. As in the T0 survey, the TWINSPAN clusters were more distributed over the whole area. The division between cluster 1 and 2 and the clusters 3 and 4 correlated well with station depth.

A TWINSPAN analyses based on presence/absence data resulted in a similar clustering of stations as in the density analyses (Appendix 9 and 10).

4. Discussion

In the nourishment area the morphological structure of the seabed had changed by filling up the trough between the middle and outer breaker bar. In this Trough stratum the depth decreased significantly with 1.5 - 2 m after the nourishment. The surface level of the nourishment was raised to about 1 m above the crest of the outer breaker bar. After the nourishment, between November 1993 and April 1994, a new trough was eroded in the nourished area, starting the development of a new breaker bar-trough system (Biegel, 1994). The newly formed outer breaker bars moved in opposite directions. The crest of the middle bar migrated landward and the crest of the outer bar migrated seaward. The decrease of depth in the North stratum of the nourishment area can be explained by the seaward movement of the outer breaker bar. A large incoming sandwave was responsible for the reduction of depth in the Trough stratum of the reference area (Biegel, 1994).

Before the nourishment, the median grain size and the sorting of the sediments of the outer breaker bar and of the trough were rather similar whereas the second (middle) breaker bar had a coarser and less well sorted sediment (Ruesink, 1993). After the nourishment the sediments in the trough stratum were coarser and less well sorted. This can be explained by the import of sand which was coarser than the original sand in the nourishment area (Ruesink, 1993).
The mud content increased in the North stratum of the nourishment- and of the reference area. As similar changes also occurred in the reference area, the increase of mud in the two North strata can not be explained only by changes in sedimentation/resuspension dynamics due to the nourishment.

The changes in the seabed morphology and of the sedimentstructure, and the relative short period of time in which the nourishment on a certain location within the Trough stratum took place, will have had an impact on the macrobenthic community. The benthos community in the trough was buried by the nourished sand. Survival of the benthic macrofauna depends on the species, type of sediment used, thickness of the layer and the deposition rate (Bijkerk, 1988). The total thickness of the sand layer that has been supplied in the Trough of the nourishment area is much more than the "fatal depth" known for certain species (*Macoma balthica, Donax vittatus, Nephtys sp., Haustoriidae*) which occur in this area. Estimations of the sedimentation rate during the nourishment operation ranged from 1.5 meter per 120 hours up to 1.5 meter per 30 hours (Tydeman, 1994). At the lower sedimentation rate certain species would be able to survive by crawling upward into the new layer of sand. Survival of some species can therefore not be excluded. The import of species from the borrow area may have been possible for certain molluscs with a strong hard shell like *Donax vittatus* or *Spisula* species. Worms, crustaceans and molluscs with a more fragile shell are not likely to have survived the forces at extraction and transport of the sand used for the nourishment. Import from nearby area's may be expected as the most important way of recolonisation of the nourished area. This may apply to species like *Nephtys hombergii* and *Tellina fabula*. Three weeks after the nourishment some species, e.g. *Spio filicornis*, had already recolonised the area (Tydeman, 1994) but had disappeared again in the T1 survey. Others, e.g. *Magellona papillicornis* and *Donax vittatus*, reached large densities for a short period (Tydeman, 1994) but were already reduced in numbers at the T1 survey.
In the T1 survey a strong reduction of species richness, density and biomass has been measured primarily in the Trough stratum and to a lesser degree in the North stratum of the nourishment area. In the Trough stratum all major taxa were negatively effected by the nourishment. Especially the Mollusca showed a strong decline in density and biomass in the period between the T0 and the T1 survey. This decrease of the Mollusca was already measured directly after the nourishment in a small survey (Tydeman, 1994). As no recovery of the mollusc population is visible at the T1 survey this group of animals seems to be affected most (on a one year time scale) by the nourishment. However a decrease in molluscs also took place in the reference area. The decline of the molluscs in the nourishment area can therefore not only be the effect of the nourishment but has to be explained partly by natural fluctuations in the population.

The change of the Trough stratum with respect to the physical boundary conditions is reflected in the results of the TWINSPAN analysis. The shift of the community structure in the Trough stratum of the nourishment area towards the relative poor community of the South stratum is clearly an effect of the impoverishment of the trough community after the nourishment. At the T1 survey, almost half a year after cessation of the nourishment, the community structure in the trough has not yet returned to its pre-nourishment state.

5. References

-Biegel, E.J., 1994. Morphological development of a shoreface nourishment, Terschelling, The Netherlands. National Institute for Coastal and Marine Management/RIKZ, Rijkswaterstaat, 1994.

-Bijkerk, R., 1988. Ontsnappen of begraven blijven, De effecten op bodemdieren van een verhoogde sedimentatie as gevolg van baggerwerkzaamheden, RDD Aquatic Ecosystems, Groningen, The Netherlands.

-Heip, C., 1974. A new index measuring evenness. J. Mar. Biol. Ass. U.K. 54: 559 -563.

-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, New York.

-Ruesink, B.G., 1993. Data report T0-campaign, EC-MAST 2 Project NOURTEC. University of Utrecht.

-Salonen, K. and J. Sarvala, 1985. Combination of freezing and aldehyde fixation, A superior preservation method for biomass determination of aquatic invertebrates, Arch. Hydrobiol. 103: 217-230.

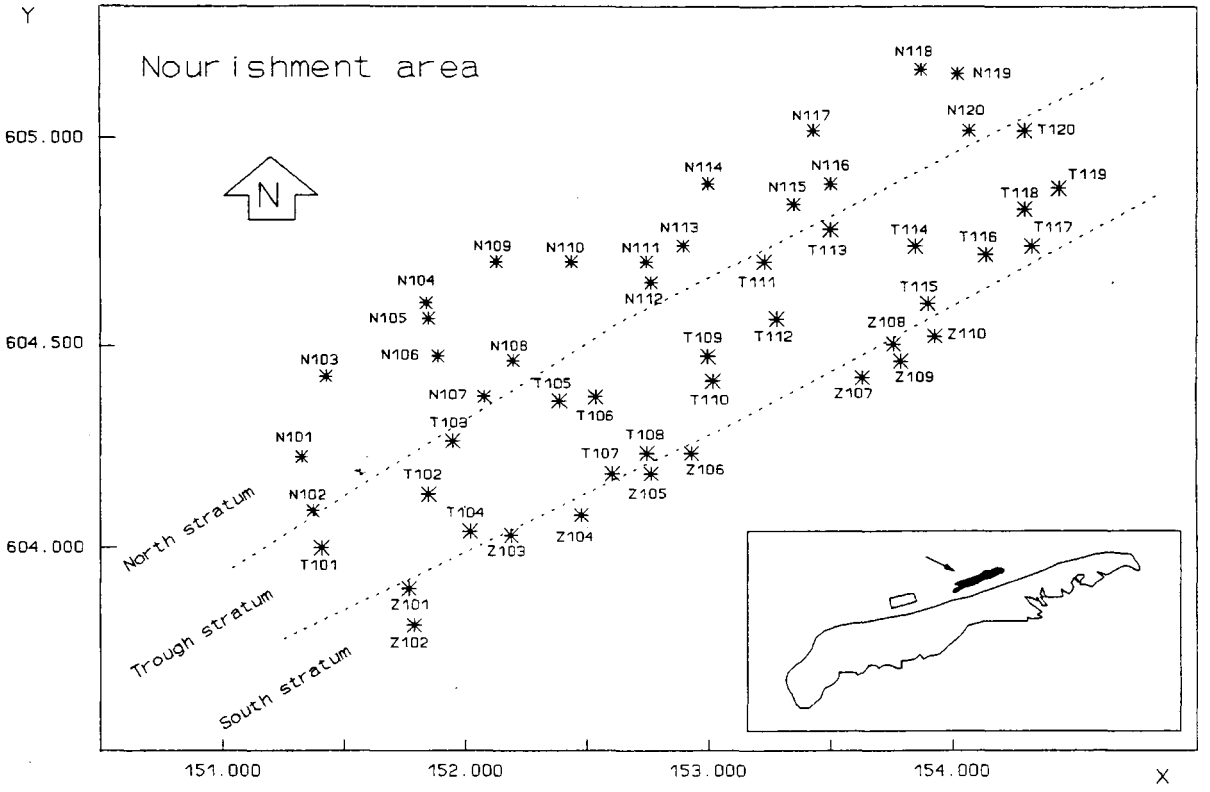
-Tydeman, P, 1994, Risk analysis of coastal nourishment techniques(RIACON), De effecten op de bodemfauna van vooroeversuppletie boven het eiland Terschelling, in de Nederlandse Waddenzee, Working document RIKZ/OS-94.625x, RIKZ, Haren.

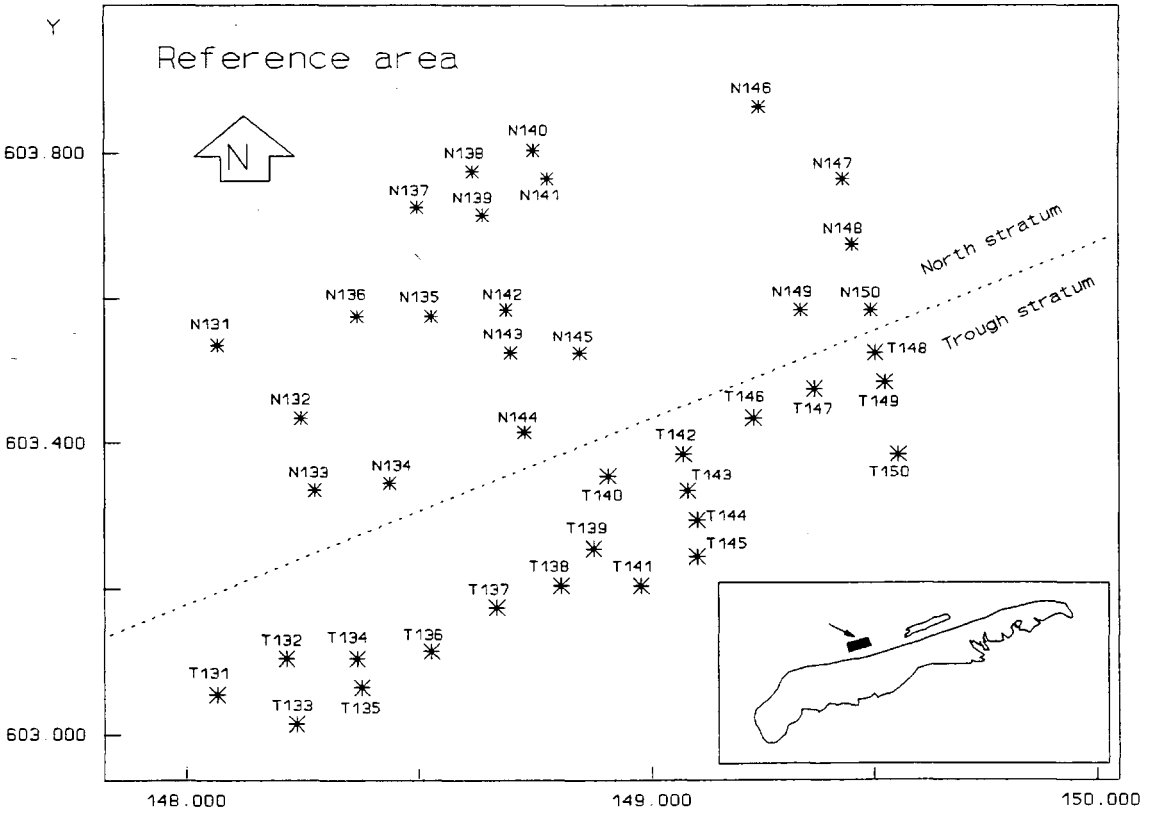
-Van Dalfsen, J.A. and C. Pinkham, 1994, Risk analysis of coastal nourishment techniques (RIACON), The effects on Benthic Fauna of Shoreface Nourishment off the Island Terschelling, the Netherlands: Report 1, National Institute for Coastal and Marine Management (RIKZ), Working document RIKZ-94.622x, Haren, The Netherlands.

