MINISTRY OF MIDDLE CLASSES AND AGRICULTURE

Centre for Agricultural Research Gent

FISHERIES RESEARCH STATION OOSTENDE

Environmental Impact Study in the framework of the construction of the INTERCONNECTOR gas pipeline on the Belgian Continental Shelf

First report : period prior to pipe laying (spring 1997)

Report - October 1997

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CONTENTS

SUMMARY

In spring 1997, samples were taken along the trajectory of the Interconnector gas pipeline in the Belgian coastal waters of the North Sea, in order to establish the environmental impact of such an installation on the benthic and fish communities in the area.

Density and species composition of the macro- and epibenthos as well as the fish populations have been studied. Furthermore sediment characteristics were determined for each sampled station.

In total 73 macrobenthos species were found, half of them polychaetes, with an average density of 247 ind./m^2. A comparison was made with similar studies showing an impoverished macrobenthos population. Based on a cluster analysis, by means of TWINSPAN ordination, of the macrofauna communities, five clusters were distinguished.

The epibenthos communities ranged from 302 ind./10^5m^2 to 24.246 ind./10^5m^2 and were dominated by *Ophiura* species (brittle stars), with very high densities near and in the vicinity of the Belgian Sand Banks. Density and biomass values indicated a decrease along the pipeline track from the coastal stations towards the open sea.

The fish densities ranged from 975 ind./10^5m^2 to 5409 ind./10^5m^2. The most common ones were dab (*Limanda limanda*) and whiting (*Merlangius merlangus*).

A significant gradient in median grain size was recorded from the coastal area to the open sea. The stations near the coast were characterised by a low median grain size, while the highest values were noted at the offshore stations.

This first report is to be considered as a basis for later comparison with results from the two following surveys, which will be carried out after the completion of the works, i.e. in the fall of 1997 and one year later.

1. INTRODUCTION

In compliance with the Oslo and Paris Conventions the Fisheries Research Station evaluates the quality of the marine environment and the possible harmful effects of the laying of pipelines, dumping of dredge spoils and sand extraction.

This research includes biological, granulometric and chemical studies. Three periods of sampling will be carried out: before, during and after the execution of the INTERCONNECTOR project. In addition underwater TV video recordings will take place to monitor the position and the condition of the pipe. The end of the research is scheduled for 1998.

This first of three reports presents the results of :

- the first survey, done in spring 1997, of the biotic environment along the trajectory of the planned pipeline, before the installation
- previous campaigns ('94-'97), done in the framework of the ongoing biomonitoring projects.

2. MATERIAL AND METHODS

All sampling programmes are carried out on board of the Belgian oceanographic research vessel A.962 'R.V. BELGICA' and the training vessel "O29- Broodwinner". The grids of the sampling cruises are shown in Figures 1-3. The geographical positions, the sampling periods and the type of area of the sampling stations are summarised in Tables 1-2.

2.1. Description of the study area

Compared to other oceans, the North Sea is very shallow, the average depth being about 60 metres, at some places only 20 metres. Because of the shallowness, the marine fauna and flora are very abundant, whereas there is a relatively small volume of water. The flow of nutrients combined with good spawning grounds have made the North Sea into a rich fishing area. Whereas the North Sea covers less than 0.2 per cent of the world's oceans, as much as 4.3 per cent of the world's total fish catches comes from there. The North Sea has also the busiest marine traffic in the world, and many of Europe's major ports are located around it. Therefore it is very vulnerable to all sorts of pollution. Tidal currents on one hand and oceanic currents on the other however, create a constant flushing of water and result into a circulation along the different coasts of the countries that surround it. The flushing time of the sea water varies from six months to three years for the different parts of the North Sea. These tidal currents are also responsible for the present geomorphology of the region (Sætevik, 1988).

In the framework of the installation of a gas pipeline that crosses the Southern Bight of the North Sea - from Bacton (UK) to Zeebrugge (B) - a large area along the planned trajectory is sampled. This survey confines itself to that part of the pipeline that currently is being laid on the bottom of the Belgian Continental Shelf. As shown in Figures 1-3, the pipeline passes also several sandbanks (Bligh Bank, Thornton Bank and Wenduine Bank), before reaching its final destination, the Zeebrugge terminal. At some places (e.g. at the crossing of the shipping lane near the western Scheur) the pipeline will be buried and stabilised in the bottom. Most of the time however it will be laid on a preswept sea floor bed.

2.2. Sampling and sorting

2.2.1. Macrobenthos : (Fig. 1)

Ten sites (H4-H8, 435, 700, 710, 780 and 140) along the pipeline trajectory were chosen for monitoring, on each site, 4 replicates were taken for macrobenthic analysis. All sampling was done during spring 1997. In order to compare this data with other macrobenthic data, 4 reference stations were considered (120, 315, ZG02 and 330). These stations are scattered all over the Belgian Continental Shelf.

Twice a year—once in spring and once in autumn—ten replicate samples of each station are analysed in the framework of a biomonitoring project. In the present survey we only consider the ones taken in spring '97.

Van Veen grabs are used at all these sampling stations with a surface sample of 0.1 m^2. The samples are stored in individual recipients and preserved in a 10% formaldehyde-seawater solution. In the laboratory the sediment is washed through a 1 mm sieve to collect the macrobenthic fauna. After sieving, the residue of the macrobenthos is stained with 0.1% eosin to facilitate subsequent sorting by microscope and identification to species level.

Total number per species, diversity and dominance are determined.

2.2.2. Epibenthos : (Fig. 2)

Fourteen sites on the Belgian Continental Shelf, of which 10 (H4-H8, 435, 340, 140, 710 and 780) lay in the vicinity of the pipeline, have been chosen as additional samples, investigating the changes in epibenthic population. Stations 120, 215, 315 and ZG02 are considered as reference.

Therefore a small meshed 8 meter beam trawl with a 22 mm mesh size at the cod-end is used. The hauls take about 30 minutes. Automatic data acquisition of the ship's position enables the exact swept surface to be calculated. For comparison, all data are then converted to a reference surface of 10^5 m^2.

A representative sub-sample of 6 l is taken after determination of the total volume of the catch. Samples are deep frozen at -18°C on board and later sorted and identified in the laboratory. Total number per species, biomass and diversity are determined.

2.2.3. Fish : (Fig. 3)

A total of 14 stations are sampled in the context of this pipeline project. Ten of these lay along the trajectory or in its near vicinity, while the others are scattered over the Belgian Continental Shelf (cfr. Epibenthos).

Another 12 stations (sampled during the period '94-'96, with the training vessel "029-Broodwinner") were considered in order to compare both data sets in the same area. And finally, the fish catches from August 1996, done with the oceanographic research vessel Belgica, are also included in this study.

An 8 meter and/or a 4 meter beam trawl with respectively 20 mm and 40 mm mesh size in the cod-end is used. The duration of each haul is 30 minutes, with a velocity of 4 knots. All data are converted to a reference surface of 10^5 m^2. Total number per species, diversity and length distribution are measured.

2.3. Mathematical analysis

2.3.1. Diversity :

Beside the species density (ind./10^5 m^2), the diversity of the benthic communities is calculated.

Diversity is a measure that takes into account the number of species and the relative abundance of those species. It is a parameter that characterises interspecific relationships, stability of the community and the complexity of the environment.

The diversity is represented by three variables:

- species richness (i.e. the number of species per sample)
- Shannon-Wiener index
- Simpson's index for dominance

Shannon-Wiener's diversity index (H') is calculated as follows:

$$H' = -\sum_{i=1}^{s} \frac{n_i}{N} \times \log_2\left(\frac{n_i}{N}\right)$$

with n_i = number of individuals of species I

N = total number of individuals

s = number of species

A high H' indicates a rich and diverse community.

Simpson's dominance index (SI) is calculated as follows:

$$SI = \sum_{i=1}^{s}\left(\frac{n_i}{N}\right)^2$$

with n_i = number of individuals of species I

N = total number of individuals

s = number of species

A high SI-value indicates a low diversity with one or more species being very dominant in the community.

2.4. Sediment analysis

The sediment sampling scheme exists of one Van Veen grab per site, stored in individual recipients and deep frozen at -18°C. The equipment used is a modified Van Veen grab with a weight of about 50 kg taking a surface sample of 0.1 m^2. The grab has heavier arms with improved level action. Gravel and mud content are measured by sieving the sediment through a 2000 µm (dry sieving) and a 63 µm sieve (wet sieving). After elimination of the gravel and mud, approximately 20 g of the remaining sediment is divided into fractions, using Buchanan and Kain's method (1971) and classified according to the Wentworth (1992) scale. Total organic carbon content (TOC) is determined by loss of weight on ignition at 450°C (Walkley and Black, 1934; J.M.G., 1981) and carbonate ($CaCO_3$) by loss of weight (CO_2) at 1050°C (J.M.G., 1981). Interstitial water content is calculated by subtracting the weight after drying the sample at 100°C, from the weight of the wet sample.

Wentworth scale :

Phi	Med. grainsize in µm	description
-1 - 0	1000-2000	very coarse sand
0 - 1	500-1000	coarse sand
1 - 2	250-500	medium coarse sand
2 - 3	125-250	fine sand
3 - 4	62.5-125	very fine sand
< 4	<62.5	silt

Sediment samples are taken only at the macrobenthic sampling stations.

3. RESULTS

Next to the data, retrieved from the sampling sites along the pipeline trajectory, we also used data sets from other sampling stations (120, 215, 315 and ZG02), scattered over the Belgian Continental Shelf, as reference. This enables us to compare both areas and observe possible changes in the environment in a more detailed way.

3.1. Sediment

The results of the TOC, $CaCO_3$ and interstitial H_2O content for spring '97 are not yet available. However, they will be presented later in a supplemental addition to this report.

Table 3. : Sediment characteristics of sampling stations along the pipeline.

Station	reference	Med. gr.	Med. gr. (µm)	grain fraction						
		(phi)	(µm)	>2000µm	<2000µm	<1000µm	<500µm	<250µm	<125µm	<63µm
H4	Pipeline	1.70	306.9	16.45	3.24	3.59	37.96	33.68	2.06	3.02
H5	Pipeline	1.65	317.9	1.55	1.81	4.21	64.96	25.81	0.63	1.04
H6	Pipeline	1.72	304.5	0.41	0.34	2.00	66.05	29.67	0.47	1.07
H7	Pipeline	1.46	363.8	0.44	0.25	15.71	73.25	9.18	0.26	0.92
H8	Pipeline	1.19	437.9	5.09	4.10	29.58	58.65	1.60	0.07	0.90
700	Zeebrugge	3.72	76.1	0.56	1.02	5.10	9.49	23.27	14.75	45.81
710	Loswal S2	2.49	177.5	0.02	0.02	0.05	4.84	91.17	2.97	0.93
780	Loswal S1	2.64	160.1	0.50	0.35	0.78	2.33	71.65	16.05	8.34
435	Bligh Bank	1.44	369.7	19.78	1.72	3.40	57.61	16.50	0.26	0.73

Nearly all sampled stations along the pipeline (H4-H8) are characterised by a sediment with phi values between 1-2, and a median grain size varying between 305 and 438. The stations nearest to the coast (700, 710 and 780) tend to have a finer substrate, dominated by fine and very fine sand fractions. Exceptions are stations 435 and H4 with a large fraction of gravel (respectively 20% and 16%) and station 700 with a considerable mud fraction (46%), this latter is normally characterised by an abundant fauna (Fig. 4).

Furthermore we notice a significant gradient in median grain size from the coastal area to the open sea. The sampled sites in the coastal area are characterised by a low median grain size, while the highest values are recorded at the offshore stations.

3.2. Macrobenthos

Benthos comprises all organisms living on or in the sediment. The term macrobenthos as used in this study, refers to the animal fraction of the benthos larger than 1 mm and living on or in the sediment. They represent a major component in the trofic organisation of the marine environment, as food for the epibenthic- and demersal fishcommunities. The major faunistic groups represented in these samples are bristle worms (Polychaeta), crustaceans (mostly sea hoppers, Amphipoda; opossum shrimps, Mysidacea; and cumaceans, Cumacea), molluscs (particularly bivalves, Bivalvia; and sea snails, Gastropoda) and echinoderms (particularly brittle stars, Ophiuroidea; and sea urchins, Echinoidea) (Fig. 5).

3.2.1. Density :

Densities of the macrofauna, taken in spring 1997 along the pipeline track, range from 103.3 ind./m² (710) to 523.3 ind./m² (H4). The mean value is 247 ind./m². In 1997 most of the sampling stations (8) are dominated by polychaetes (> 50% of the population). The most common ones are the species from the genus *Nephtys* (*N. cirrosa, N. hombergii* and *N.* species). In H5 however a dominance of crustaceans, mainly amphipods (*Bathyporeia* species, *Urothoe brevicornis* and *Pariambus typicus*) is recorded.

In the reference stations, densities vary between 46.7 ind./m² (140) and 563.3 ind./m² (315). Similar to the pipeline stations there is a clear dominance of polychaetes (*Nephtys cirrosa, N. hombergii* and *N.* spec.), except in station 120, where the bivalve *Spisula subtruncata* reaches almost 60% of the entire population.