-Van Heuvel, T. and R. Hillen, 1991. Coastline Management. Directorate- General for Public Works and Water Management, Tidal Waters Division, The Hague, The Netherlands.

APPENDICES

Appendix 1. Map of the Nourishment area and of the reference area showing station locations. T1 survey (April 1994).





Appendix 2. Station coordinates (X, Y) and depth (dm -NAP). T-1 survey (April 1994).

X- and Y coordinates

Nourishment area;

station	X	Y	depth
N 101	151.38	604.09	50
N 102	151.33	604.22	53
N 103	151.43	604.42	63
N 104	151.84	604.60	64
N 105	151.85	604.56	63
N 106	151.89	604.47	55
N 107	152.08	604.37	51
N 108	152.20	604.46	52
N 109	152.13	604.70	66
N 110	152.44	604.70	61
N 111	152.75	604.70	52
N 112	152.77	604.65	53
N 113	152.90	604.74	55
N 114	153.00	604.89	64
N 115	153.35	604.84	54
N 116	153.50	604.89	65
N 117	153.43	605.02	65
N 118	153.87	605.17	62
N 119	154.02	605.16	63
N 120	154.07	605.02	51
T 101	151.41	604.00	54
T 102	151.85	604.13	53
T 103	151.95	604.26	52
T 104	152.02	604.04	46
T 105	152.39	604.36	54
T 106	152.54	604.37	54
T 107	152.61	604.18	43
T 108	152.75	604.23	41
T 109	153.00	604.47	52
T 110	153.02	604.41	50
T 111	153.23	604.70	48
T 112	153.28	604.56	55
T 113	153.50	604.78	46
T 114	153.85	604.74	56
T 115	153.90	604.60	45
T 116	154.14	604.72	45
T 117	154.33	604.74	47
T 118	154.30	604.83	50
T 119	154.44	604.88	47
T 120	154.30	605.02	48
Z 101	151.77	603.90	43
Z 102	151.79	603.81	40
Z 103	152.19	604.03	42
Z 104	152.48	604.08	46
Z 105	152.77	604.18	37
Z 106	152.93	604.23	43
Z 107	153.63	604.42	32
Z 108	153.76	604.50	35
Z 109	153.79	604.46	37
Z 110	153.93	604.52	35

Reference area;

station	X	Y	depth
N 131	148.07	603.53	62
N 132	148.25	603.43	64
N 133	148.28	603.33	47
N 134	148.44	603.34	40
N 135	148.53	603.57	59
N 136	148.37	603.57	70
N 137	148.50	603.72	68
N 138	148.62	603.77	64
N 139	148.64	603.71	58
N 140	148.75	603.80	64
N 141	148.78	603.76	58
N 142	148.69	603.58	54
N 143	148.70	603.52	49
N 144	148.73	603.41	44
N 145	148.85	603.52	48
N 146	149.23	603.86	70
N 147	149.41	603.76	52
N 148	149.43	603.67	44
N 149	149.32	603.58	46
N 150	149.47	603.58	52
T 131	148.07	603.05	51
T 132	148.22	603.10	52
T 133	148.24	603.01	50
T 134	148.37	603.10	51
T 135	148.38	603.06	55
T 136	148.53	603.11	55
T 137	148.67	603.17	55
T 138	148.88	603.25	50
T 139	148.81	603.20	54
T 140	148.91	603.35	38
T 141	148.98	603.20	60
T 142	149.07	603.38	43
T 143	149.08	603.33	40
T 144	149.10	603.29	50
T 145	149.10	603.24	60
T 146	149.22	603.43	47
T 147	149.35	603.47	48
T 148	149.48	603.52	48
T 149	149.50	603.48	55
T 150	149.53	603.38	60

Appendix 3. Sediment parameters per station of the April 1994 survey; percentage of organic material, $CaCO_3$ and mud (< 53μm).

Nourishment area			
station	org.mat	$CaCO_3$	< 53μm
N101	1.4	4.0	1.80
N102	1.3	3.9	1.43
N103	0.8	5.0	0.53
N104	0	5.7	0.79
N105	0	4.5	0.58
N106	0	4.9	1.84
N107	0.4	5.0	0.69
N108	0.4	4.9	0.41
N109	0	5.1	0.55
N110	0	5.1	1.26
N111	0.4	4.8	1.11
N112	0.8	3.1	0.40
N113	0.9	5.5	0.78
N114	0.5	5.0	0.60
N115	0.9	5.4	1.42
N116	0.8	5.9	0.41
N117	0.5	5.4	0.75
N118	0.9	4.3	1.76
N119	0	4.1	0.46
N120	0	4.5	0.40
T101	0.4	4.0	0.54
T102	0	7.7	0.71
T103	1.4	5.0	0.69
T104	0.9	6.5	0.61
T105	1.4	4.1	0.37
T106	1.4	0.7	0.44
T107	0.8	4.6	0.47
T108	0	3.8	0.36
T109	0	7.8	1.04
T110	0.9	4.6	0.71
T111	0.9	5.6	0.43
T112	1.2	4.7	1.04
T113	0.9	4.5	0.39
T114	1.3	4.5	0.46
T115	0.5	3.1	0.43
T116	1.3	29.7	1.61
T117	0.9	6.0	0.54
T118	1.4	9.0	0.74
T119	0.9	5.7	0.36
T120	1.3	6.4	0.33
Z101	0.9	7.4	0.48
Z102	0	6.0	0.60
Z103	0.4	4.3	0.22
Z104	0	3.3	0.21
Z105	0	6.7	0.37
Z106	0.8	5.0	0.33
Z107	0.4	5.6	0.56
Z108	0	10.3	0.89
Z109	1.2	4.9	0.43
Z110	0.4	5.6	0.60

Reference area			
station	org.mat	$CaCO_3$	< 53μm
N131	0	5.3	0.23
N132	0.4	5.0	0.42
N133	0	6.1	0.43
N134	0.4	4.9	0.33
N135	0.9	4.8	1.24
N136	0	6.1	3.83
N137	0	3.9	0.55
N138	0	4.0	0.35
N139	0	4.1	0.41
N140	0	4.7	0.37
N141	0	4.6	0.25
N142	0	4.5	0.38
N143	0	4.3	1.52
N144	0.8	4.6	2.68
N145	0	3.7	0.36
N146	0.4	6.0	3.70
N147	0	4.6	0.52
N148	0	4.3	0.37
N149	0	3.9	0.28
N150	0	4.3	0.23
T131	0.9	3.6	0.59
T132	0.5	4.0	0.32
T133	1.4	3.5	0.19
T134	1.4	3.5	0.14
T135	0	4.5	0.29
T136	0.5	3.9	0.32
T137	0.9	5.2	0.42
T138	0.4	3.6	0.38
T139	1.3	3.9	0.41
T140	0	6.2	0.64
T141	0.8	3.6	0.25
T142	0	4.4	0.38
T143	0.5	4.1	0.52
T144	1.4	3.8	0.35
T145	0.5	3.3	0.39
T146	0.5	3.4	0.24
T147	0.4	2.4	0.24
T148	1.3	3.1	0.24
T149	0	3.4	0.19
T150	1.3	9.5	0.47

Appendix 4. List of macrofauna species found in the April 1994 survey (with abbreviation) and the number and percentage of stations (n, %) where the species is found.

		n	%
Annalida			
Anaitides maculata	(anaimacu)	1	1
Eteone longa	(eteolong)	1	1
Eumida sanguinea	(eumisang)	5	6
Eumida species	(eumispec)	2	2
Harmothoe ljungmani	(harmljun)	1	1
Harmothoe lunulata	(harmlunu)	10	11
Lanice conchilega	(laniconc)	31	34
Magelona papillicornis	(magepapi)	50	56
Nephtys caeca	(nephcaec)	17	19
Nephtys hombergii	(nephhomb)	85	94
Scolelepis bonnieri	(scolbonn)	7	8
Scolelepis squamata	(scolsqua)	4	4
Scoloplos armiger	(scolarmi)	2	2
Spiophanes bombyx	(spiobomb)	6	7
Crustacea			
Atylus falcatus	(atylfalc)	12	13
Atylus swammerdami	(atylswam)	26	29
Bathyporeia elegans	(batheleg)	67	74
Bathyporeia guilliamsoniana	(bathguil)	15	17
Crangon crangon	(crancran)	2	2
Crustacea larve	(cruslarv)	7	8
Diastylis lucifera	(diasluci)	1	1
Gastrosaccus spinifer	(gastspin)	1	1
Idothea linearis	(idotline)	2	2
Liocarcinus holcatus	(liocholc)	1	1
Liocarcinus marmoreus	(liocmarm)	3	3
Mysis species	(mysispec)	6	7
Pontocrates altamarinus	(pontalta)	74	82
Urothoe poseidonis	(urotpose)	63	70
Mollusca			
Donax vittatus	(donavitt)	9	10
Ensis directus	(ensidire)	11	12
Lunatia catena	(lunacate)	1	1
Macoma balthica	(macobalt)	36	40
Montecuta ferruginosa	(montferr)	8	9
Mysella bidentata	(mysebide)	3	3
Spisula solida	(spissoli)	2	2
Spisula subtruncata	(spissubt)	10	11
Tellina fabula	(tellfabu)	35	39
Tellina tenuis	(telltenu)	37	41
Echinodermata			
Echinocardium cordatum	(echicord)	16	18
Nemertinae			
Nemertinae	(nemertin)	38	42
total nr species	40		

Appendix 5. Density (ind/m²) per station of macrofauna species found in the April 1994 survey. (size of the boxcorer was 0.06 m²).

Nourishment area; North stratum

	station									
Species	N101	N102	N103	N104	N105	N106	N107	N108	N109	N110
anaimacu	0	0	0	0	0	0	0	0	0	0
eteolong	0	0	0	0	0	0	0	0	0	0
eumisan	0	0	0	0	0	0	0	0	0	0
eumispec	0	0	0	0	17	0	0	0	0	0
harmljun	0	0	0	0	0	0	0	0	0	0
harmlunu	0	0	0	0	17	0	0	0	17	0
laniconc	0	0	17	0	300	33	0	0	50	50
magepapi	0	0	33	17	17	17	33	17	17	0
nephcaec	0	0	0	0	0	0	17	0	0	33
nephhomb	67	50	67	150	83	33	200	83	100	50
scolarmi	0	0	0	0	0	0	0	0	0	0
scolbonn	0	0	0	0	0	0	0	0	0	0
scolsqua	0	0	0	0	0	0	0	0	0	0
spiobomb	0	0	0	0	0	0	0	0	0	0
atylfalc	0	17	0	17	17	0	0	0	0	0
atylswam	0	0	33	0	0	17	0	0	0	0
batheleg	0	17	17	0	0	0	133	33	0	0
bathguil	0	0	0	17	0	0	0	0	0	0
crancran	0	0	0	0	17	0	0	0	0	0
cruslarv	0	0	0	0	0	0	17	0	0	0
diasluci	0	0	0	0	17	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	0
idotline	0	0	0	0	0	0	0	0	0	0
liocholc	0	0	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	0	0	0	0	0
mysisspe	0	0	0	0	0	0	0	0	0	0
pontalta	33	17	0	0	17	17	100	33	0	0
urotpose	600	417	50	83	117	450	50	33	150	117
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	0	0
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	17
3.0-3 cm	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0	0	0	17	0	17	0	0
macobalt										
maco 89	0	0	0	0	0	0	0	0	0	0
maco 90	33	0	0	17	17	17	17	0	0	0
maco 91	0	0	17	33	50	0	0	0	33	17
maco 92	0	0	0	0	0	0	0	0	0	0
maco 93	0	0	17	0	0	0	0	0	0	0
montferr	33	0	0	0	17	17	0	17	0	17
mysebide	0	0	0	0	0	0	0	0	0	0
spissubt										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	17	0	0	0	0	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
tellfabu										
0.5-1 cm	0	0	0	0	17	0	0	0	0	0
1.0-1 cm	0	0	67	0	100	17	83	0	67	33
1.5-2 cm	0	0	0	17	0	17	0	0	0	67
telltenu										
0.5-1 cm	0	0	0	0	0	17	0	17	0	0
1.0-1 cm	0	0	33	50	0	0	0	0	0	0
1.5-2 cm	0	0	33	0	0	0	0	17	0	0
2.0-2 cm	0	0	0	0	0	0	0	17	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	33	67	17	17	0	83	0	17	17	50
nemertin	17	17	0	50	17	0	33	17	100	0
Total n/m²	816	602	401	468	854	752	683	318	551	451
nr species	7	7	10	10	15	12	10	10	9	9
H'-index	1.03	1.11	2.18	1.99	2.12	1.56	1.98	2.13	1.94	1.98
Heip's index	0.3	0.34	0.87	0.7	0.52	0.34	0.69	0.82	0.74	0.78

Nourishment area; North stratum (continued)

Species	N111	N112	N113	N114	N115	N116	N117	N118	N119	N120
anaimacu	0	0	0	0	0	0	0	0	0	0
eteolong	0	0	0	0	0	17	0	0	0	0
eumisan	17	0	0	0	0	0	17	0	0	0
eumispec	0	0	0	0	0	0	0	0	0	0
harmljun	0	0	0	0	0	0	0	0	0	0
harmlunu	17	17	0	50	0	0	0	33	0	0
laniconc	0	33	33	17	33	0	0	17	0	0
magepapi	17	267	100	67	17	217	33	0	50	0
nephcaec	0	0	17	0	17	0	0	0	0	0
nephhomb	150	117	117	0	50	133	33	50	83	50
scolarmi	0	0	0	0	0	0	0	0	0	0
scolbonn	0	0	17	0	17	33	0	0	0	0
scolsqua	0	0	0	0	0	0	0	0	0	0
spiobomb	0	0	17	0	0	0	0	0	0	0
atylfalc	0	0	0	0	0	0	17	0	0	0
atylswam	17	0	0	33	0	0	0	0	0	0
batheleg	0	17	17	33	33	33	50	0	0	200
bathguil	0	0	0	17	0	0	0	17	0	0
crancran	0	0	0	0	0	0	0	0	0	0
cruslarv	0	0	0	0	0	0	0	0	0	0
diasluci	0	0	0	0	0	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	17
idotline	0	0	0	0	0	0	0	0	0	0
liocholc	0	0	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	0	0	0	0	0
mysisspe	0	0	0	0	17	0	0	0	0	0
pontalta	83	117	0	50	67	67	17	17	50	17
urotpose	133	883	183	217	117	117	200	367	33	33
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	0	0
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	17	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	17	0	0
3.0-3 cm	0	0	0	0	0	0	0	0	0	17
ensidire	0	0	0	0	0	0	0	0	0	0
macobalt										
maco 89	0	0	0	0	0	0	0	0	0	0
maco 90	0	0	0	0	17	0	0	50	0	0
maco 91	17	0	0	0	17	0	0	0	17	0
maco 92	0	0	0	17	0	0	0	0	0	0
maco 93	0	0	0	0	0	0	0	0	0	0
montferr	0	17	0	0	33	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
spissubt										
<2.5 cm	17	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	17	0	0	0	17	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
tellfabu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	17	0	17	33	17	17	0	17	50	0
1.5-2 cm	33	17	0	0	50	0	0	0	0	17
telltenu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	17	17	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	17	0	0	0
2.0-2 cm	17	0	0	0	0	0	17	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	67	33	67	0	0	0	50	50	0	0
nemertin	17	17	0	0	0	17	0	0	0	33
Total n/m²	619	1552	619	534	519	651	451	635	300	384
nr species	13	12	12	10	13	9	9	10	7	8
H'-index	2.18	1.47	2.06	1.92	2.36	1.82	1.79	1.56	1.82	1.58
Heip's index	0.65	0.3	0.62	0.65	0.8	0.65	0.62	0.42	0.86	0.55

Nourishment area; Trough stratum

Species	T101	T102	T103	T104	T105	T106	T107	T108	T109	T110
anaimacu	0	0	0	0	0	0	0	0	0	0
eteolong	0	0	0	0	0	0	0	0	0	0
eumisan	17	0	0	0	0	0	0	0	0	0
eumispec	0	0	0	0	0	0	0	0	0	0
harmljun	0	0	0	0	0	0	0	0	0	0
harmlunu	0	0	17	0	0	0	0	0	0	0
laniconc	0	17	0	0	0	0	0	0	0	0
magepapi	0	0	0	283	0	33	0	0	17	67
nephcaec	0	0	0	0	0	0	17	0	0	0
nephhomb	67	117	67	83	17	0	133	67	100	83
scolarmi	0	0	0	0	0	0	0	0	0	0
scolbonn	0	0	0	0	0	0	0	0	0	0
scolsqua	0	0	0	0	0	0	0	0	0	0
spiobomb	0	0	0	0	0	0	0	0	0	17
atylfalc	0	0	0	0	0	0	0	0	0	0
atylswam	0	0	0	0	0	0	0	17	0	0
batheleg	33	67	0	100	50	17	17	33	0	0
bathguil	0	0	0	0	0	0	0	0	0	0
crancran	0	0	0	0	0	0	0	0	0	0
cruslarv	0	0	0	0	0	0	0	0	0	0
diasluci	0	0	0	0	0	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	0
idotline	0	0	0	0	0	0	0	0	0	0
liocholc	0	0	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	0	0	0	0	0
mysisspe	0	0	0	0	0	0	0	0	0	0
pontalta	33	67	67	150	67	17	17	50	50	0
urotpose	133	0	583	200	0	33	33	0	33	0
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	0	0
0.5-1 cm	0	0	0	0	0	17	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
3.0-3 cm	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0	0	0	0	17	0	0	0
macobalt										
maco 89	0	0	0	0	0	0	0	0	0	0
maco 90	0	0	0	0	0	0	0	0	0	0
maco 91	0	0	33	0	0	0	0	0	33	0
maco 92	0	0	0	0	0	0	0	0	17	0
maco 93	0	0	0	0	0	0	0	0	0	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
spissubt										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
tellfabu										
0.5-1 cm	17	0	0	0	0	0	0	0	0	0
1.0-1 cm	33	0	17	0	0	0	0	0	50	0
1.5-2 cm	0	0	0	33	0	0	0	0	17	0
telltenu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	17	0	0	0	0	17	17	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	67	0	0	0	0	0	0	0
nemertin	0	17	33	50	17	50	0	33	0	83
Total n/m²	333	285	901	899	151	167	234	217	334	250
nr species	6	5	9	7	4	6	6	6	7	4
H'-index	1.58	1.38	1.33	1.74	1.22	1.7	1.36	1.67	1.79	1.27
Heip's index	0.77	0.74	0.35	0.78	0.8	0.89	0.58	0.86	0.83	0.85

Nourishment area; Trough stratum (continued)