A comparison of fauna densities from previous years ('94-'96) show in some of the stations (710, 780, 140 and 435) a downward tendency in the macrobenthic populations. However in station 700 a significant increase is noticed due to the presence of the polychaete, *Chaetozone setosa* and the molluscs *Macoma baltica* and *Petricola pholadiformis*.

In the following reports a more elaborate assessment of the macrobenthic densities near the pipeline and on the Belgian Continental Shelf will be given.

All basic data are listed in Tables 4-6 and Figures 6 & 7.

General considerations:

Densities of macrobenthos from different sampling sites are generally low. Holtmann et all (1995) found in the coastal area and offshore areas on the Dutch Continental Shelf between 321.9 ind./m² and 19.033 ind./m². Vanosmael & Heip (1985) recorded around three Belgian sandbanks from 37 to 3337 ind./m². The number of species inhabiting a soft substrate is considered to depend on median grain size of the sand fraction, sorting efficiency and the silt content of the sediment (Warwick & Buchanan, 1970). With increasing median grain size the interstitial space becomes larger and more varied.

Nearly all stations along the pipeline trajectory (except for 700, 710 & 780) have sediments with a median grain size above 300 µm. Interstitial polychates become very abundant above this grain size, although they occur in finer sediments as well. In this study this is not the case.

Besides a few *Hesionura augeneri* species in H7 and H8, no other interstitial polychates are found. It is however possible that by using a 1 mm sieve a lot of material is lost. But even then densities are still low in comparison with other studies. It is also known that the temperate macrobenthic communities in Europe shallow waters are characterised by strong seasonal oscillations of most species (Arntz, 1981). Very cold winters may have a disastrous effect on the macrobenthos, and surprisingly species living in deeper water are the more effected (Arntz et all, 1976; Rumohr et all in prep.). Especially temperature and O_2 content are the limiting factors.

On the other hand predation by demersal fish causes also very high mortality for some species. And last but not least, the direct effects of beam trawling on macrofauna in a sandy sediment results in a decrease in density (10-60%) of a number of species of echinoderms, polychaetes and molluscs (Bergmann & Hup, 1992).

3.2.2. Diversity :

A total of 73 species are found during spring 1997. The mean values of the Shannon-Wiener diversity index are highest at the stations along the trajectory of the planned pipeline (Fig. 6 ; Tab. 4). A comparison of the diversity at the different stations with values from 1994-1996, reveals that there are some substantial differences between the years at a number of stations, but there is no consistent trend.

3.2.3. Patterns in fauna composition :

A classification of the 14 stations investigated, based on their fauna composition (species specific abundancies), is carried out by means of TWINSPAN ordination (Hill, 1979). The results of the analysis are presented in Figs.19 & 19bis.

Five clusters are distinguished. At the first division-level 6 stations (700, 710, 780, 120, 140 & H4) are split from the rest. The second division resulted in another split where the coastal stations (120, 140, 700 & 710) are separated from stations 780 and H4. Indicator species for the consecutive divisions are respectively *Nephtys hombergii* and *Abra alba.*

On the other side of the classification (-), the second division causes a split into two clusters. One containing stations H5 and H6, the other 435, H7, H8 and the three other sandbank stations (ZG02, 315 & 330) And finally the last split divides the latter in the last two clusters. The different indicator species are shown in Fig. 19.

3.3. Epibenthos

The term epibenthos as used in this study, refers to the animal fraction of the large benthos living on the sediment. The major faunistic groups represented in these samples are sea anemones (Anthozoa), crustaceans (particularly crabs, Brachyura; hermit crabs, Paguridae; shrimps and prawns, Caridea), molluscs (mostly sea snails, Gastropoda; squid and cuttlefish, Cephalopoda), and echinoderms (mostly brittle stars, Ophiuroidea; and starfish, Asteroidea) (Fig. 8).

This study aims at gathering qualitative data on the epibenthic fauna which can be correlated with quantitative data obtained by the macrobenthos and sediment sampling programmes. Time trends on presence/absence and relative abundance are also investigated.

3.3.1. Density : (Fig. 9 ; Tables 7 & 8)

The total abundance of the epibenthos population along the Interconnector pipeline ranges from 302 ind./10^5m^2 in H6 to 24.246 ind./10^5m^2 in 780. There is a tendency of decrease in density along the trajectory towards the open sea.

The most common species are *Ophiura* species (brittle stars); *Asterias rubens* (starfish); *Liocarcinus holsatus*) (flying crab) ; *Pagurus bernhardus* (hermit crab) ; *Anthozoa* species (sea anemones) and *Crangon crangon* (shrimp).

Their relative densities (in %) are shown in Fig. 11.

Most of the epibenthic communities are dominated by the echinoderms *Ophiura* species and *Asterias rubens*. High densities are found near or in the vicinity of sandbanks (340, H4, H5, 215, 315 & ZG02). However, their maximums are reached in station 780 (respectively 19533 and 282 ind./10^5m^2). The *Ophiura* species are considered to be the most successful group of living echinoderms ; they attribute this success in part to their motility, small size, and ability to utilize the protective cover of crevices, holes spaces beneath stones, and other natural retreats. Also *Asterias rubens* is a common known echinoderm species in our coastal waters. It lives mainly on sandy or muddy bottoms. Densities vary from 11 ind./10^5m^2 in H8 up to 430 ind./10^5m^2 in ZG02.

Other important species that are regularly caught are the crustaceans *Liocarcinus holsatus* and *Pagurus bernhardus*. The scavenging hermit crabs reach their highest number in the offshore stations (H7 & H8). Unlike the crabs, which tend to favour the dumping sites (710 & 780) and the sandbanks near the coast (315 & ZG02). *Liocarcinus holsatus* prefers clean sands to bury themselves in (Verwey, 1978). It is not remarkable that the highest concentrations are found near the coast, because this crab species has the tendency of migrating every year from deeper water to the littoral zone as result of changing salinity/water temperature ratios (Adema, 1991).

By comparing the pipeline area with the reference area, we notice similar epibenthic communities, both clearly dominated by the *Ophiura* species (respectively 76% and 82%). The *Anthozoa* species are the second most common species (8%) in the pipeline area, while *Asterias rubens* species (8%) are in the reference area.

3.3.2. Biomass : (Figs. 10 & 12 ; Tables 9 & 10)

Although the starfish are nearly always outnumbered by the *Ophiura* species, their biomass is still considerably higher (ca. 50% of the entire epibenthos population).

In both areas (pipeline and reference) we note a similar biomass distribution among the epibenthic community. Similar as in densities there is a tendency in biomass decrease in the pipeline area from the coastal stations towards the offshore sampling sites. The highest biomass values are recorded in station 780 (67.512 $g/10^5m^2$), the lowest in station 140 (620 $g/10^5m^2$).

3.3.3. Diversity : (Fig. 9)

A total of 18 epibenthos species are found in spring 1997 at the different sampling stations along the trajectory. The Shannon-Wiener diversity index varies from 0.21 (710) to 1.95 (H6).

These values seem very low in comparison with the macrobenthos diversity (mean diversity = 2.88). A high density however does not necessarily correspond with a high diversity. The community is often dominated by one species and a fall of the diversity is the result.

3.4. Fish

3.4.1. Density : (Tables 11 & 12 ; Fig. 13)

In spring 1997 the total density of the sampling sites along the pipeline varies between 975 ind./10^5 m^2 (station 780) and 5409 ind./10^5 m^2 (station H4). The total amount of fish caught equals 21.865 ind./10^5m^2. The most common ones are dab (*Limanda limanda*) (9275 ind./10^5m^2), whiting (*Merlangius merlangus*) (3340 ind./10^5m^2), lesser weever (*Trachurus vipera*) (3516 ind./10^5m^2), and cod (*Gadus morhua*) (1032 ind./10^5m^2). Practically all stations are dominated by either one or several of these species.

General information (e.g. habitat, size, reproduction, food, etc.) of the commercial and the most common caught fish species on the Belgian Continental Shelf is given in the appendix .

Length-frequency figures of the commercial fish species are shown in Figs. 14 and 15.

The dab population, in spring 1997, is clearly separated into a juvenile (around 8 cm, with a max. of 926 ind./10^5m^2) and a semi-adult fraction (around 18 cm, with a max. of 1110 ind./10^5m^2). This phenomenon is also visible in the plaice and cod communities. The whiting population however lacks a clear distinction between the juvenile and the adult population. Whereas in the common sole catches, there is a considerable juvenile fraction present but practically no adults. Their highest densities are found in the littoral zone, especially near stations 710 and 780.

In comparison with the reference zone, there are a lot of similarities recorded. The commercial fish populations show in general the same structure. The difference in mean abundancy is due to the fact that in the reference zone only five sites are sampled. (the highest density is measured in 120 with 5226 ind./10^5m^2.

3.4.2. Diversity and dominance : (Fig. 13 ; Tables 11 & 12)

A total of 28 species are found at the different sampling sites. The diversity index of the pipeline stations ranges from 1.38 (in H4) to 3.03 (in 780). Station H4 is characterised by a high dominance of dab (*Limanda limanda*) (3915 ind./10^5m^2) what keeps the diversity value low, although the amount of species is the same as in 780.

The fish communities in the reference zones have comparable diversities and dominances. In 215, 315 and ZG02 there is also a clear dominance of dab (*Limanda limanda*) noticeable. The other sites have a more stable community in which the different species are more or less equally divided.

3.4.3. Results of earlier fish campaigns in 1996 : (Figs. 16 & 17 ; Tables 13 & 14)

(1) 0.29 Broodwinner (period '94-'96):

Twelve stations are sampled, with a 18 mm meshed bottom trawl, situated along the Belgian coast in the neighbourhood of the Interconnector pipeline.

Fish data of catches near to the pipeline, during the period '94-'96 for commercial fish only, show no significant trends in fish stock density.

But as fish has the ability of moving around in very short periods, it makes it very difficult to make accurate assumptions on fish stock at particular sampling stations. Only the total catches of the whole sampling area are taken in account to asses the present fish communities.

In relation to the previous, we can conclude that for that particular area, 1995 was a bad year for catching flatfish in comparison with 1994, but that in 1996 a recovery is noted and a firm community of flatfish and whiting is established (13.591 ind./10^5m^2).

A comparison of the total densities (juveniles & adults) of commercial fish caught in the area along the pipeline and the area sampled with Broodwinner (in '96) reveals a great similarity between both areas. Although the number of sampled pipeline stations is less than those of the Broodwinner campaign, they reach comparable densities, respectively 14.968 ind./10^5m^2 and 13.591 ind./10^5m^2.

Totals of the fish densities are shown in Table 13 and Figs. 16 & 17 Their length-frequency distribution is shown in Table 14.

(2) A.962 Belgica (period august 1996) :

Ten sites are sampled, with a 40 mm meshed bottom trawl, scattered all over the Belgian Continental Shelf.

Table 16. Sampling positions Fish (A.962 "R.V. Belgica ")

STATION	POSITION SHOT		AREA
1	51°24' 07"	2°31' 37"	Westhinder
2	51°38' 73"	2°44' 78"	Oosthinder
36	51°27' 78"	2°20' 66"	Fairy-Bank
37	51°22' 70"	2°10' 93"	Fairy-Bank
39	51°17' 80"	2°20' 49"	Oostdyck
40a	51°21' 14"	2°55' 45"	Wenduine Bank
P1	51°34' 02"	2°45' 54"	Bligh-Bank
P2	51°27' 44"	2°43' 16"	Goote Bank
P3	51°23' 26"	2°30' 36"	Oostdyck

Due to the usage of a net with bigger mesh size, the fish densities are considerably lower in comparison with the Broodwinner campaigns of '96. Here, only the fish with an admissible commercial length are caught.

The total densities per sampled station vary from 17 ind./10^5m^2 (in 40a) to 163 ind./10^5m^2 (in 86). All samples are dominated by the commercial important species: dab (*Limanda limanda*), common sole (*Solea solea*) and plaice (*Pleuronectes platessa*).

The diversity index ranges from 1.17 (40a) to 2.72 (P2). In station 40a only 3 species (common sole, flounder and plaice) are caught, whereas in station P2 11 different species are recorded (Fig. 18 & Table 15).

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Figures & Tables

Fig. 1. - INTERCONNECTOR - Positions of sampling stations for macrobenthos research

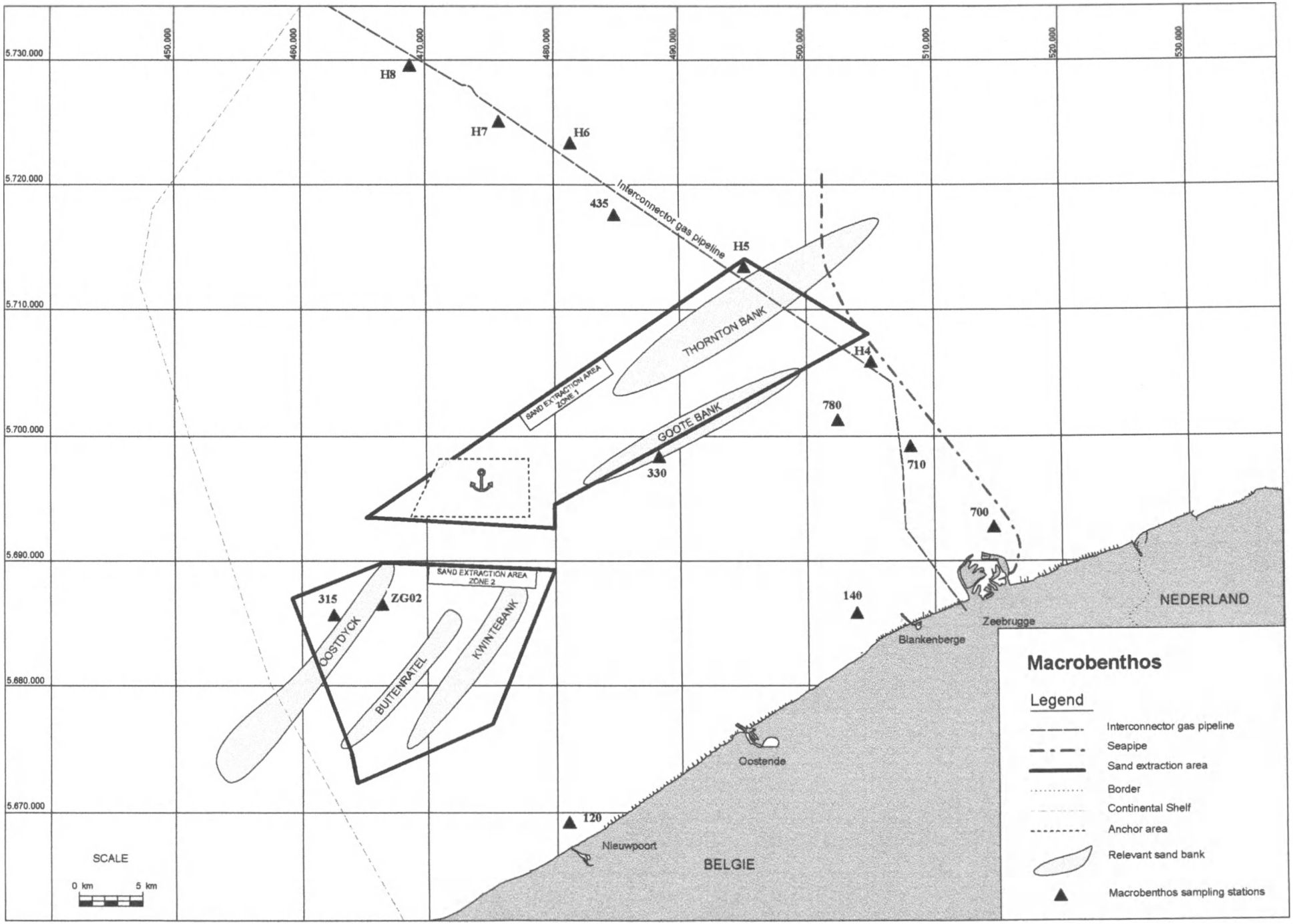


Fig. 2. - INTERCONNECTOR - Positions of sampling stations for epibenthos research

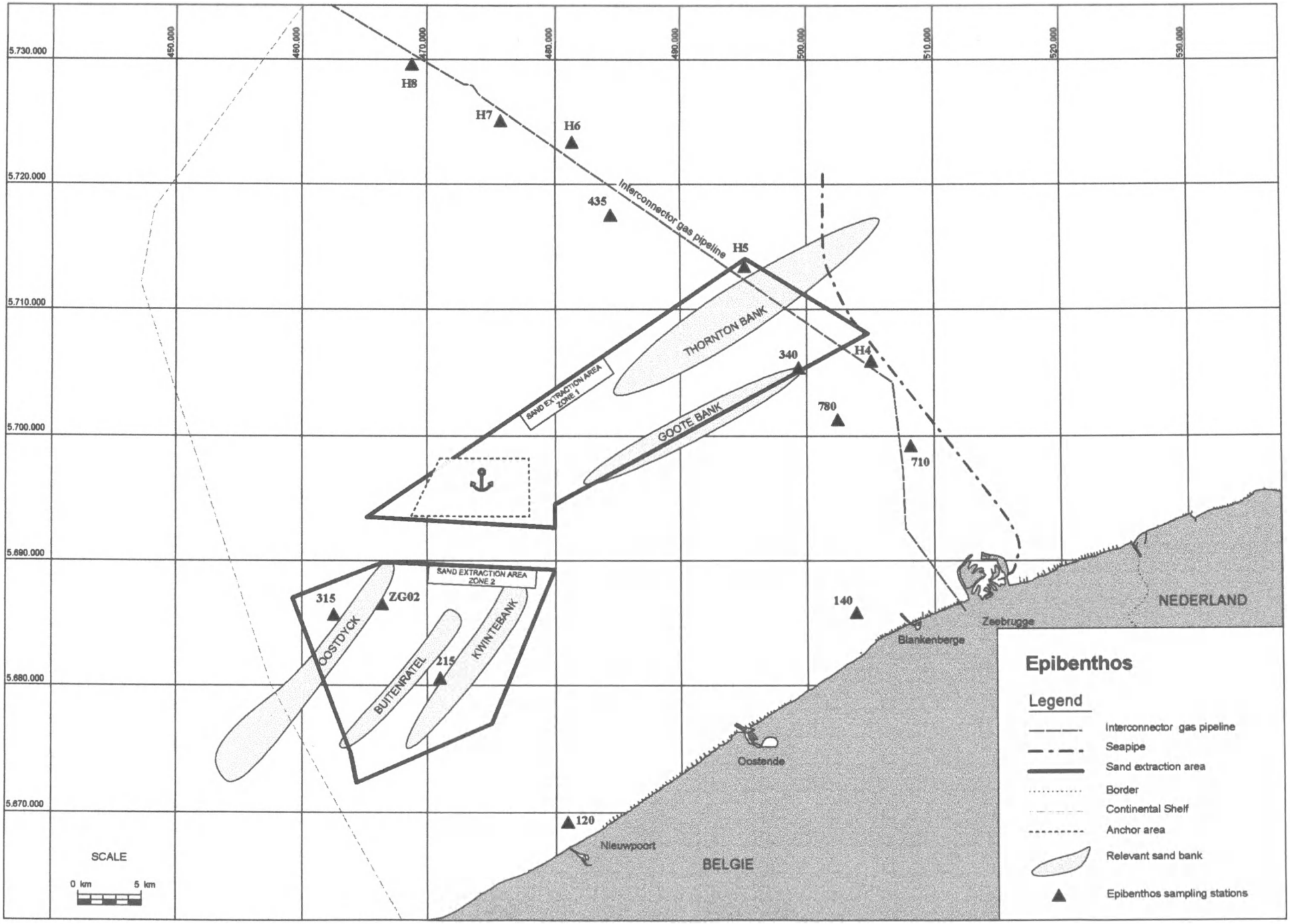


Fig. 3. - INTERCONNECTOR - Positions of sampling stations for fish research

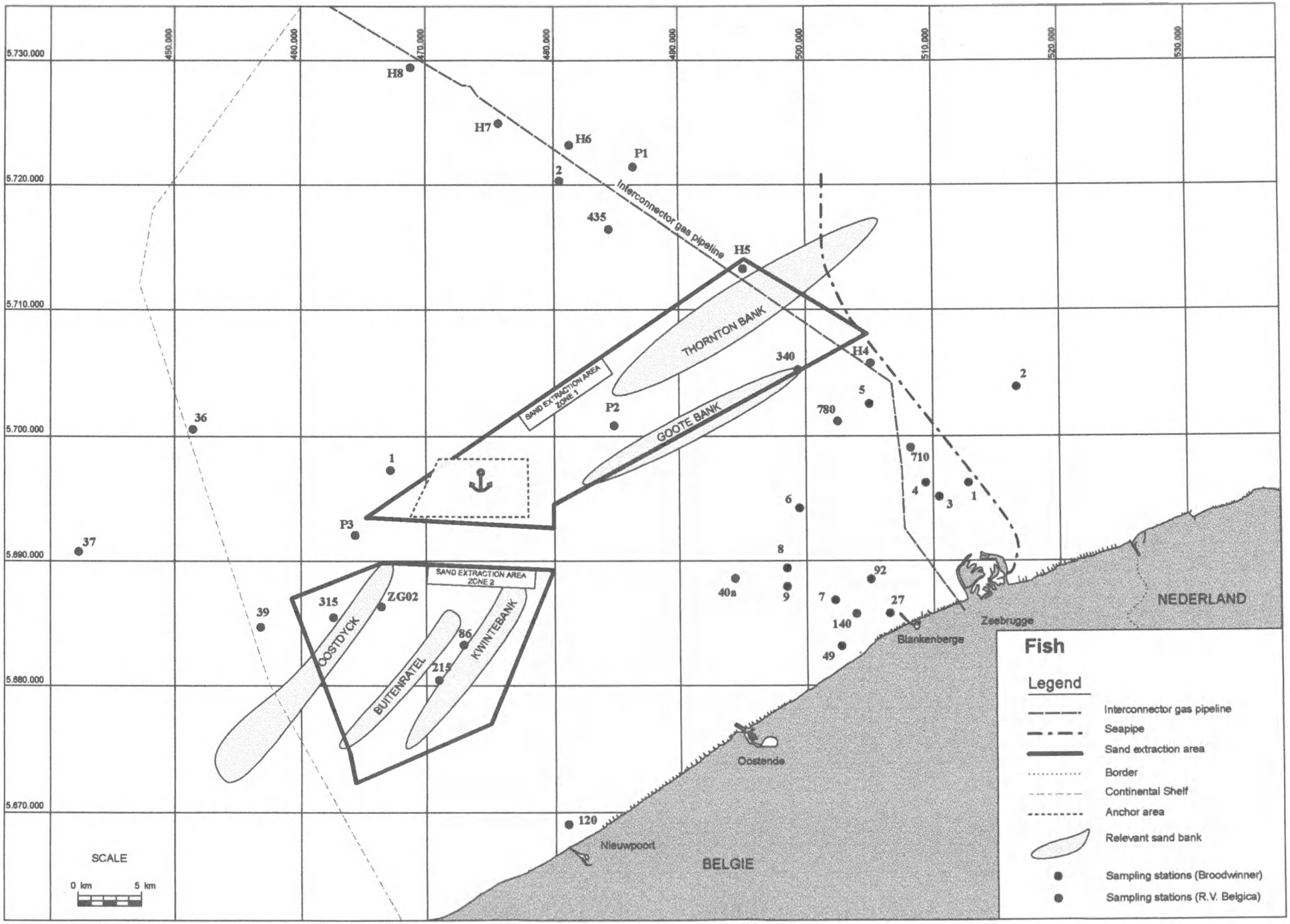


Table 1. : Sampling positions epi-and macrobenthos and fish (*) (Interconnector)

Ship : A.962 "R.V. Belgica"

STATION	POSITION SHOT		TYPE
H4*	51°30.00'	3°03.00'	Pipeline
H5*	51°34.00'	2°55.00'	Pipeline
H6*	51°40.00'	2°43.50'	Pipeline
H7*	51°42.50'	2°38.50'	Pipeline
H8*	51°45.00'	2°32.50'	Pipeline
120*	51°11.05'	2°42.15'	reference
140*	51°19.65'	3°03.05'	dredging
315*	51°19.35'	2°27.80'	reference
215*	51°16.75'	2°36.95'	reference
330	51°26.00'	2°48.50'	sand
340*	51°30.00'	3°00.10'	sand
435*	51°34.80'	2°47.40'	reference
700	51°22.60'	3°13.20'	
710*	51°26.00'	3°08.00'	dredging
780*	51°28.30'	3°03.55'	dredging
ZG02*	51°20.00'	2°30.00'	reference

Ship : 0.29 "Broodwinner"

STATION	POSITION SHOT	
1*	51°25'47"	3°12'21"
2*	51°29'17"	3°15'36"
3*	51°25'02"	3°09'17"
4*	51°25'83"	3°08'58"
5*	51°28'45"	3°03'43"
6*	51°23'86"	2°59'56"
7*	51°19'69"	3°01'51"
8*	51°21'45"	2°58'50"
9*	51°20'29"	2°57'64"
27*	51°18'88"	3°04'54"
49*	51°17'23"	3°07'32"
92*	51°20'62"	3°04'50"

Table 2. : Sampling periods (Interconnector)

Ship : A.962 "R.V. Belgica"

Station	macrobenthos	epibenthos	Fish
H4	Spring 1997	Spring 1997	Spring 1997
H5	Spring 1997	Spring 1997	Spring 1997
H6	Spring 1997	Spring 1997	Spring 1997
H7	Spring 1997	Spring 1997	Spring 1997
H8	Spring 1997	Spring 1997	Spring 1997
315	Spring 1997	Spring 1997	Spring 1997
215	-	Spring 1997	Spring 1997
340	-	Spring 1997	Spring 1997
ZG02	Spring 1997	Spring 1997	Spring 1997
120	Spring 1997	Spring 1997	Spring 1997
710	Spring '94-'97	Spring 1997	Spring 1997
780	Spring '94-'97	Spring 1997	Spring 1997
140	Spring '94-'97	Spring 1997	Spring 1997
435	Spring '94-'97	Spring 1997	Spring 1997
700	Spring '94-'97	-	-
330	Spring 1997	-	-