Species	T111	T112	T113	T114	T115	T116	T117	T118	T119	T120
anaimacu	0	0	0	0	0	0	0	0	0	0
eteolong	0	0	0	0	0	0	0	0	0	0
eumisan	0	0	0	0	0	0	0	0	0	0
eumispec	0	0	0	0	0	0	0	0	0	0
harmljun	0	0	0	0	0	17	0	0	0	0
harmlunu	0	0	0	0	0	0	0	0	0	0
laniconc	0	0	0	0	0	0	0	0	0	0
magepapi	633	100	50	0	83	83	0	33	0	0
nephcaec	0	0	0	0	0	0	0	0	33	17
nephhomb	83	133	133	0	150	117	100	83	83	83
scolarmi	0	0	0	0	0	0	0	33	0	0
scolbonn	0	0	17	0	0	0	0	50	0	0
scolsqua	0	0	0	0	0	0	0	0	0	0
spiobomb	17	0	0	100	0	0	0	0	0	0
atylfalc	0	0	0	0	17	0	0	0	0	0
atylswam	0	0	0	0	33	0	0	0	17	0
batheleg	417	0	33	17	17	17	17	17	33	0
bathguil	0	0	0	0	0	0	0	0	0	0
crancran	0	0	0	0	0	0	0	0	0	0
cruslarv	0	0	0	0	0	0	0	0	0	0
diasluci	0	0	0	0	0	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	0
idotline	0	0	0	0	0	0	0	0	0	0
liocholc	0	0	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	0	0	0	0	0
mysisspe	0	0	0	0	0	0	0	0	17	0
pontalta	117	17	100	0	317	83	50	0	33	17
urotpose	17	0	150	50	0	0	0	50	0	0
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	0	0
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	17
2.0-2 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
3.0-3 cm	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0	0	0	0	17	0	0	0
macobalt										
maco 89	0	0	0	0	0	0	0	0	0	0
maco 90	0	0	0	0	0	0	0	0	0	0
maco 91	0	17	0	0	0	0	0	0	0	0
maco 92	0	0	0	0	17	0	0	0	0	0
maco 93	0	0	0	0	0	0	0	0	0	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
spissubt										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
tellfabu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
telltenu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	0	17	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	17	0	0	0
2.0-2 cm	0	0	17	0	17	0	0	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	17	0	0	0	0	0
nemertin	0	0	50	0	33	0	0	17	33	0
Total n/m²	1284	267	550	167	701	334	201	283	249	134
nr species	6	4	8	3	10	6	5	7	7	4
H'-index	1.22	1.07	1.83	0.9	1.68	1.52	1.32	1.81	1.8	1.08
Heip's index	0.48	0.64	0.75	0.73	0.49	0.71	0.69	0.85	0.84	0.65

Nourishment area; South stratum

Species	Z101	Z102	Z103	Z104	Z105	Z106	Z107	Z108	Z109	Z110
anaimacu	0	0	0	0	0	0	0	17	0	0
eteolong	0	0	0	0	0	0	0	0	0	0
eumisan	0	0	0	0	0	0	0	0	0	0
eumispec	0	0	0	0	0	0	0	17	0	0
harmljun	0	0	0	0	0	0	0	0	0	0
harmlunu	0	0	0	0	0	0	0	0	0	0
laniconc	0	0	0	0	0	0	0	0	17	0
magepapi	0	67	100	17	0	17	0	17	0	0
nephcaec	67	17	0	0	33	0	0	0	0	0
nephhomb	133	17	117	83	50	17	17	33	0	17
scolarmi	0	0	0	0	17	0	0	0	0	0
scolbonn	0	0	17	0	0	0	0	0	0	0
scolsqua	0	0	0	0	0	0	0	0	0	0
spiobomb	0	0	0	0	17	0	0	0	0	0
atylfalc	0	0	0	0	0	17	0	0	0	0
atylswam	0	0	0	17	0	17	33	0	17	0
batheleg	33	33	33	83	83	183	67	50	167	200
bathguil	0	0	0	0	0	0	0	0	0	0
crancran	0	0	0	0	0	0	0	0	0	0
cruslarv	0	0	17	0	0	0	0	0	0	0
diasluci	0	0	0	0	0	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	0
idotline	0	0	0	0	0	17	0	0	0	0
liocholc	0	0	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	0	0	0	0	0
mysisspe	0	0	0	0	0	17	0	0	0	0
pontalta	50	33	33	33	50	50	167	33	67	67
urotpose	100	0	33	0	0	17	0	33	0	0
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	0	0
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
3.0-3 cm	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0	0	0	0	0	0	0	0
macobalt										
maco 89	0	0	0	0	0	0	0	0	0	0
maco 90	0	0	0	0	0	0	0	0	0	0
maco 91	0	0	0	0	17	0	0	0	0	0
maco 92	0	0	0	0	0	0	17	0	0	0
maco 93	0	0	0	0	0	0	17	0	0	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
spissubt										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
tellfabu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	17	0	0	0	0	0	0	0
1.5-2 cm	0	17	0	0	0	0	0	0	0	0
telltenu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	33	0	0	0	0	0	0	0	17	0
2.0-2 cm	17	17	17	17	0	0	0	33	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	0	0
nemertin	17	0	0	0	0	0	0	17	0	0
Total n/m²	450	201	384	250	267	352	318	250	285	284
nr species	7	7	9	6	7	9	5	9	5	3
H'-index	1.78	1.8	1.9	1.55	1.78	1.65	1.29	2.12	1.16	0.76
Heip's index	0.82	0.84	0.71	0.74	0.82	0.53	0.66	0.92	0.55	0.57

Reference area; North stratum

Species	N131	N132	N133	N1034	N135	N136	N137	N138	N139	N140
anaimacu	0	0	0	0	0	0	0	0	0	0
eteolong	0	0	0	0	0	0	0	0	0	0
eumisan	17	0	0	0	0	0	0	0	0	0
eumispec	0	0	0	0	0	0	0	0	0	0
harmljun	0	0	0	0	0	0	0	0	0	0
harmlunu	17	0	0	0	0	17	0	0	0	0
laniconc	133	50	17	0	50	50	0	83	0	17
magepapi	0	17	0	0	0	0	0	67	17	50
nephcaec	0	0	0	0	0	0	0	0	0	0
nephhomb	150	183	100	50	117	117	117	167	133	83
scolarmi	0	0	0	0	0	0	0	0	0	0
scolbonn	0	0	0	0	0	0	0	0	0	0
scolsqua	0	0	0	0	0	0	0	0	0	0
spiobomb	0	0	0	0	0	0	0	0	0	0
atylfalc	0	0	17	0	0	0	0	0	0	0
atylswam	67	67	0	0	0	0	0	0	0	17
batheleg	33	17	67	0	67	17	33	183	0	50
bathguil	117	0	0	0	33	0	0	117	33	50
crancran	0	0	0	0	0	0	0	0	0	0
cruslarv	0	0	17	17	0	0	17	17	0	0
diasluci	0	0	0	0	0	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	0
idotline	0	0	0	0	0	0	0	0	0	0
liocholc	0	0	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	0	0	0	0	0
mysisspe	0	0	0	0	0	17	17	0	0	0
pontalta	117	83	67	50	0	0	0	33	0	17
urotpose	267	183	17	50	0	133	117	300	817	633
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	17	0
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	0	0	0	0	17	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
3.0-3 cm	0	0	0	0	0	0	0	0	0	0
ensidire	0	33	0	0	17	0	0	0	17	17
macobalt										
maco 89	0	0	0	0	0	0	0	0	0	0
maco 90	0	0	0	0	0	0	0	0	0	0
maco 91	17	0	17	0	0	0	17	17	50	17
maco 92	0	17	0	0	0	0	0	0	0	0
maco 93	0	0	0	0	0	0	0	0	0	0
montferr	0	0	0	0	0	0	0	0	17	0
mysebide	0	0	0	0	17	0	0	0	17	0
spissubt										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	17	17	0	0	0	0	17	0	17	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
tellfabu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	17	17	50	17	83	0
1.5-2 cm	0	33	0	0	0	17	33	0	33	0
telltenu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	17	0	0	0	0	0	0	0	0	0
1.5-2 cm	17	0	0	17	0	0	0	0	0	0
2.0-2 cm	17	0	0	17	17	0	0	17	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	17	0
nemertin	0	67	0	17	0	0	0	50	17	33
Total n/m²	1003	767	319	218	335	385	435	1068	1285	984
nr species	12	12	8	6	8	7	9	12	12	11
H'-index	2.13	2.14	1.81	1.7	1.81	1.62	1.85	2.08	1.4	1.41
Heip's index	0.67	0.68	0.73	0.89	0.73	0.68	0.67	0.64	0.28	0.31

Reference area; North stratum (continued)

Species	N141	N142	N143	N144	N145	N146	N147	N148	N149	N150
anaimacu	0	0	0	0	0	0	0	0	0	0
eteolong	0	0	0	0	0	0	0	0	0	0
eumisan	0	0	0	0	0	0	0	0	0	0
eumispec	0	0	0	0	0	0	0	0	0	0
harmljun	0	0	0	0	0	0	0	0	0	0
harmlunu	0	0	0	0	0	0	0	0	0	0
laniconc	50	33	167	0	17	0	0	17	17	0
magepapi	17	0	0	133	33	0	33	33	17	0
nephcaec	0	0	0	33	50	0	33	0	0	0
nephhomb	167	83	67	67	50	67	33	0	67	117
scolarmi	0	0	0	0	0	0	0	0	0	0
scolbonn	0	0	0	0	0	0	0	0	17	0
scolsqua	0	0	33	33	0	0	0	0	0	0
spiobomb	0	0	0	0	0	0	0	0	0	0
atylfalc	17	0	17	0	0	0	0	0	0	0
atylswam	0	0	17	17	0	0	17	17	0	0
batheleg	100	17	100	17	133	33	83	0	0	100
bathguil	17	33	33	0	17	0	33	17	0	0
crancran	0	0	0	0	0	0	0	0	0	0
cruslarv	0	0	0	0	0	0	17	0	0	0
diasluci	0	0	0	0	0	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	0
idotline	0	0	0	0	0	0	0	0	0	0
liocholc	0	17	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	0	0	0	0	0
mysisspe	0	0	0	0	0	0	0	0	0	0
pontalta	33	33	17	33	83	0	17	50	50	100
urotpose	0	17	67	100	17	67	900	167	800	117
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	0	0
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
3.0-3 cm	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0	0	17	0	0	0	0	0
macobalt										
maco 89	0	0	0	0	0	0	0	0	0	0
maco 90	17	0	0	0	0	0	0	0	0	0
maco 91	17	17	0	0	0	0	17	0	0	0
maco 92	17	0	17	0	0	0	0	0	0	0
maco 93	0	0	0	0	0	0	0	0	0	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
spissubt										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
tellfabu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	17	33	0	0	17	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
telltenu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	17	0	0	17	0	0	0	0	0	17
2.0-2 cm	17	0	0	0	0	17	0	0	50	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	0	0
nemertin	17	0	0	0	0	0	0	0	0	0
Total n/m²	503	267	568	450	417	201	1183	301	1018	451
nr species	10	9	11	9	9	5	10	6	6	5
H'-index	1.97	2.02	2.09	1.92	1.92	1.45	1.04	1.36	0.79	1.49
Heip's index	0.69	0.82	0.71	0.73	0.73	0.82	0.2	0.58	0.24	0.86