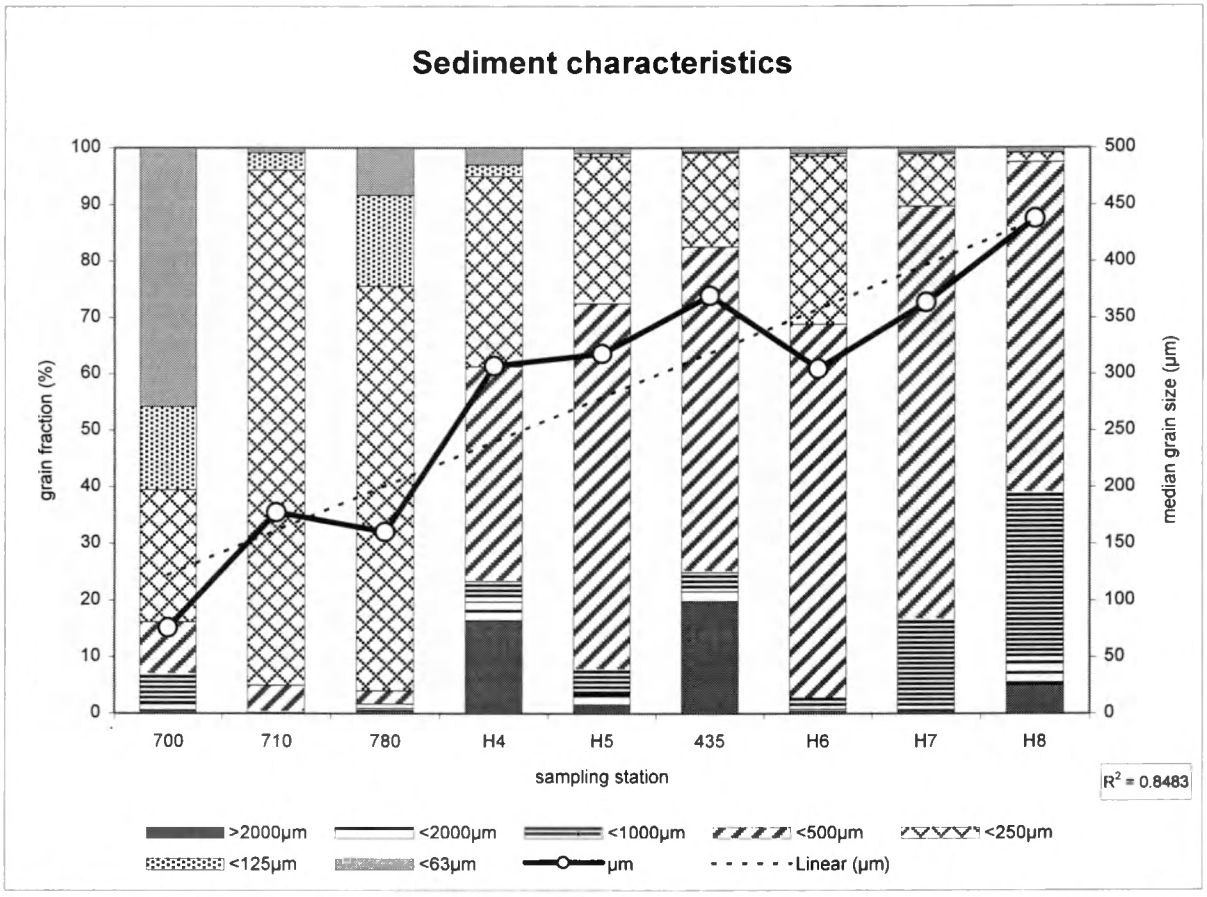
Ship : 0.29 "Broodwinner"

Station	Fish
1	1994-1996
2	1994-1996
3	1994-1996
4	1994-1996
5	1994-1996
6	1994-1996
7	1994-1996
8	1994-1996
9	1994-1996
27	1994-1996
49	1994-1996
92	1994-1996

Fig. 4. : Sediment characteristics Interconnector pipeline (spring 1997)

Wentworth scale

Phi	ed. grainsize in µm	description
-1 - 0	1000-2000	very coarse sand
0 - 1	500-1000	coarse sand
1 - 2	250-500	medium coarse sand
2 - 3	125-250	fine sand
3 - 4	62.5-125	very fine sand
< 4	<62.5	silt



Macrobenthos

Fig. 5. : the major faunistic groups of a macrobenthic community: (a) Polychaeta (bristle worms); (b) Crustacea: (b1) Amphipoda, (b2) Mysidacea and (b3) Cumacea; (c) Mollusca : (c1) bivalves and (c2) sea snails; (d) Echinodermata: (d1) brittle stars and (d2) sea urchins.

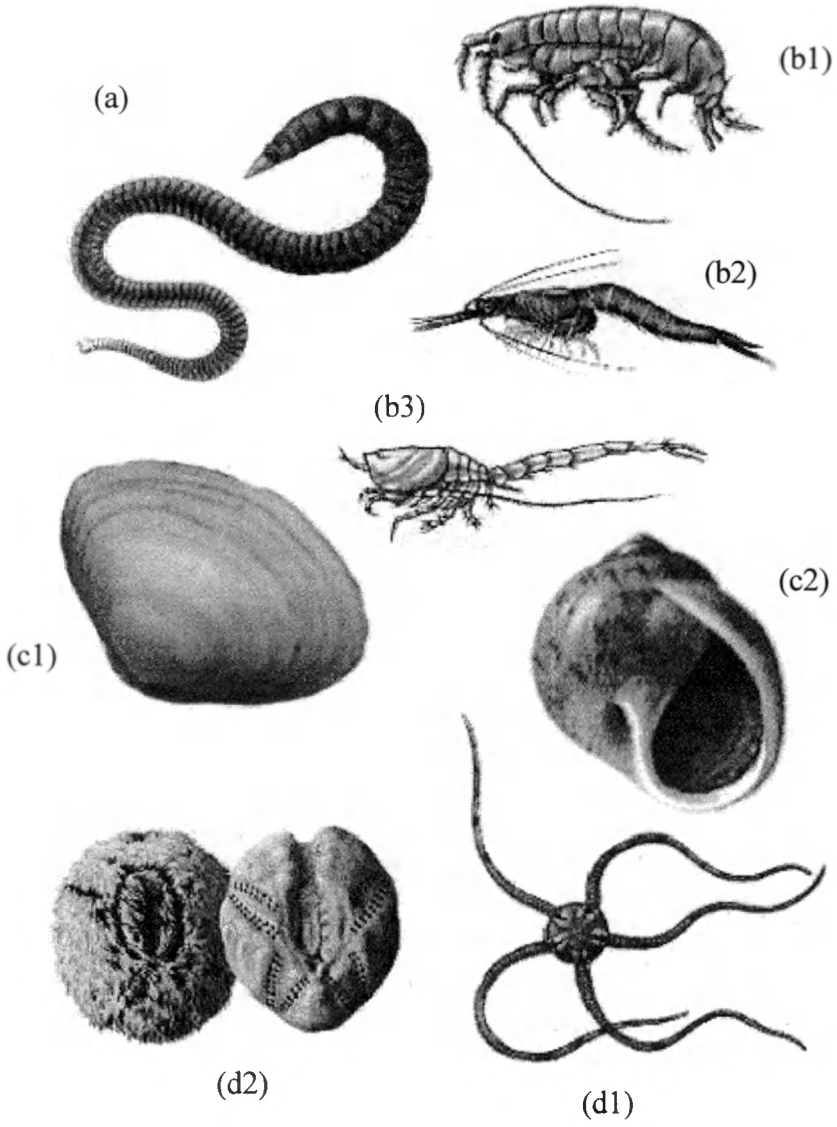
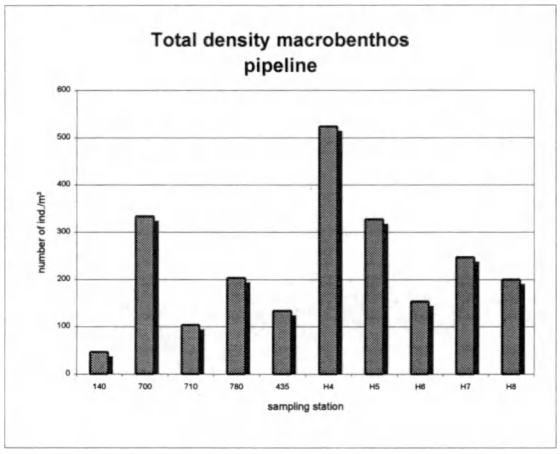
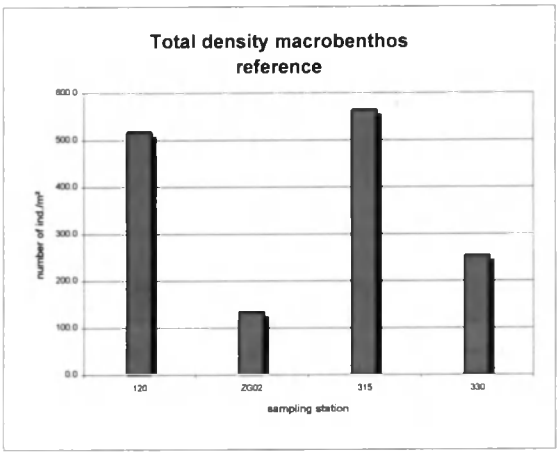
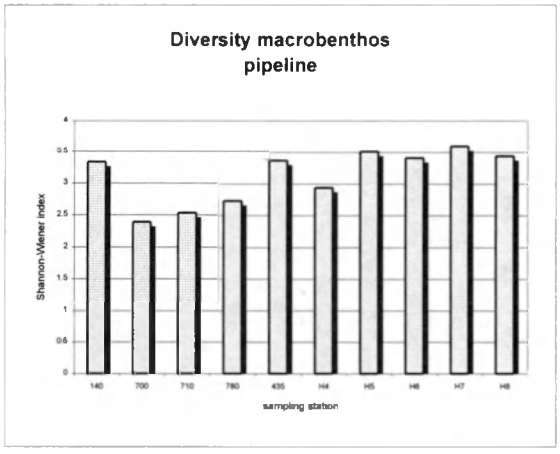
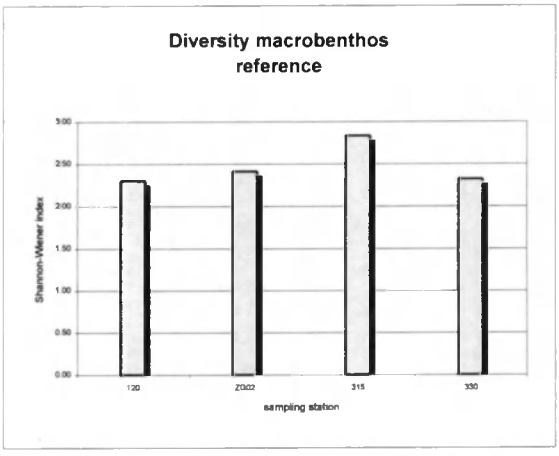


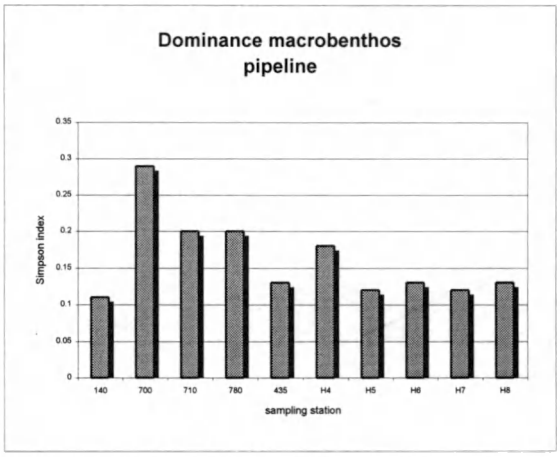
Fig. 6. : Total density, diversity and dominance of sampled macrobenthos stations along the pipeline and reference (spring 1997)