Reference area; Trough stratum

Species	T131	T132	T133	T134	T135	T136	T137	T138	T139	T140
anaimacu	0	0	0	0	0	0	0	0	0	0
eteolong	0	0	0	0	0	0	0	0	0	0
eumisan	17	0	0	0	0	0	0	0	0	0
eumispec	0	0	0	0	0	0	0	0	0	0
harmljun	0	0	0	0	0	0	0	0	0	0
harmlunu	0	0	0	0	0	0	17	0	0	0
laniconc	17	17	0	0	0	0	33	0	0	0
magepapi	17	0	33	0	17	83	17	0	0	0
nephcaec	0	0	17	0	0	0	0	0	0	0
nephhomb	50	17	33	33	83	50	50	17	67	67
scolarmi	0	0	0	0	0	0	0	0	0	0
scolbonn	0	0	0	0	0	0	0	0	0	0
scolsqua	17	0	0	0	0	0	0	17	0	0
spiobomb	0	0	0	17	0	0	0	0	0	0
atylfalc	0	0	0	0	33	17	0	0	0	0
atylswam	17	0	0	0	33	17	17	0	17	0
batheleg	0	433	0	150	0	100	33	0	50	67
bathguil	0	0	0	0	0	0	0	0	0	0
crancran	0	0	0	0	0	0	0	0	0	0
cruslarv	0	0	0	0	0	0	0	0	0	0
diasluci	0	0	0	0	0	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	0
idotline	0	0	0	0	0	0	0	0	0	0
liocholc	0	0	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	0	17	0	0	17
mysisspe	0	0	17	0	0	0	0	0	0	0
pontalta	0	17	17	50	17	17	83	117	0	50
urotpose	0	17	0	0	0	0	17	0	0	0
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	0	0
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
3.0-3 cm	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	17	0	0	0	0	0	0	0
macobalt										
maco 89	0	0	0	33	0	0	0	0	0	0
maco 90	0	0	0	0	0	0	0	0	0	0
maco 91	0	0	0	83	0	17	0	0	0	0
maco 92	0	0	0	0	0	0	17	0	0	0
maco 93	0	0	0	0	0	0	0	0	0	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	17	0	0	0
spissubt										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	17
2.5-3 cm	0	0	0	0	17	0	0	0	0	0
tellfabu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
tellteñu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	17	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	17	0	33	0	0	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	0	0
nemertin	0	67	17	0	50	83	0	0	0	0
Total n/m²	152	568	168	366	283	384	318	151	134	218
nr species	7	6	8	5	8	8	11	3	3	5
H'-index	1.85	0.88	2.04	1.36	1.92	1.83	2.21	0.69	0.98	1.46
Heip's index	0.89	0.28	0.96	0.72	0.83	0.75	0.81	0.5	0.83	0.83

Reference area; Trough stratum (continued)

Species	T141	T142	T143	T144	T145	T146	T147	T148	T149	T150
anaimacu	0	0	0	0	0	0	0	0	0	0
eteolong	0	0	0	0	0	0	0	0	0	0
eumisan	0	0	0	0	0	0	0	0	0	0
eumispec	0	0	0	0	0	0	0	0	0	0
harmljun	0	0	0	0	0	0	0	0	0	0
harmlunu	0	0	0	0	0	0	0	0	0	0
laniconc	0	0	0	33	0	17	0	0	0	0
magepapi	83	0	33	17	0	33	33	17	67	67
nephcaec	0	0	0	0	0	50	0	0	17	17
nephhomb	133	83	83	100	17	83	33	67	100	83
scolarmi	0	0	0	0	0	0	0	0	0	0
scolbonn	0	0	0	0	0	0	0	0	0	0
scolsqua	0	0	0	0	0	0	0	0	0	0
spiobomb	0	0	0	0	0	0	0	0	0	0
atylfalc	0	0	0	0	0	0	17	0	0	0
atylswam	33	0	0	0	17	0	0	17	0	0
batheleg	150	17	217	83	233	83	17	67	67	0
bathguil	0	0	0	0	0	0	0	0	0	17
crancran	0	0	0	0	0	0	17	0	0	0
cruslarv	0	0	0	0	33	0	0	0	0	0
diasluci	0	0	0	0	0	0	0	0	0	0
gastspin	0	0	0	0	0	0	0	0	0	0
idotline	0	0	0	0	0	0	0	17	0	0
liocholc	0	0	0	0	0	0	0	0	0	0
liocmarm	0	0	0	0	0	17	0	0	0	0
mysisspe	0	0	0	0	0	0	0	0	0	0
pontalta	33	17	133	117	133	83	33	0	50	50
urotpose	17	33	100	17	17	17	0	33	150	50
donavitt										
<0.5 cm	0	0	0	0	0	0	0	0	0	0
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	0	0	0	0
2.0-2 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	17	0
3.0-3 cm	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0	0	0	0	0	0	0	17
macobalt										
maco 89	0	0	0	0	17	0	0	0	0	0
maco 90	0	0	0	0	0	0	0	0	0	17
maco 91	0	0	0	0	0	0	0	0	0	17
maco 92	0	0	17	0	0	0	0	0	0	0
maco 93	0	0	0	0	0	0	0	0	0	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
spissubt										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	17	0	0	0	0	0	0	0	17	0
spissoli										
<2.5 cm	0	0	0	0	0	0	0	0	0	0
2.5-3 cm	0	0	0	0	0	0	0	0	0	0
tellfabu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	17	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	17	0	0	0	17
telltenu										
0.5-1 cm	0	0	0	0	0	0	0	0	0	0
1.0-1 cm	0	0	0	0	0	0	0	0	0	0
1.5-2 cm	0	0	0	0	0	0	17	0	17	0
2.0-2 cm	0	0	50	50	0	0	0	0	17	0
lunacate	0	0	0	0	17	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	0	0
nemertin	0	33	0	33	0	0	33	0	67	0
Total n/m²	483	183	633	450	484	400	200	218	586	352
nr species	8	5	7	8	8	9	8	6	10	9
H'-index	1.74	1.42	1.7	1.87	1.48	1.98	2.03	1.61	2.08	2.02
Heip's index	0.67	0.78	0.75	0.78	0.48	0.78	0.94	0.8	0.78	0.82

Appendix 6. Biomass (g/m²) per station of macrofauna species found in the April 1994 survey. (size of the boxcorer was 0.06 m²).

Nourishment area; North stratum

	station									
	N101	N102	N103	N104	N105	N106	N107	N108	N109	N110
species										
magepapi	0	0	0.00293	0.00147	0.0015	0.0015	0.003	0.0015	0.0015	0
nephhomb	0.1604	0.0943	0.2147	0.2147	0.0966	0.0406	0.1555	0.248	0.3236	0.2582
nephcaec	0	0	0	0	0	0	0.0725	0	0	0.0014
rest worms	0	0	0.0195	0	0.1351	0.0465	0.0165	0.0054	0.0796	0.0712
total donax	0	0	0	0	0	0	0	0	0	0.1804
ensidire	0	0	0	0	0	0.0425	0	0.2376	0	0
macobalt 93	0	0	0	0	0	0	0	0	0	0
macobalt 92	0	0	0	0	0	0	0	0	0	0
macobalt 91	0.0564	0	0.0589	0.2597	0.113	0.0861	0	0	0.2354	0.0675
macobalt 90	0	0	0	0	0.1064	0	0.1483	0	0	0
total maco	0.0564	0	0.0589	0.2597	0.2194	0.0861	0.1483	0	0.2354	0.0675
tellfabu	0	0	0.0501	0.0204	0.0581	0.0463	0.0422	0	0.0548	0.1386
telltenu	0	0	0.0664	0.0402	0	0.0047	0	0.0812	0	0
total tell	0	0	0.1165	0.0606	0.0581	0.051	0.0422	0.0812	0.0548	0.1386
montferr	0.0083	0	0	0	0	0	0	0.002	0	0.001
mysebide	0	0	0	0	0	0	0	0	0	0
tot.spis	0	0	0	0	0.2367	0	0	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	1.7549	2.0217	1.0524	1.1316	0	2.3624	0	0.6562	0	0
Total g/m²	2.0364	2.116	1.64033	1.98837	1.0249	2.7677	0.6285	1.3131	0.9851	0.9244
worms g/m²	0.1604	0.0943	0.23713	0.21617	0.2332	0.0886	0.2475	0.2549	0.4047	0.3308
Mollusca g/m²	0.1211	0	0.3508	0.6406	0.7917	0.3167	0.381	0.402	0.5804	0.5936

	N111	N112	N113	N114	N115	N116	N117	N118	N119	N120
species										
magepapi	0.0015	0.0147	0.0058	0.0019	0.00222	0.02888	0.0016	0	0.0046	0
nephhomb	0.2063	0.0898	0.0983	0	0.0205	0.1163	0.0837	0.0052	0.2293	0.0358
nephcaec	0	0	0.0725	0	0.0057	0	0	0	0	0
rest worms	0.0007	0.0965	0.0308	0.0526	0.0055	0.011	0.0007	0.025	0	0.0055
total donax	0	0	0.1158	0	0	0	0	0.1738	0	0.1692
ensidire	0	0	0	0	0	0	0	0	0	0
macobalt 93	0	0	0	0	0	0	0	0	0	0
macobalt 92	0	0	0	0	0	0	0	0	0	0
macobalt 91	0.193	0	0	0.0364	0.0969	0	0	0.032	0	0
macobalt 90	0	0	0	0	0	0	0	0.3344	0.0815	0
total maco	0.193	0	0	0.0364	0.0969	0	0	0.3664	0.0815	0
tellfabu	0.0423	0.0382	0.0108	0.0357	0.1085	0.0097	0	0.0253	0.0307	0.0154
telltenu	0.0516	0.0231	0.025	0	0	0	0.1039	0	0	0
total tell	0.0939	0.0613	0.0358	0.0357	0.1085	0.0097	0.1039	0.0253	0.0307	0.0154
montferr	0	0.0006	0	0	0.0031	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
tot.spis	0.1465	0	0	0	0.2564	0	0	0	0.1749	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	2.6072	1.2827	2.2117	0	0	0	2.1455	2.1228	0.5216	0
Total g/m²	3.536	1.6069	2.6065	0.1987	0.70422	0.17558	2.4393	3.1102	1.1548	0.2413
worms g/m²	0.2085	0.201	0.2074	0.0545	0.03392	0.15618	0.086	0.0302	0.2339	0.0413
Mollusca g/m²	0.7203	0.1232	0.1874	0.1442	0.6703	0.0194	0.2078	0.9572	0.3993	0.2