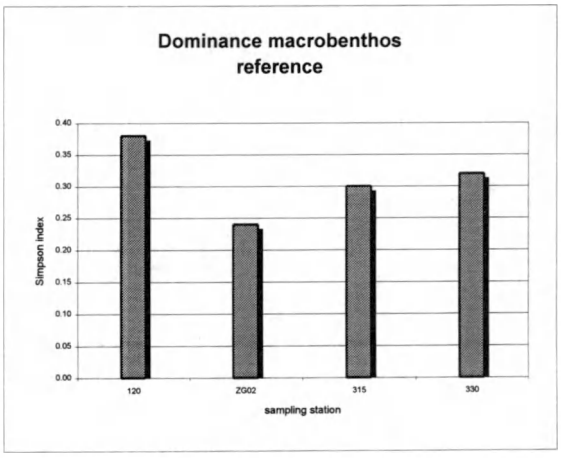
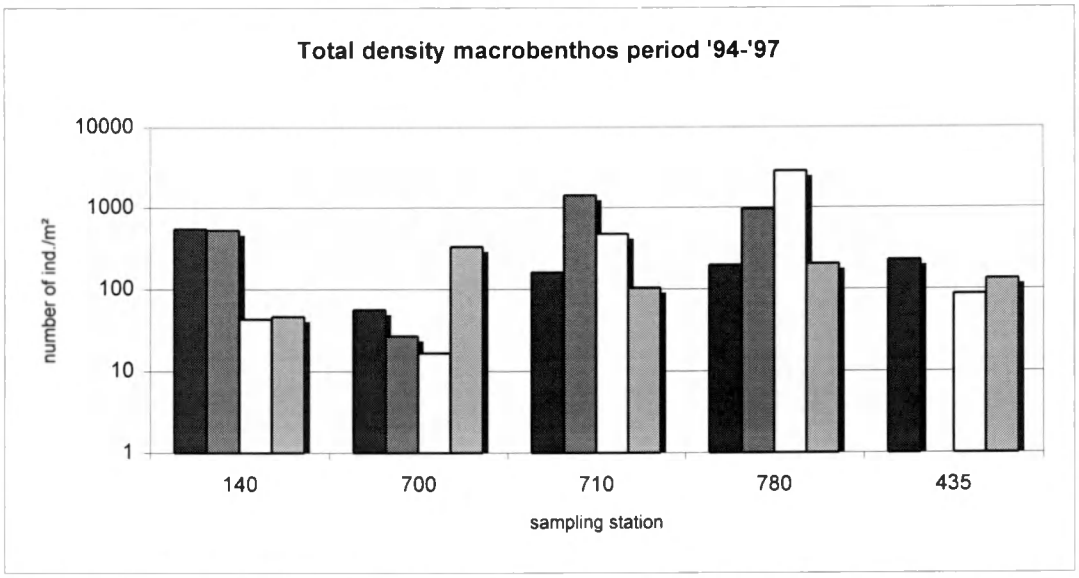
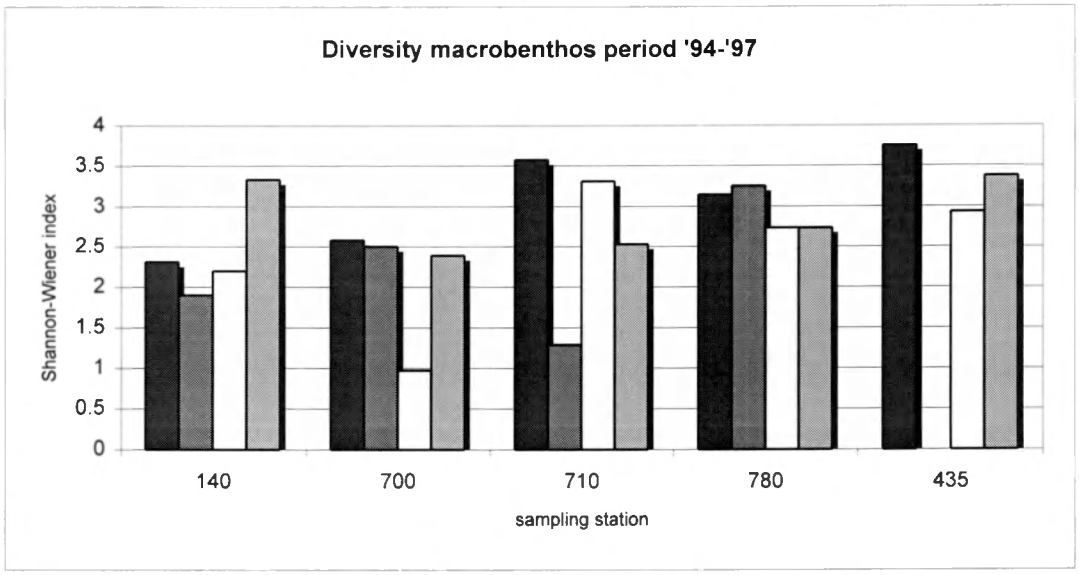


Fig. 7. : Diversity, dominance and total density of the macrobenthic communities (spring '94-'97)





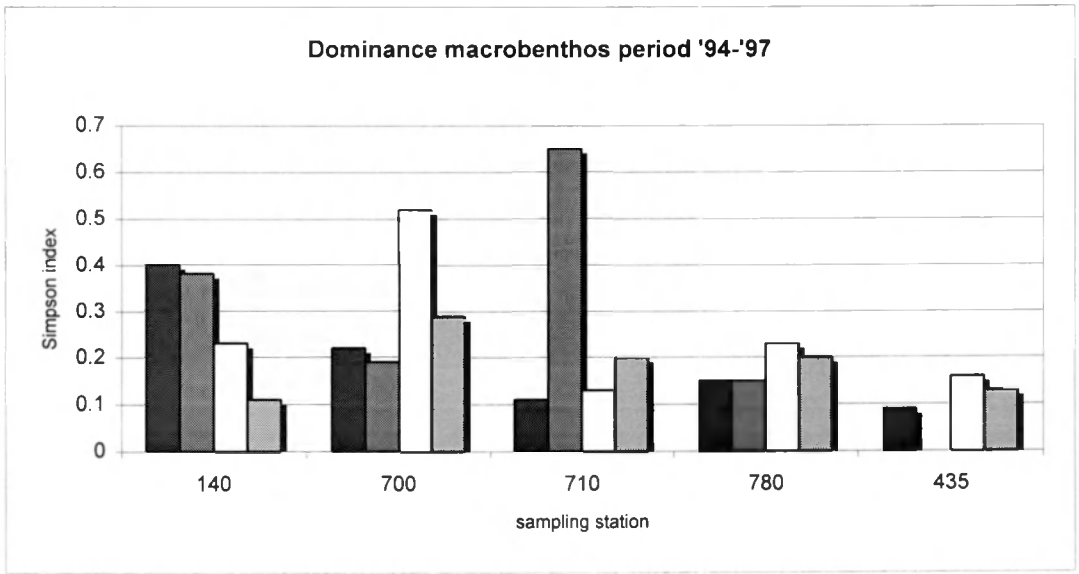


Fig. 19. Output of TWINSPAN analysis (cut levels 0, 1.40, 2.00 and 2.40)

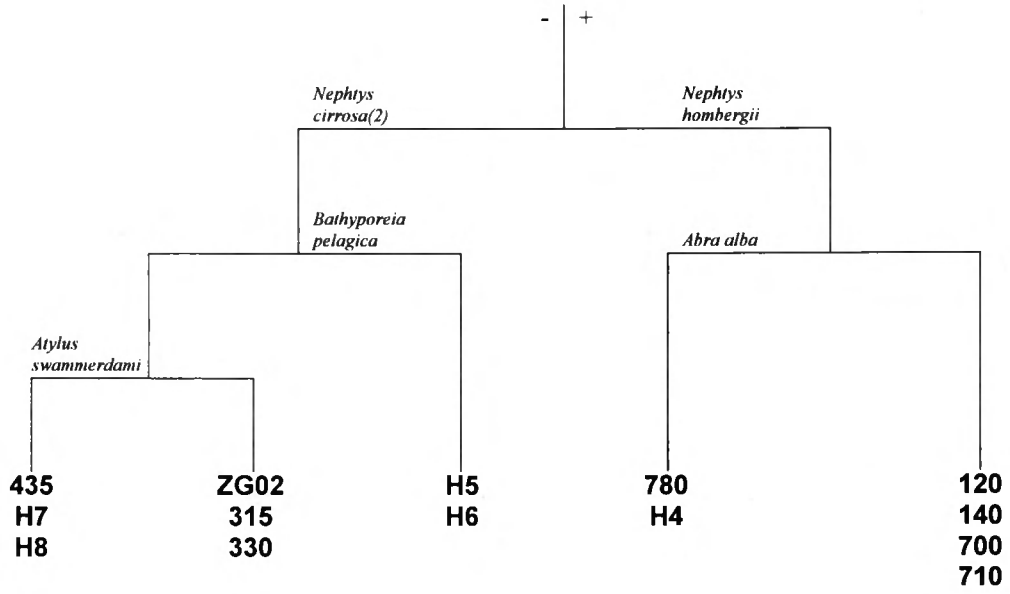


Fig. 19.bis : TWINSPAN table (cut levels 0, 1.40, 2.00 and 2.40)

```
Order of samples
6(435); 13(H7); 14(H8); 3(ZG02); 4(315); 11(H5); 12(H6); 9(780); 10(H4);1(120); 2(140); 7(700); 8(710).


                  11   11 1
                 63434512901278

 69 Spio bomb  ---24322-13---  000
 30 Gamm Spec  1-1----2-1----  0010
 37 Ophi juve  --1---31----1-  0010
 45 Neph cirr  343334344-11-1  0010
 10 Bath guil  24--2-42------  00110
 21 Echi cord  ----1-21------  001110
 49 Ophi albi  ----1-2-------  001110
 54 Pari typi  ----1-3-------  001110
 75 Urot brev  ----2-42------  001110
 12 Bath Spec  ------21------  001111
 20 Dias brad  -------1------  001111
 38 Leuc lill  ------1-------  001111
 68 Spio Spec  ------2-------  001111
  8 Atyl falc  2-2-1-2-------  01000
  9 Atyl swam  223----2------  01000
 22 Echi pusi  -24-2-2-------  01000
 31 Gast spin  3122-1-1--1---  01000
  7 Aoni pauc  23------------  010010
 16 Cope spec  -1------------  010010
 23 Echi Spec  1-------------  010010
 26 Euni Spec  --1-----------  010010
 28 Euzo flab  --1-----------  010010
 29 Exog hebe  -11-----------  010010
 32 Glyc lapi  -1------------  010010
 39 Lumb Spec  -1------------  010010
 56 Peri typi  -1------------  010010
 62 Pseu long  -2------------  010010
 73 Syll arma  1-------------  010010
 13 Bran lanc  -21-1---------  010011
 33 Glyc spec  133-2---------  010011
 48 Ophe lima  -22-323--1----  01010
 52 Orbi Spec  --1-1---------  01010
 67 Spio mart  313434--------  01010
  1 Amph Spar  ----1---------  01011
  5 Amph Spec  ----1---------  01011
 17 Cran cran  ----11--------  01011
 18 Cuma Spec  -----1--------  01011
 19 Cumo good  ----1---------  01011
 27 Eury Spec  ---1----------  01011
 34 Goni bobr  ----1---------  01011
 35 Harm Spec  ----4---------  01011
 36 Hesi augi  -11441--------  01011
 53 Pagu Spec  ----1---------  01011
 59 Poly Spec  ---11---------  01011
 74 Thel Spec  -----1--------  01011
 61 Pseu gils  -2---------1--  011
 63 Pseu Spec  --2-1-----1---  011
 11 Bath pela  ------12-1---2  10
 43 Mysi Spec  -------1---1--  10
 50 Ophi Spec  -1--4----22---  10
 60 Pont alta  1----------1--  10
 47 Neph Spec  1--21243442242  110
 66 Scol armi  -2---23--412-2  110
 70 Spis elli  -------1-2----  110
 71 Spis subt  1----2---241--  110
  2 Ablu obtu  ----------1---  111000
 14 Bucc unda  ----------1---  111000
 15 Chae seto  ----------4-4-  111000
 24 Ensi Spec  -------11-2--4  111000
 25 Eteo long  ------------1-  111000
 40 Maco balt  -----------24-  111000
 41 Mage mira  ----------2--2  111000
 57 Petr phol  ------------4-  111000
 58 Phyl macu  ----------1---  111000
 64 Pygo eleg  ------------2-  111000
 44 Neph caec  ---------12-2-  111001
 46 Neph homb  --------2-3213  111001
 65 Saga trog  --------3-3---  11101
 55 Pect kore  --------14--2-  11110
  3 Abra alba  --------23----  11111
  4 Ampe Spec  --------12----  11111
  6 Anth Spec  ---------4----  11111
 42 Myse bide  --------44--1-  11111
 51 Ophi text  --------2-----  11111
 72 Sthe boas  ---------1----  11111
 76 Vene pull  ---------1----  11111

               00000000111111
               00000011001111
               000111
```

Table 4. : Macrobenthos density (# ind./m²) and diversity along the trajectory of the Interconnector pipeline before installation (spring 1997)

STATION	H4	H5	H6	H7	H8	140	435	700	710	780
Polychaeta										
Aonides paucibranchiata	0.0	0.0	0.0	20.0	0.0	0.0	6.7	0.0	0.0	0.0
Chaetozone setosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	170.0	0.0	0.0
Eteone longa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0
Eunice species	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Euzonus flabelligerus	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Exogone hebes	0.0	0.0	0.0	3.3	3.3	0.0	0.0	0.0	0.0	0.0
Glycera lapidum	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Glycera species	0.0	0.0	0.0	26.7	30.0	0.0	3.3	0.0	0.0	0.0
Hesionura augeneri	0.0	0.0	0.0	3.3	3.3	0.0	0.0	0.0	0.0	0.0
Lumbrineris species	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Magelone mirabilis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	0.0
Nephtys caeca	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nephtys cirrosa	0.0	30.0	43.3	46.7	20.0	3.3	23.3	0.0	3.3	33.3
Nephtys hombergii	0.0	0.0	0.0	0.0	0.0	6.7	0.0	3.3	23.3	10.0
Nephtys species	160.0	43.3	23.3	0.0	0.0	6.7	3.3	36.7	10.0	86.7
Ophelia limacina	3.3	16.7	0.0	13.3	6.7	0.0	0.0	0.0	0.0	0.0
Orbinia species	0.0	0.0	0.0	0.0	3.3	0.0	0.0	6.7	0.0	0.0
Pectinaria koreni	46.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
Pygospio elegans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0
Scoloplos armiger	103.3	16.7	0.0	6.7	0.0	10.0	0.0	0.0	10.0	0.0
Spio martinensis	0.0	0.0	0.0	3.3	16.7	0.0	30.0	0.0	0.0	0.0
Spio species	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spiophanes bombyx	3.3	6.7	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sthenelais boa	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Syllidia armata	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Crustacea										
Ampelisca brevicornis	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
Atylus falcatus	0.0	6.7	0.0	0.0	13.3	0.0	10.0	0.0	0.0	0.0
Atylus swammerdami	0.0	0.0	6.7	13.3	23.3	0.0	6.7	0.0	0.0	0.0
Bathyporeia guilliamsoniana	0.0	80.0	6.7	56.7	0.0	0.0	10.0	0.0	0.0	0.0
Bathyporeia pelagica	3.3	3.3	13.3	0.0	0.0	0.0	0.0	0.0	10.0	0.0
Bathyporeia species	0.0	13.3	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copepoda species	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Diastylis bradyi	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
gammaridea species	3.3	0.0	10.0	0.0	3.3	0.0	3.3	0.0	0.0	0.0
Gastrosaccus spinifer	0.0	0.0	3.3	3.3	6.7	0.0	23.3	0.0	0.0	0.0
Leucothoe lilljeborgi	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mysidacea species	0.0	0.0	3.3	0.0	0.0	3.3	0.0	0.0	0.0	0.0
Pariambus typicus	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perioculodes typicus	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Pontocrates altamarinus	0.0	0.0	0.0	0.0	0.0	3.3	3.3	0.0	0.0	0.0
Pseudocuma gilsoni	0.0	0.0	0.0	6.7	0.0	3.3	0.0	0.0	0.0	0.0
Pseudocuma longicornis	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0
Pseudocuma similis	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0
Pygospio elegans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0
Urothoe brevicornis	0.0	40.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Echinodermata										
echinodermata species	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Echinocardium cordatum	0.0	6.7	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Echinocyamus pussilus	0.0	6.7	0.0	10.0	50.0	0.0	0.0	0.0	0.0	0.0
juvenile Ophiura spec.	0.0	20.0	3.3	0.0	3.3	0.0	0.0	3.3	0.0	0.0
Ophiura albida	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ophiurida species	6.7	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Ophiura texturata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
Mollusca										
Abra alba	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
Ensis species	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	33.3	3.3
Macoma baltica	0.0	0.0	0.0	0.0	0.0	6.7	0.0	50.0	0.0	0.0
Mysella bidentata	36.7	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	33.3
Petricola pholadiformis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.3	0.0	0.0
Spisula elliptica	13.3	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spisula subtruncata	13.3	0.0	0.0	0.0	0.0	3.3	3.3	0.0	0.0	0.0
Venerupis pullastra	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous										
anthozoa species	93.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Branchiostoma lanceolatum	0.0	0.0	0.0	6.7	3.3	0.0	0.0	0.0	0.0	0.0
Sagartia troglodytes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7
Total # ind./m²	523.3	326.7	153.3	246.6	200.0	46.6	133.1	333.3	103.2	203.3
Diversity										
Number of species	17	17	15	20	17	9	13	10	5	9
Shannon-Wiener index	2.94	3.51	3.41	3.59	3.44	3.04	3.29	2.24	2.53	2.50
Simpson's index	0.18	0.12	0.13	0.12	0.13	0.13	0.13	0.31	0.20	0.25

Table 5. : Macrobenthos density (# ind./m²) and diversity of 4 reference stations (spring 1997)

STATION	120	ZG02	315	330
Polychaeta				
Ampharete species	0.0	0.0	3.3	0.0
Aonides paucibranchiata	0.0	0.0	0.0	0.0
Chaetozone setosa	66.7	0.0	0.0	0.0
Eteone longa	0.0	0.0	0.0	0.0
Glycera species	0.0	0.0	10.0	0.0
Goniadella bobretzkii	0.0	0.0	3.3	0.0
Harmothoe species	0.0	0.0	36.7	0.0
Hesionura augeneri	0.0	43.3	36.7	3.3
Magelone mirabilis	6.7	0.0	0.0	0.0
Nephtys caeca	10.0	0.0	0.0	0.0
Nephtys cirrosa	3.3	16.7	16.7	46.7
Nephtys hombergii	30.0	0.0	0.0	0.0
Nephtys species	13.3	6.7	3.3	10.0
Ophelia limacina	0.0	0.0	16.7	6.7
Orbinia species	0.0	0.0	3.3	0.0
Phyllodoce maculata	3.3	0.0	0.0	0.0
Polygordius species	0.0	3.3	3.3	0.0
Pygospio elegans	0.0	0.0	0.0	0.0
Scoloplos armiger	3.3	0.0	0.0	6.7
Spio martinensis	0.0	43.3	30.0	130.0
Spiophanes bombyx	20.0	6.7	300.0	30.0
Thelepus species	0.0	0.0	0.0	3.3
Crustacea				
Abludomelita obtusata	3.3	0.0	0.0	0.0
amphipoda species	0.0	0.0	3.3	0.0
Atylus falcatus	0.0	0.0	3.3	0.0
Atylus swammerdami	0.0	0.0	0.0	0.0
Bathyporeia guilliamsoniana	0.0	0.0	6.7	0.0
Bathyporeia pelagica	0.0	0.0	0.0	0.0
Crangon crangon	0.0	0.0	3.3	3.3
Cumacea species	0.0	0.0	0.0	3.3
Cumopsis goodsiri	0.0	0.0	3.3	0.0
Eurydice spinigera	0.0	3.3	0.0	0.0
Gastrosaccus spinifer	3.3	10.0	0.0	3.3
Pagurus species	0.0	0.0	3.3	0.0
Pariambus typicus	0.0	0.0	3.3	0.0
Pseudocuma species	3.3	0.0	3.3	0.0
Urothoe brevicornis	0.0	0.0	13.3	0.0
Echinodermata				
Echinocardium cordatum	0.0	0.0	3.3	0.0
Echinocyamus pusilus	0.0	0.0	6.7	0.0
Ophiura albida	0.0	0.0	3.3	0.0
Ophiura species	6.7	0.0	40.0	0.0
Mollusca				
Hinia reticulata	3.3	0.0	0.0	0.0
Ensis species	13.3	0.0	0.0	0.0
Spisula subtruncata	306.7	0.0	0.0	6.7
Miscellaneous				
Branchiostoma lanceolatum	0.0	0.0	3.3	0.0
Sagartia troglodytes	20.0	0.0	0.0	0.0
Total # ind./m²	516.7	133.3	563.3	253.3
Diversity				
Number of species	17	8	26	12
Shannon-Wiener index	2.30	2.41	2.83	2.32
Simpson's index	0.38	0.24	0.30	0.32

Table 6. : Macrobenthos density (# ind./m²) and diversity of sampling stations in the vicinity of the Interconnector pipeline (spring 1994-1996)

STATION	140			700			710			780			435	
Year	94	95	96	94	95	96	94	95	96	94	95	96	94	96
Polychaeta														
Ampharete species	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0
Aphelochaeta marioni	0.0	0.0	0.0	23.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capitella species	0.0	0.0	0.0	0.0	0.0	10.0	0.0	3.3	0.0	0.0	3.3	0.0	0.0	0.0
Chaetozone setosa	23.3	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eteone longa	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.3	0.0	0.0	0.0	6.7	0.0	0.0
Eteone species	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Eumida sanguinea	0.0	3.3	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euzonus flabelligerus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
Glycera species	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	10.0
Harmothoe species	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	6.7	0.0	0.0
Hesionura augeneri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	3.3
Heteromastus filiformis	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heteromatus filiformis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0
Lanice conchilega	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.0	0.0	0.0	0.0
Magelona mirabilis	50.0	0.0	6.7	0.0	0.0	0.0	6.7	1133.0	119.9	33.3	3.3	0.0	0.0	0.0
Nephtys caeco	16.7	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	3.3	0.0	43.3	0.0	0.0
Nephtys cirrosa	0.0	103.0	0.0	0.0	3.3	0.0	26.6	0.0	46.6	53.3	0.0	0.0	16.7	23.3
Nephtys hombergii	6.7	0.0	10.0	0.0	0.0	0.0	3.3	83.0	46.6	6.7	107.0	23.3	0.0	0.0
Nephtys species	10.0	0.0	0.0	0.0	3.3	0.0	16.7	0.0	56.6	13.3	0.0	53.3	0.0	0.0
Nereis longissima	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0
Nereis succinea	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Notomastus species	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0
Ophelia species	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0
Owenia fusiformis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.3	0.0	0.0
Pectinaria koreni	3.3	6.7	0.0	6.7	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phyllodoce groenlandica	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0
Phyllodoce maculata	3.3	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	3.3	26.6	0.0	0.0
Pistone remota	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.6	0.0
polychaeta	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polydora species	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0
Protodorvillea kefersteini	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	0.0
Pygospio elegans	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scololepis bonnieri	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	10.0	0.0	0.0	0.0	0.0
Scoloplos armiger	0.0	0.0	0.0	0.0	0.0	0.0	26.6	0.0	20.0	26.6	0.0	6.7	0.0	0.0
Spio martinensis	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0
Spio species	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	3.3
Spiophanes bombyx	339.7	6.7	0.0	0.0	0.0	0.0	3.3	63.0	30.0	26.6	113.0	972.4	0.0	3.3
Sthenelais boa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	6.7	0.0	0.0	0.0
Typosyllis hyaline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	3.3
Crustacea														
Abludomelita obtusata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0
amphipoda species	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0
Anoplodactylus petiolatus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0
Atylus falcatus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Atylus swammerdami	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0
Bathyporeia guilliamsoniana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0
Bathyporeia pelagica	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0
Bathyporeia species	6.7	0.0	0.0	0.0	0.0	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bodotria scorpioides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Copepoda species	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diastylis rathkei	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0
Diastylis species	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	10.0	0.0	0.0	0.0
Gastrosaccus spinifer	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	3.3	0.0
Idotea linearis	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pariambus typicus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	13.3	0.0	130.0	10.0	0.0	0.0
Pontocrates altamarinus	6.7	0.0	0.0	0.0	0.0	0.0	13.3	10.0	0.0	0.0	0.0	0.0	3.3	0.0
Pontophilus trispinosus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	10.0	0.0	0.0	0.0
Pseudocuma gilsoni	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pseudocuma similis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0
Pseudocuma species	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0
Tainaissus lilljeborgi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Urothoe poseidonis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.3	0.0	0.0	0.0	0.0
Echinodermata														
Amphipholis squamata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0
Echinocardium cordatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.3	0.0	0.0
Echinocyamus pusilus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.6	16.7
Ophiura albida	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7	46.6	0.0	0.0
Ophiura texturata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Mollusca														
Abra alba	0.0	6.7	0.0	3.3	6.7	0.0	0.0	3.3	0.0	0.0	33.3	196.5	0.0	0.0
Hinia reticulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0
Ensis directus	0.0	3.3	0.0	0.0	0.0	0.0	0.0	30.0	0.0	6.7	6.7	0.0	0.0	0.0
Ensis species	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.3	3.3	0.0	23.3	0.0	0.0
Fabulina fabula	0.0	0.0	0.0	0.0	0.0	0.0	3.3	10.0	0.0	3.3	3.3	13.3	0.0	0.0
Lunatia alderi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.3	0.0	0.0
Macoma balthica	30.0	83.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
Mactra stultorum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0
Modiolula phaseolina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0
Moerella pygmaea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	13.3
Mysella bidentata	0.0	0.0	3.3	0.0	0.0	6.7	0.0	6.7	13.3	0.0	293.0	383.0	0.0	0.0
Petricola pholadiformis	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spisula subtruncata	0.0	300.0	13.3	0.0	0.0	0.0	0.0	43.0	26.6	0.0	90.0	819.2	0.0	0.0
Venerupsis pullastra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Miscellaneous														
Branchiostoma lanceolatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0
Sagartia troglodytes	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	26.6	0.0	0.0
unknown species	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.6	0.0	0.0
Total # ind /m²	546.1	529.0	43.3	56.6	26.6	16.7	159.8	1408.5	476.2	196.5	963.5	2807.1	226.4	87.1
Diversity														
Number of species	19	10	5	8	6	2	17	16	16	14	23	28	10	19
Shannon-Wiener index	2.31	1.85	2.20	2.58	2.50	0.97	3.57	1.28	3.31	3.14	3.25	2.73	3.75	2.93
Simpson's index	0.40	0.39	0.23	0.22	0.19	0.52	0.11	0.65	0.13	0.15	0.15	0.23	0.09	0.16

Epibenthos

Fig. 8.: the major faunistic groups of the epibenthic community: (a) Anthozoa (sea anemones); (b) Crustacea: (b1) crabs and (b2) shrimps; (c) Echinodermata (starfish) and (d) Mollusca: (d1) sea snails and (d2) cuttlefish.