Nourishment area; Trough stratum

	T101	T102	T103	T104	T105	T106	T107	T108	T109	T110
species										
magepapi	0	0		0.0184	0	0.0019	0	0	0.00093	0.00372
nephhomb	0.1123	0.1629	0.1238	0.0945	0.0151	0	0.1713	0.0466	0.2618	0.2582
nephcaec	0	0	0	0	0	0	0.3347	0	0	0
rest worms	0.0005	0.0012	0.0032	0.011	0.0012	0.0102	0	0.0122	0	0.1192
total donax	0	0	0	0	0	0.0157	0	0	0	0
ensidire	0	0	0	0	0	0	0.0829	0	0	0
macobalt 93	0	0	0	0	0	0	0	0	0	0
macobalt 92	0	0	0	0	0	0	0	0	0.0497	0
macobalt 91	0	0	0.2432	0	0	0	0	0	0.1972	0
macobalt 90	0	0	0	0	0	0	0	0	0	0
total maco	0	0	0.2432	0	0	0	0	0	0.2469	0
tellfabu	0.0242	0	0.0066	0.1236	0	0	0	0	0.0384	0
telltenu	0	0	0.0666	0	0	0	0	0.0571	0.046	0
total tell	0.0242	0	0.0732	0.1236	0	0	0	0.0571	0.0844	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
tot.spis	0	0	0	0	0	0	0	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	2.1605	0	0	0	0	0	0	0
Total g/m²	0.1612	0.1641	2.9203	0.3711	0.0163	0.0278	0.5889	0.173	0.92533	0.38112
worms g/m²	0.1128	0.1641	0.127	0.1239	0.0163	0.0121	0.506	0.0588	0.26273	0.38112
Mollusca g/m²	0.0484	0	0.6328	0.2472	0	0.0157	0.0829	0.1142	0.6626	0

	T111	T112	T113	T114	T115	T116	T117	T118	T119	T120
species										
magepapi	0.0639	0.0136	0.00279	0	0.00465	0.00465	0	0.00186	0	0
nephhomb	0.0403	0.5402	0.1403	0.3	0.2079	0.4203	0.0779	0.1084	0.2958	0.0326
nephcaec	0	0	0	0	0	0	0	0.0223	0.0083	0.0037
rest worms	0.0003	0	0.0028	0.0084	0.0101	0	0	0	0.0256	0
total donax	0	0	0	0	0	0	0	0	0	0.0439
ensidire	0	0	0	0	0	0	0.4041	0	0	0
macobalt 93	0	0	0	0	0	0	0	0	0	0
macobalt 92	0	0	0	0	0.027	0	0	0	0	0
macobalt 91	0	0.1092	0	0	0	0	0	0	0	0
macobalt 90	0	0	0	0	0	0	0	0	0	0
total maco	0	0.1092	0	0	0.027	0	0	0	0	0
tellfabu	0	0	0	0	0	0	0	0	0	0
telltenu	0	0	0.0487	0	0.0785	0.0107	0.0399	0	0	0
total tell	0	0	0.0487	0	0.0785	0.0107	0.0399	0	0	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
tot.spis	0	0	0	0	0	0	0	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0.7241	0	0	0	0	0
Total g/m²	0.1045	0.7722	0.24329	0.3084	1.15775	0.44635	0.5618	0.13256	0.3297	0.0802
worms g/m²	0.1045	0.5538	0.14589	0.3084	0.22265	0.42495	0.0779	0.13256	0.3297	0.0363
Mollusca g/m²	0	0.2184	0.0974	0	0.211	0.0214	0.4839	0	0	0.0439

Nourishment area; South stratum

species	Z101	Z102	Z103	Z104	Z105	Z106	Z107	Z108	Z109	Z110
magepapi	0	0.00603	0.00905	0.00151	0	0.00151	0	0.00151	0	0
nephhomb	0.0822	0.0166	0.0756	0.0337	0.1219	0.0171	0.0236	0.0292	0	0.0108
nephcaec	0.0211	0.0033	0	0	0.0207	0	0	0.0015	0	0
rest worms	0.001	0	0.0009	0	0.002	0	0	0	0.0025	0
total donax	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0	0	0	0	0	0	0	0
macobalt 93	0	0	0	0	0	0	0.0066	0	0	0
macobalt 92	0	0	0	0	0	0	0.0197	0	0	0
macobalt 91	0	0	0	0	0.0949	0	0	0	0	0
macobalt 90	0	0	0	0	0	0	0	0	0	0
total maco	0	0	0	0	0.0949	0	0.0263	0	0	0
tellfabu	0	0.0299	0.0129	0	0	0	0	0	0	0
telltenu	0.1328	0.0401	0.0683	0.0556	0	0	0	0.0516	0.2199	0
total tell	0.1328	0.07	0.0812	0.0556	0	0	0	0.0516	0.2199	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
tot.spis	0	0	0	0	0	0	0	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	0	0
Total g/m²	0.3699	0.16593	0.24795	0.14641	0.3344	0.01861	0.0762	0.13541	0.4423	0.0108
worms g/m²	0.1043	0.02593	0.08555	0.03521	0.1446	0.01861	0.0236	0.03221	0.0025	0.0108
Mollusca g/m²	0.2656	0.14	0.1624	0.1112	0.1898	0	0.0526	0.1032	0.4398	0

Reference area; North stratum

	N131	N132	N133	N134	N135	N136	N137	N138	N139	N140
species										
magepapi	0	0.00222	0	0	0	0	0	0.00887	0.00222	0.00665
nephhomb	0.2711	0.4767	0.1253	0.0282	0.1543	0.2572	0.1582	0.2652	0.2058	0.1064
nephcaec	0	0	0	0	0	0	0	0	0	0
rest worms	0.1265	0.0503	0.001	0.0389	0.0112	0.0767	0	0.1421	0.0048	0.0204
total donax	0	0	0	0	0	0	0.1021	0	0.0029	0
ensidire	0	0.4055	0	0	0.1087	0	0	0	0.2953	0.6377
macobalt 93	0	0	0	0	0	0	0	0	0	0
macobalt 92	0	0.0667	0	0	0	0	0	0	0	0
macobalt 91	0.1297	0	0.1363	0	0	0	0.1124	0.1124	0.3563	0.0769
macobalt 90	0	0	0	0	0	0	0	0	0	0
total maco	0.1297	0.0667	0.1363	0	0	0	0.1124	0.1124	0.3563	0.0769
tellfabu	0	0.0354	0	0	0.0093	0.0323	0.079	0.0114	0.0934	0
telltenu	0.1064	0	0	0.0797	0.0411	0	0	0.0438	0	0
total tell	0.1064	0.0354	0	0.0797	0.0504	0.0323	0.079	0.0552	0.0934	0
montferr	0	0	0	0	0	0	0	0	0.0002	0
mysebide	0	0	0	0	0.0002	0	0	0	0.0002	0
tot.spis	0.2102	0.2102	0	0	0	0	0.2255	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	1.9433	0
Total g/m²	1.08	1.34912	0.3989	0.2265	0.3752	0.3985	0.8686	0.75137	3.35412	0.92495
worms g/m²	0.3976	0.52922	0.1263	0.0671	0.1655	0.3339	0.1582	0.41617	0.21282	0.13345
Mollusca g/m²	0.6824	0.8199	0.2726	0.1594	0.2097	0.0646	0.7104	0.3352	1.198	0.7915

0

	N141	N142	N143	N144	N145	N146	N147	N148	N149	N150
species										
magepapi	0.00222	0	0	0.01775	0.003	0	0.00444	0.00444	0.00444	0
nephhomb	0.1285	0.4086	0.139	0.1167	0.0596	0.159	0.1468	0	0.0518	0.1413
nephcaec	0	0	0	0.0087	0.0515	0	0.00878	0	0	0
rest worms	0.0032	0.0009	0.0007	0.0068	0.0082	0	0	0.0212	0.0002	0
total donax	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0	0	0.0128	0	0	0	0	0
macobalt 93	0	0	0	0	0	0	0	0	0	0
macobalt 92	0.0468	0	0.0447	0	0	0	0	0	0	0
macobalt 91	0.1034	0.1147	0	0	0	0	0.1372	0	0	0
macobalt 90	0.1202	0	0	0	0	0	0	0	0	0
total maco	0.2704	0.1147	0.0447	0	0	0	0.1372	0	0	0
tellfabu	0	0.0061	0.0341	0	0	0.0121	0	0	0	0
telltenu	0.0573	0	0	0.027	0	0.0458	0	0	0.1824	0.0215
total tell	0.0573	0.0061	0.0341	0.027	0	0.0579	0	0	0.1824	0.0215
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
tot.spis	0	0	0	0	0	0	0	0	0	0
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	0	0
Total g/m²	0.78932	0.4086	0.2973	0.20395	0.1351	0.2748	0.43442	0.02564	0.42124	0.1843
worms g/m²	0.13392	0.167	0.1397	0.14995	0.1223	0.159	0.16002	0.02564	0.05644	0.1413
Mollusca g/m²	0.6554	0.2416	0.1576	0.054	0.0128	0.1158	0.2744	0	0.3648	0.043

Reference area; Trough stratum

species	T131	T132	T133	T134	T135	T136	T137	T138	T139	T140
magepapi	0	0	0	0	0.0015	0.0075	0.00254	0	0	0
nephhomb	0.0313	0.0067	0.1595	0.0902	0.2148	0.0689	0.0765	0.007	0.1079	0.0498
nephcaec	0	0	0.0064	0	0	0	0	0	0	0
rest. worms	0.0212	0.0205	0.028	0.0017	0.0469	0.0294	0.0202	0.0005	0	0
total donax	0	0	0	0	0	0	0	0	0	0
ensidire	0	0	0.1349	0	0	0	0	0	0	0
macobalt 93	0	0	0	0	0	0	0.4722	0	0	0
macobalt 92	0	0	0	0	0	0	0	0	0	0
macobalt 91	0	0	0	0.4579	0	0.0694	0	0	0	0
macobalt 90	0	0	0	0.2134	0	0	0	0	0	0
total maco	0	0	0	0.6713	0	0.0694	0.4722	0	0	0
tellfabu	0.01	0	0	0	0	0	0	0	0	0
telltenu	0.0783	0	0.0812	0	0.1537	0	0	0	0	0
total tell	0.0883	0	0.0812	0	0.1537	0	0	0	0	0
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0.0005	0	0	0
tot.spis	0	0	0	0	0.0478	0	0	0	0	0.0167
lunacate	0	0	0	0	0	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	0	0
Total g/m²	0.2291	0.0272	0.4912	1.4345	0.6184	0.2446	1.04414	0.0075	0.1079	0.0665
worms g/m²	0.0525	0.0272	0.1939	0.0919	0.2632	0.1058	0.09924	0.0075	0.1079	0.0498
Mollusca g/m²	0.1766	0	0.2973	1.3426	0.3552	0.1388	0.9449	0	0	0.0167

species	T141	T142	T143	T144	T145	T146	T147	T148	T149	T150
magepapi	0.0127	0	0.00508	0.00254	0	0.00508	0.00508	0.00254	0.01016	0.01016
nephhomb	0.2967	0.0722	0.1851	0.2257	0.0203	0.1615	0.0395	0.0728	0.1638	0.1714
nephcaec	0	0	0	0	0	0.0151	0	0	0.0178	0.0178
rest worms	0	0.0026	0	0.0197	0	0.0073	0.0083	0	0.037	0
total donax	0	0	0	0	0	0	0	0	0.1611	0
ensidire	0	0	0	0	0	0	0	0	0	0.0569
macobalt 93	0	0	0	0	0	0	0	0	0	0
macobalt 92	0	0	0.0228	0	0	0	0	0	0	0
macobalt 91	0	0	0	0	0	0	0	0	0	0.1042
macobalt 90	0	0	0	0	0	0	0	0	0	0.0951
total maco	0	0	0.0228	0	0.0963	0	0	0	0	0.1993
tellfabu	0.0307	0	0	0	0	0.0255	0	0	0	0.0169
telltenu	0	0	0.1365	0.155	0	0	0.0275	0	0.1057	0
total tell	0.0307	0	0.1365	0.155	0	0.0255	0.0275	0	0.1057	0.0169
montferr	0	0	0	0	0	0	0	0	0	0
mysebide	0	0	0	0	0	0	0	0	0	0
tot.spis	0.1636	0	0	0	0	0	0	0	0.1104	0
lunacate	0	0	0	0	0.0225	0	0	0	0	0
echicord	0	0	0	0	0	0	0	0	0	0
Total g/m²	0.5344	0.0748	0.50878	0.55794	0.2354	0.23998	0.10788	0.07534	0.71166	0.68866
worms g/m²	0.3094	0.0748	0.19018	0.24794	0.0203	0.18898	0.05288	0.07534	0.22876	0.19936
Mollusca g/m²	0.225	0	0.3186	0.31	0.2151	0.051	0.055	0	0.4829	0.4893

Appendix 7. Two-way table resulting from TWINSPAN on density data (ind/m²). T1 survey (April 1994). The values denote categories of density defined by the pseudospecies cut levels. The values present catogories of

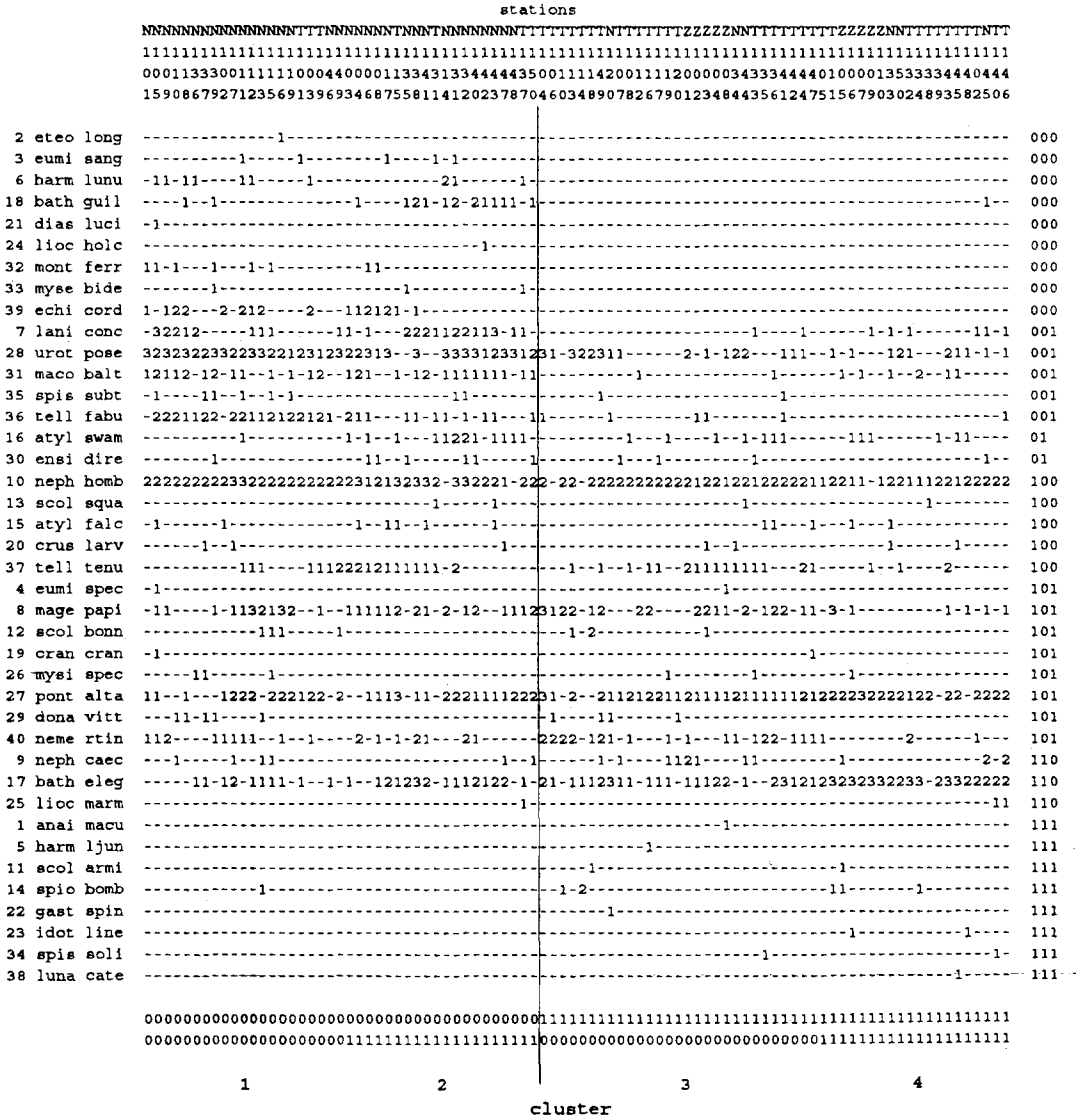
- \- 0 individuals per m²
- 1 10 - 49 individuals per m²
- 2 50 - 149 individuals per m²
- 3 > 150 individuals per m²

ORDER OF SPECIES INCLUDING RARER ONES

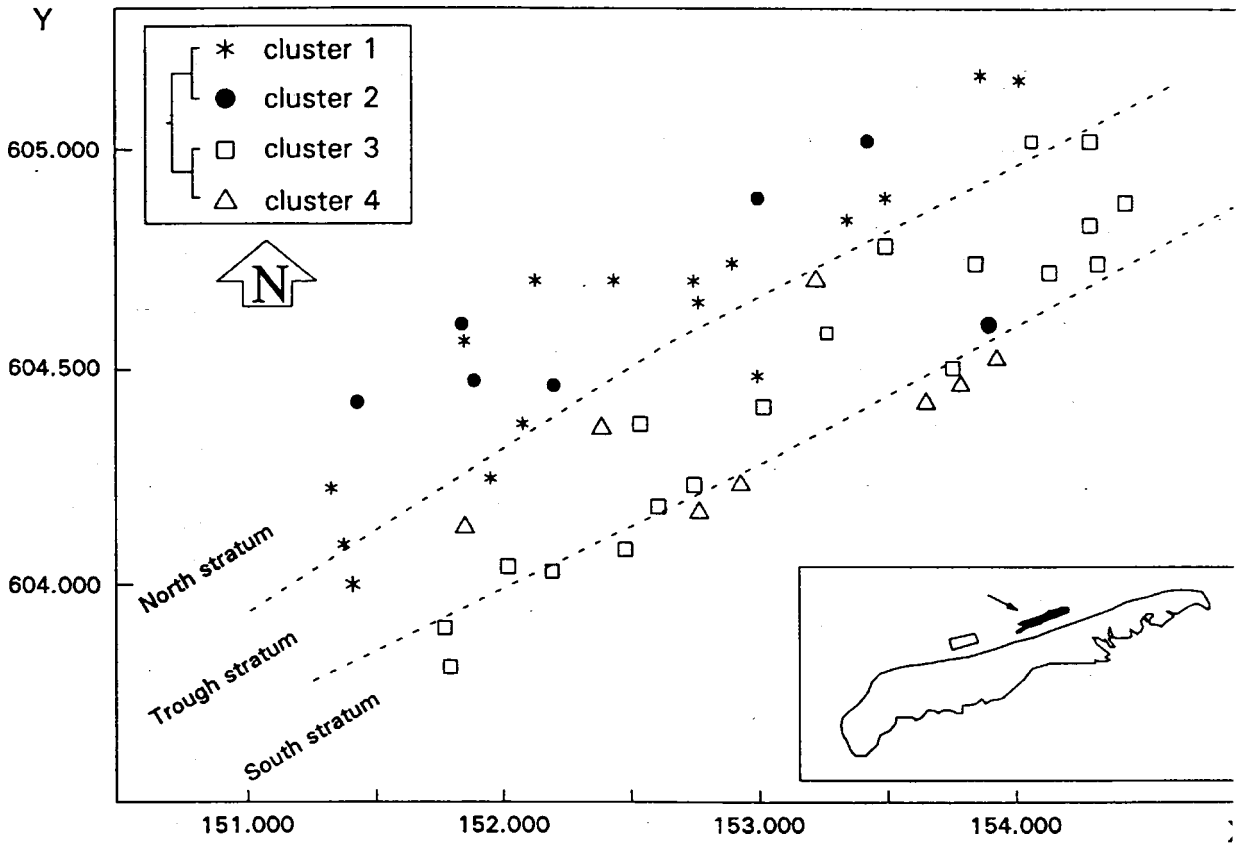
2 eteo long!	3 eumi sang!	6 harm lunu!	18 bath guil!	21 dias luci!	24 lioc holc!	32 mont ferr!	33 myse bide
39 echi cord!	7 lani conc!	28 urot pose!	31 maco balt!	35 spis subt!	36 tell fabu!	16 atyl swam!	30 ensi dire
10 neph homb!	13 scol squa!	15 atyl falc!	20 crus larv!	37 tell tenu!	4 eumi spec!	8 mage papi!	12 scol bonn
19 cran cran!	26 mysi spec!	27 pont alta!	29 dona vitt!	40 neme rtin!	9 neph caec!	17 bath eleg!	25 lioc marm
1 anai macu!	5 harm ljun!	11 scol armi!	14 spio bomb!	22 gast spin!	23 idot line!	34 spis soli!	38 luna cate