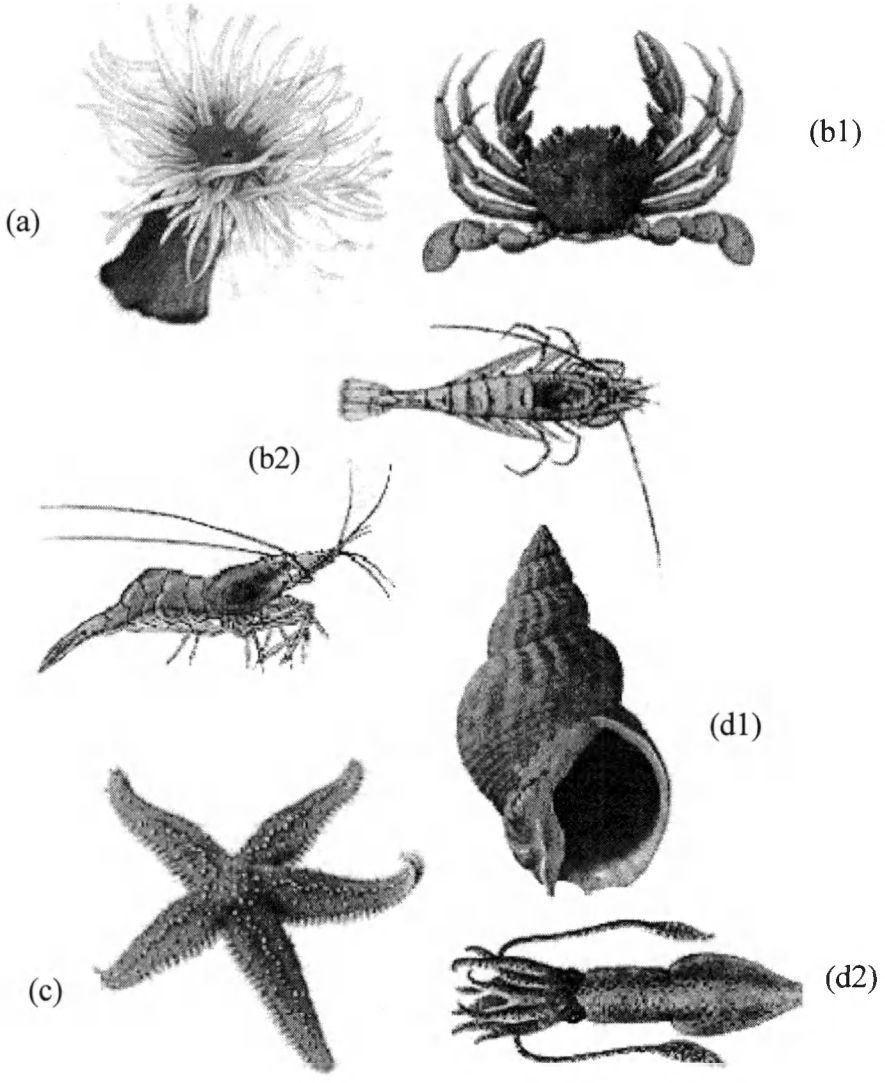
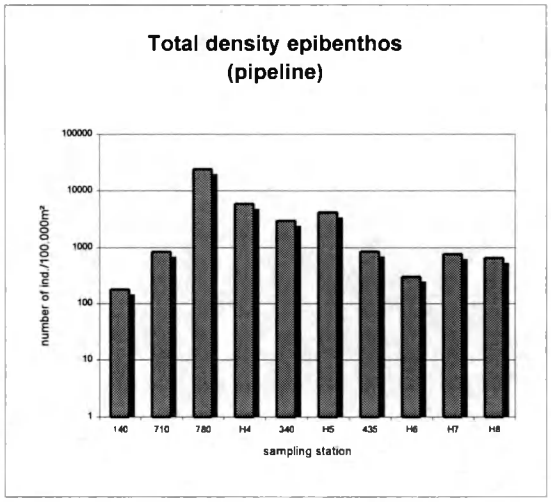
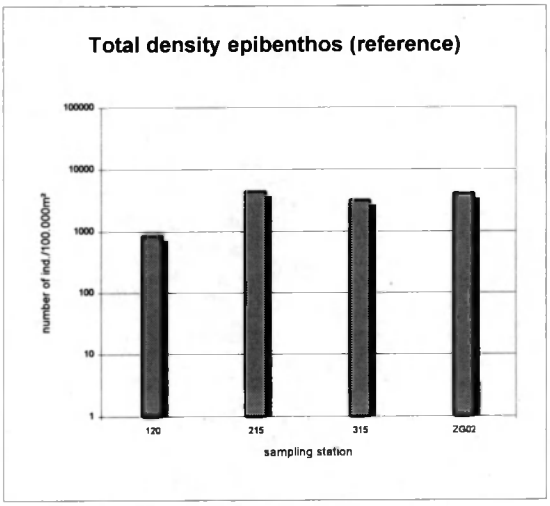
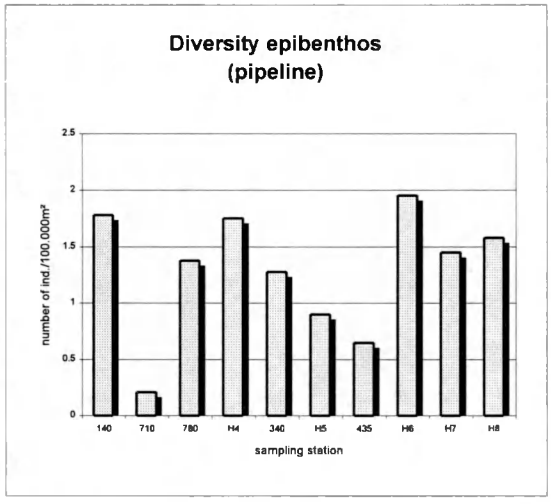
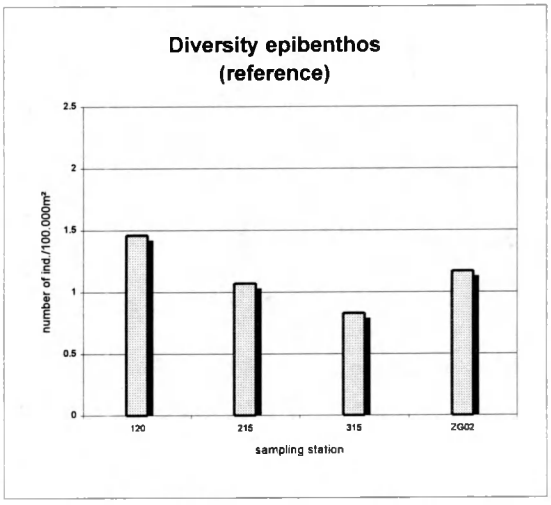


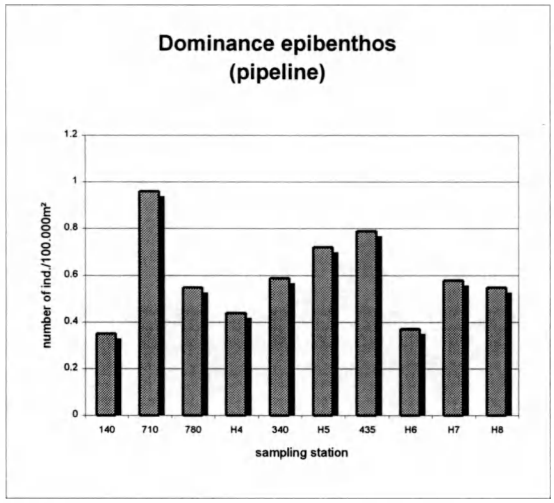
Fig. 9. : Total density, diversity and dominance of sampled epibenthos stations (spring 1997)











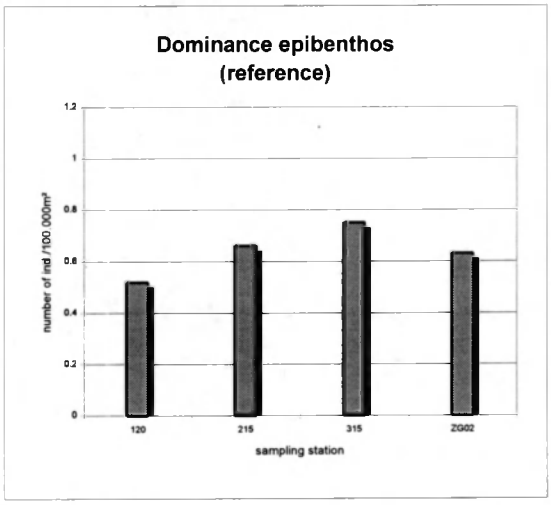
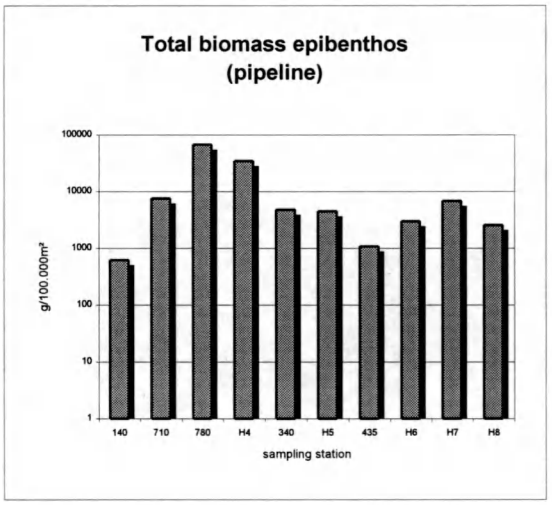


Fig. 10. : Total biomass of sampled epibenthos stations (spring 1997)



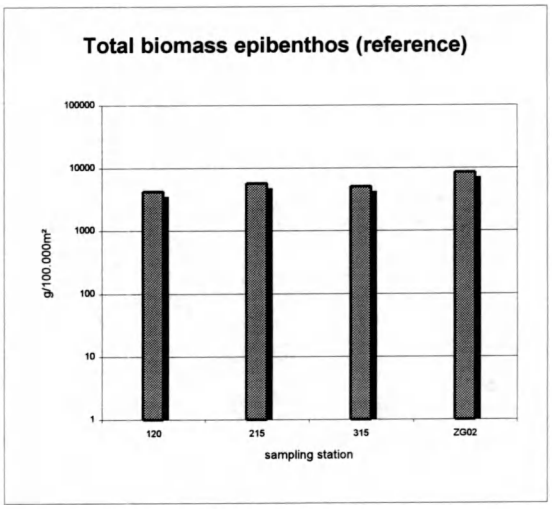
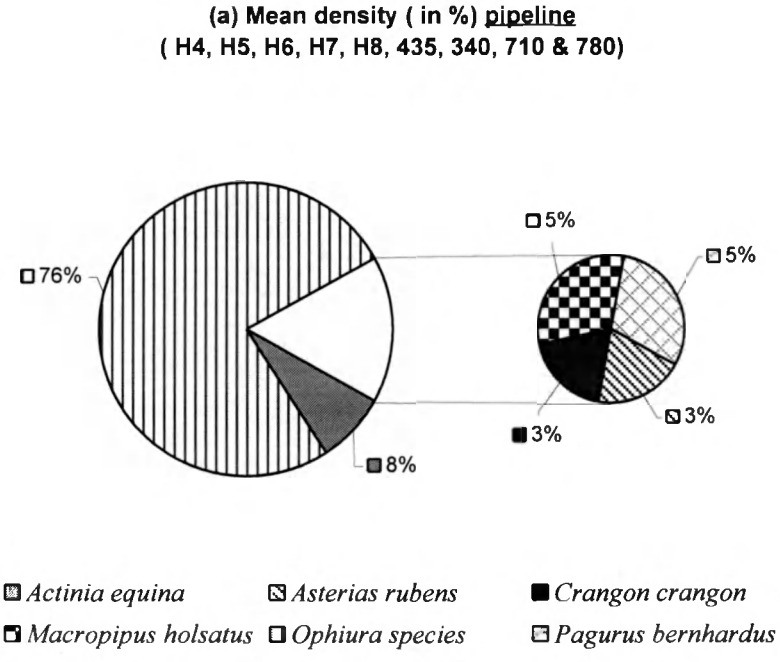


Fig. 11. Mean densities (in % values) of the most important epibenthic species along the interconnect pipeline (a) and of some reference stations (b) (spring 1997).