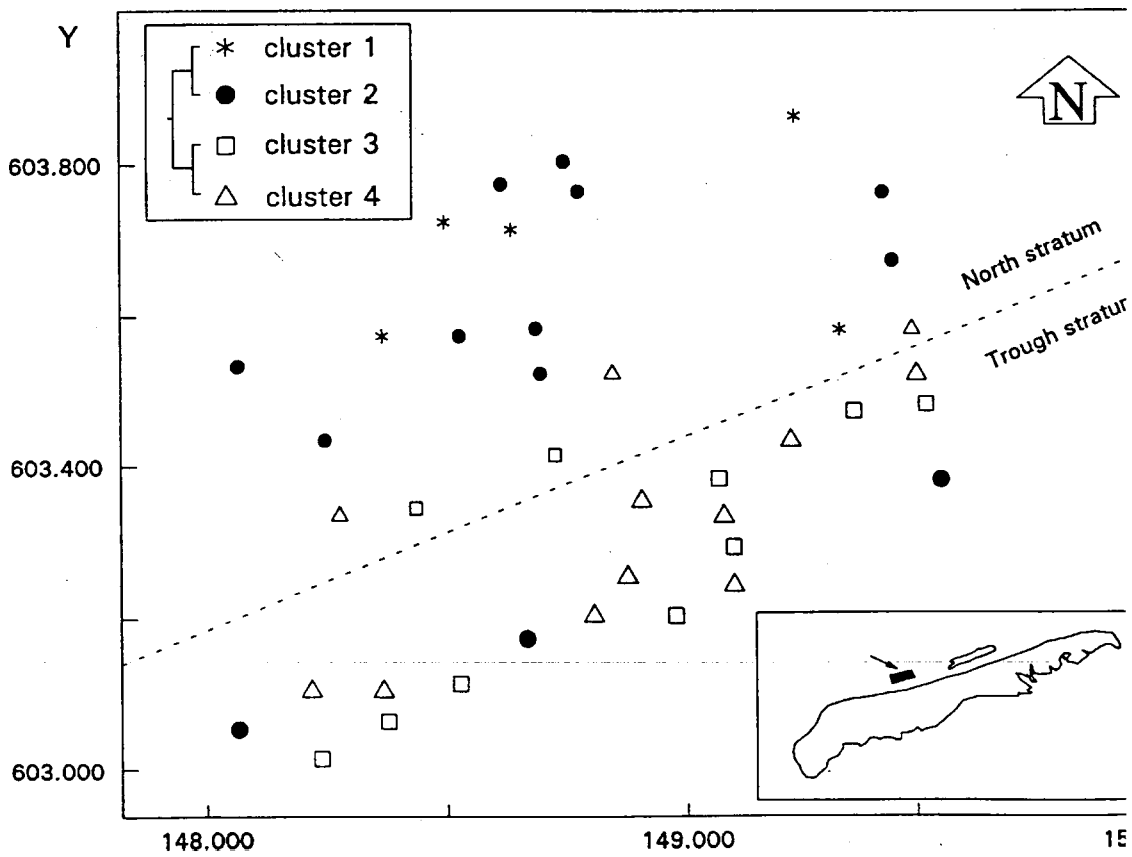
ORDER OF SAMPLES

1	N101	5	N105	9	N109	10	N110	18	N118	56	N136	57	N137	59	N139
2	N102	7	N107	11	N111	12	N112	13	N113	15	N115	16	N116	19	N119
21	T101	23	T103	29	T109	66	N146	69	N149	3	N103	4	N104	6	N106
8	N108	17	N117	35	T115	55	N135	58	N138	61	N141	71	T131	14	N114
51	N131	52	N132	60	N140	62	N142	63	N143	67	N147	68	N148	77	T137
90	T150	24	T104	26	T106	30	T110	33	T113	34	T114	38	T118	89	T149
20	N120	27	T107	28	T108	32	T112	36	T116	37	T117	39	T119	40	T120
41	Z101	42	Z102	43	Z103	44	Z104	48	Z108	54	N134	64	N144	73	T133
75	T135	76	T136	81	T141	82	T142	84	T144	87	T147	25	T105	31	T111
45	Z105	46	Z106	47	Z107	49	Z109	50	Z110	53	N133	70	N150	72	T132
74	T134	78	T138	79	T139	83	T143	85	T145	88	T148	22	T102	65	N145
80	T140	86	T146												



Appendix 8. Map showing the location of the stations and the TWINSPAN cluster they belong to in the nourishment area and the reference area (density analysis). T1 survey (April 1994).





Appendix 9. Two-way table resulting from TWINSPAN on presence/ absence data. T1 survey (April 1994). Values denote catogories of:

1 species present in sample

\- species absent in sample

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ORDER OF SPECIES INCLUDING RARER ONES
  1 anai macu!  2 eteo long!  5 harm ljun!  11 scol armi!  14 spio bomb!  20 crus larv!  22 gast spin!  23 idot line
 34 spis soli!  38 luna cate!  9 neph caec!  12 scol bonn!  17 bath eleg!   8 mage papi!  10 neph homb!  26 mysi spec
 27 pont alta!  28 urot pose!  29 dona vitt!  37 tell tenu!  40 neme rtin!  15 atyl falc!  16 atyl swam!  25 lioc marm
  4 eumi spec!  19 cran cran!  31 maco balt!  35 spis subt!  36 tell fabu!  39 echi cord!   3 eumi sang!   7 lani conc
 13 scol squa!  30 ensi dire!   6 harm lunu!  18 bath guil!  24 lioc holc!  33 myse bide!  21 dias luci!  32 mont ferr

ORDER OF SAMPLES
  2 N102    ! 17 N117    ! 22 T102    ! 25 T105    ! 28 T108    ! 30 T110    ! 35 T115    ! 36 T116
 37 T117    ! 39 T119    ! 44 Z104    ! 46 Z106    ! 49 Z109    ! 50 Z110    ! 61 N141    ! 64 N144
 75 T135    ! 76 T136    ! 79 T139    ! 80 T140    ! 87 T147    ! 88 T148    ! 32 T112    ! 45 Z105
 47 Z107    ! 53 N133    ! 67 N147    ! 74 T134    ! 78 T138    ! 83 T143    ! 85 T145    !  8 N108
 13 N113    ! 16 N116    ! 24 T104    ! 26 T106    ! 27 T107    ! 31 T111    ! 33 T113    ! 34 T114
 38 T118    ! 40 T120    ! 41 Z101    ! 42 Z102    ! 43 Z103    ! 48 Z108    ! 54 N134    ! 65 N145
 66 N146    ! 69 N149    ! 70 N150    ! 72 T132    ! 73 T133    ! 82 T142    ! 84 T144    ! 86 T146
 89 T149    !  7 N107    ! 20 N120    ! 21 T101    ! 57 N137    ! 81 T141    !  1 N101    !  4 N104
  5 N105    !  6 N106    !  9 N109    ! 11 N111    ! 12 N112    ! 23 T103    ! 29 T109    ! 58 N138
 10 N110    ! 15 N115    ! 18 N118    ! 19 N119    ! 59 N139    ! 90 T150    !  3 N103    ! 14 N114
 51 N131    ! 52 N132    ! 55 N135    ! 56 N136    ! 60 N140    ! 62 N142    ! 63 N143    ! 68 N148
 77 T137    ! 71 T131    !
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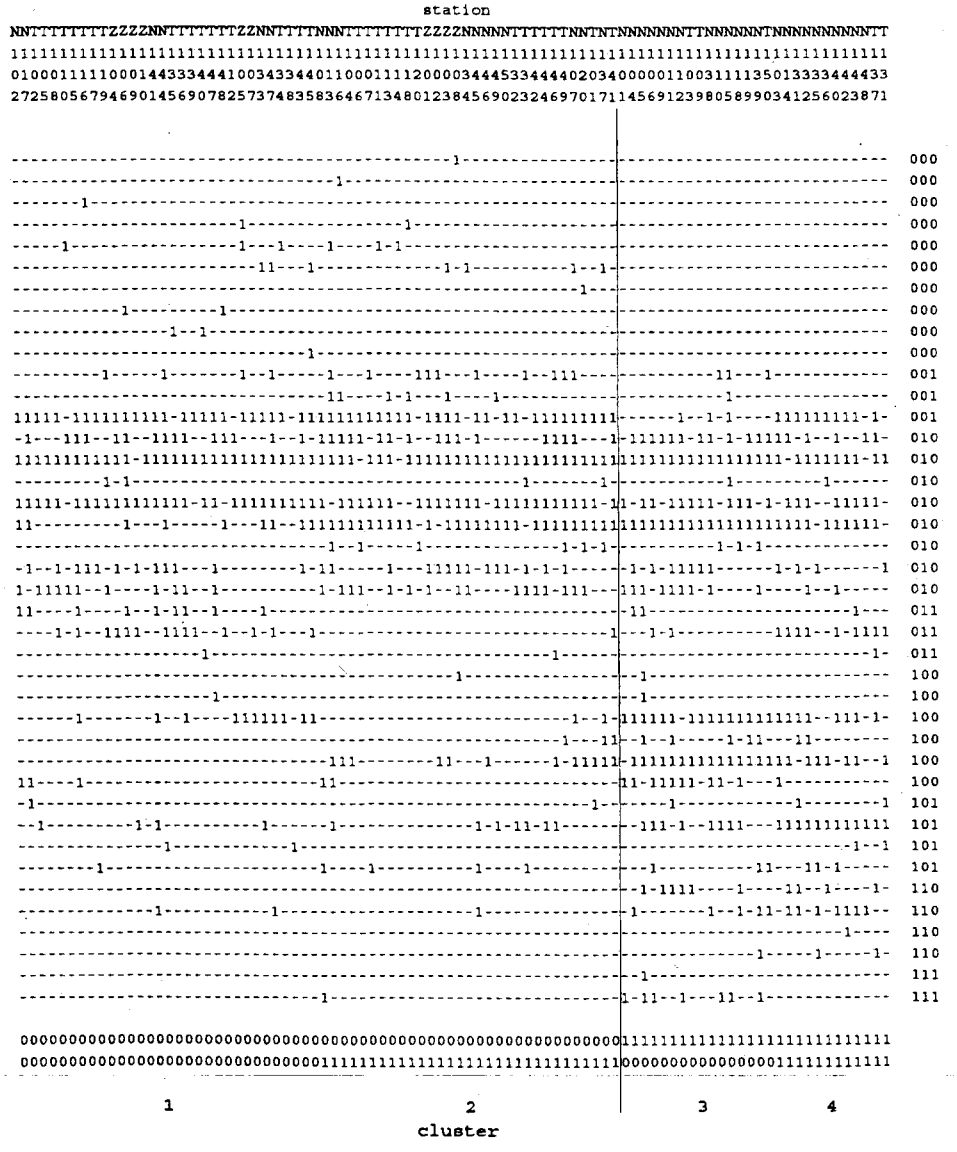

Appendix 10. Map showing the location of the stations and the TWINSPAN cluster they belong to in the nourishment area and the reference area (presence/ absence analysis). T1 survey (April 1994).