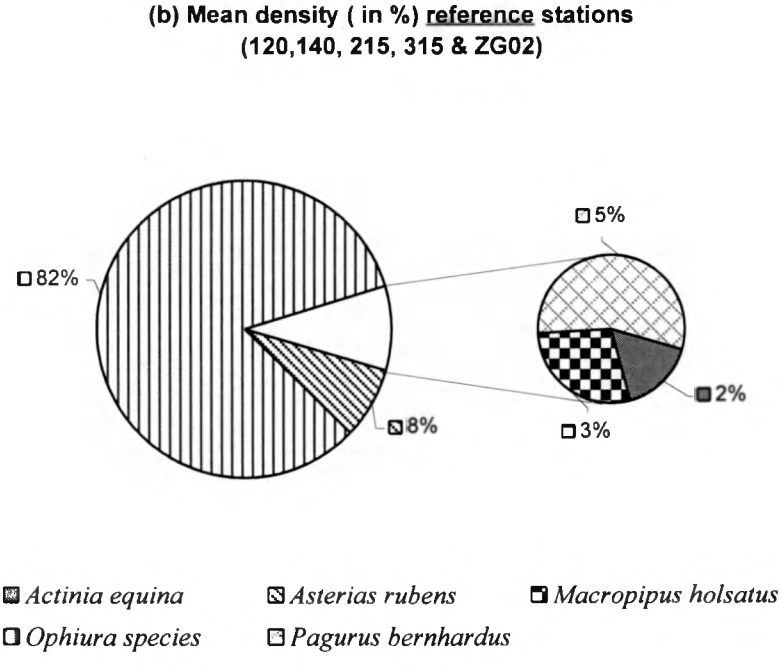
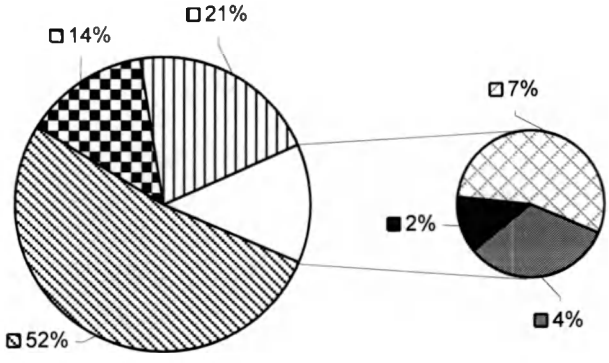


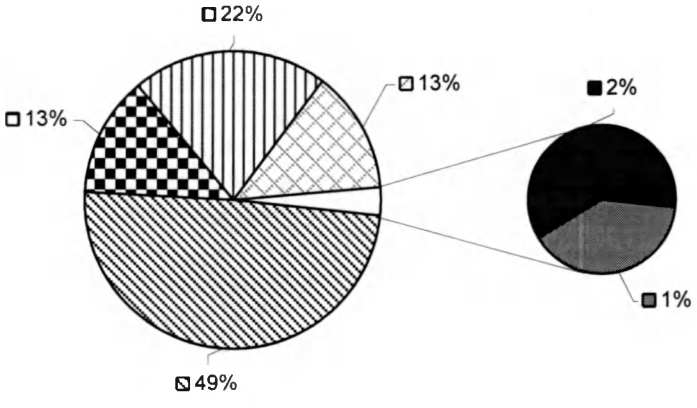
Fig. 12. Mean biomass (in % values) of the most important epibenthic species along the interconnecto pipeline (a) and of some reference stations (b) (spring 1997).

(a) Mean biomass (in %) pipeline
(H4, H5, H6, H7, H8, 435, 340, 710 & 780)



Actinia equina *Asterias rubens* *Crangon crangon*
Macropipus holsatus *Ophiura species* *Pagurus bernhardus*

(b) Mean biomass (in %) reference stations
(120,140, 215, 315 & ZG02)



Actinia equina *Asterias rubens* *Loligo vulgaris*
Macropipus holsatus *Ophiura species* *Pagurus bernhardus*

Table 7. : Total density of epibenthos for sampling stations along the trajectory of the Interconnector pipeline (density in # ind./100.000m²)

STATION	H4	H5	H6	H7	H8	140	340	435	710	780	Total
Anthozoa species	26	0	0	0	5	19	7	0	3	3110	3170
Alloteuthis subulata	0	0	0	0	5	0	0	0	0	0	5
Asterias rubens	524	35	22	27	11	16	351	16	3	282	1287
Carcinus maenas	0	0	0	0	0	0	0	0	3	0	3
Crangon allmanni	96	6	0	9	32	0	20	0	0	0	163
Crangon crangon	786	314	43	27	42	0	115	0	0	0	1327
Echinocardium cordatum	0	3	0	0	0	0	0	0	0	85	88
Loligo vulgaris	0	0	4	45	0	0	0	0	0	0	49
Liocarcinus holsatus	35	16	39	9	21	53	14	0	820	1044	2051
Liocarcinus marmoreus	0	0	9	0	0	0	0	0	0	0	9
Ophiura albida	3722	3520	13	27	26	88	2249	749	0	2061	12455
Ophiura texturata	524	31	0	0	0	0	187	4	3	17472	18221
Pagurus bernhardus	166	261	172	573	480	3	30	75	7	192	1959
Psammechinus miliaris	0	0	0	45	26	0	0	4	0	0	75
Thia polita	0	0	0	0	0	0	3	0	0	0	3
Thyonidium commune	0	0	0	0	5	0	0	0	0	0	5
Total	5879	4186	302	762	653	179	2976	848	839	24246	40870
Diversity											
Number of species	8	8	7	8	10	5	9	5	6	7	
Shannon-Wiener index	1.75	0.90	1.95	1.45	1.58	1.78	1.28	0.65	0.21	1.38	
Simpson index	0.44	0.72	0.37	0.58	0.55	0.35	0.59	0.79	0.96	0.55	

Table 8. : Total density of epibenthos for reference sampling stations (density in # ind./100.000m²)

STATION	120	215	ZG02	315	Total
Anthozoa species	91	81	0	0	172
Asterias rubens	81	240	430	221	972
Corystes cassivelaunus	0	0	3	0	3
Echinocardium cordatum	0	0	3	0	3
Loligo vulgaris	0	0	7	3	10
Liocarcinus holsatus	20	7	134	115	276
Necora puber	0	0	0	3	3
Ophiura albida	10	3568	3179	2751	9508
Ophiura texturata	596	170	155	21	942
Pagurus bernhardus	49	360	151	80	640
Psammechinus miliaris	0	0	0	3	3
Total	847	4426	4062	3197	12532
Diversity					
Number of species	6	6	8	8	
Shannon-Wiener index	1.46	1.07	1.17	0.83	
Simpson index	0.52	0.66	0.63	0.75	

Table 9. : Total biomass of epibenthos for sampling stations along the trajectory of the interconnector pipeline (biomass in g/100.000m²)

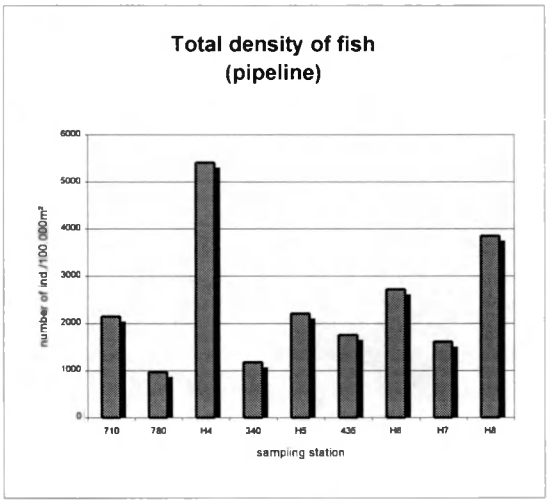
STATION	H4	H5	H6	H7	H8	140	340	435	710	780	Total
Anthozoa species	21	0	0	0	7	27	10	0	6	5337	5408
Alloteuthis subulata	0	0	0	0	10	0	0	0	0	0	10
Asterias rubens	30578	943	516	289	153	79	2915	138	81	31047.5	66740
Carcinus maenas	0	0	0	0	0	0	0	0	64	0	64
Corystes cassivelaunus	0	0	0	0	0	0	0	0	0	0	0
Crangon allmanni	74	6	0	9	29	0	13	0	0	0	131
Crangon crangon	1076	588	93	65	75	0	167	0	0	0	2064
Echinocardium cordatum	0	39	0	0	0	0	0	0	0	960	999
Loligo vulgaris	0	0	859	2726	0	0	0	0	0	0	3585
Liocarcinus holsatus	246	123	380	104	92	483	94	0	7264	8930	17716
Liocarcinus marmoreus	0	0	55	0	0	0	0	0	0	0	55
Ophiura albida	1111	1744	6	10	12	28	819	401	0	916	5047
Ophiura texturata	810	84	0	0	0	0	550	9	3	20040.3	21496
Pagurus bernhardus	709	961	1068	3264	1884	3	197	491	140	281	8998
Psammechinus miliaris	0	0	0	317	149	0	0	39	0	0	505
Thia polita	0	0	0	0	0	0	3	0	0	0	3
Thyonidium commune	0	0	0	0	131	0	0	0	0	0	131
Total	34625	4488	2977	6784	2542	620	4768	1078	7558	67511.7	132952

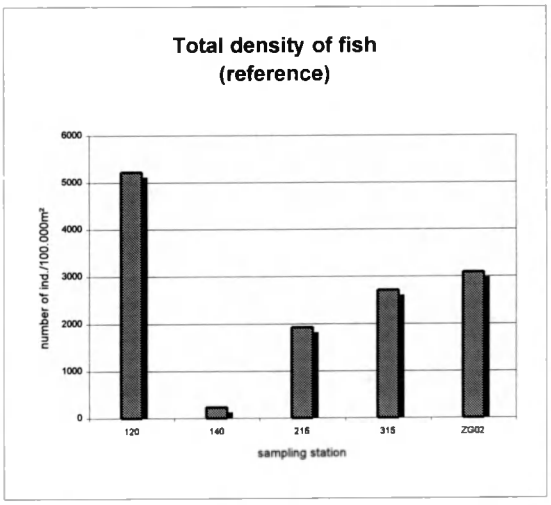
Table 10. : Total biomass of epibenthos for reference sampling stations (biomass in g/100.000m²)

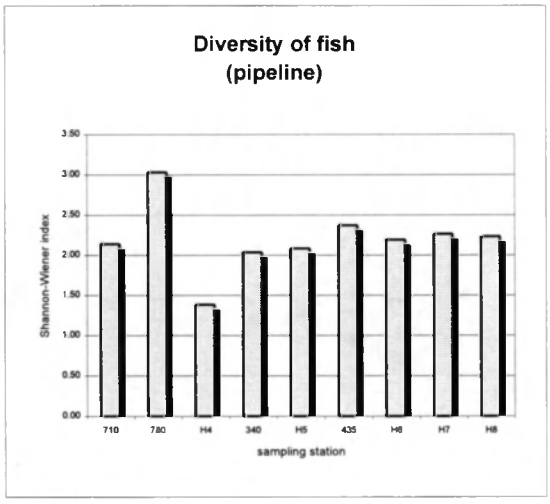
STATION	120	215	ZG02	315	Total
Anthozoa species	164	110	0	0	274
Alloteuthis subulata	0	0	0	0	0
Asterias rubens	2975	2896	3567	2314	11752
Corystes cassivelaunus	0	0	31	0	31
Echinocardium cordatum	0	0	81	0	81
Loligo vulgaris	0	0	336	118	454
Liocarcinus holsatus	174	91	1507	843	2615
Necora puber	0	0	0	6	6
Ophiura albida	1	1008	1507	1228	3744
Ophiura texturata	683	272	374	71	1400
Pagurus bernhardus	261	1333	1172	399	3165
Psammechinus miliaris	0	0	0	63	63
Total	4257	5710	8575	5042	23584

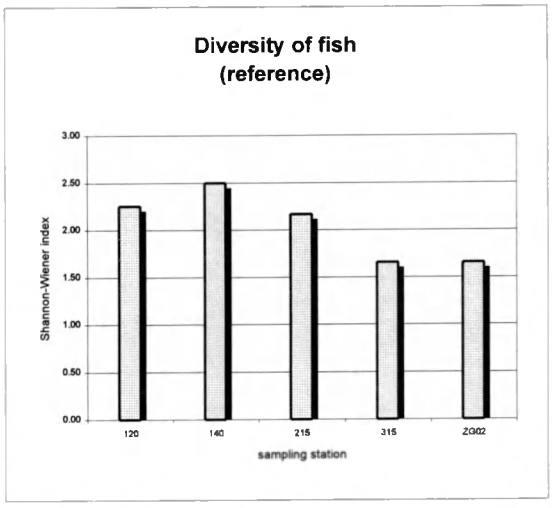
Fish

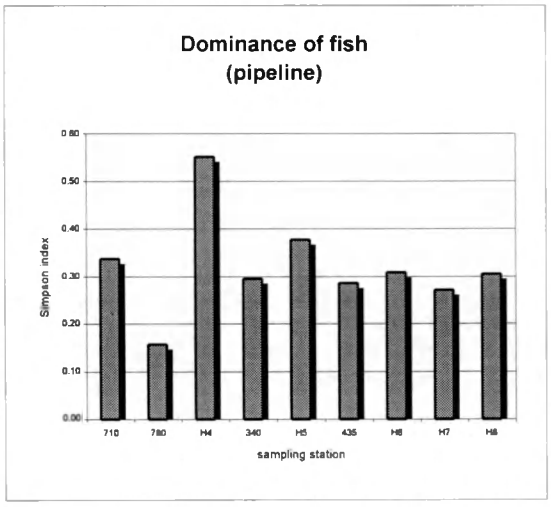
Fig. 13. : Total density, diversity and dominance of sampled fish stock (spring 1997)











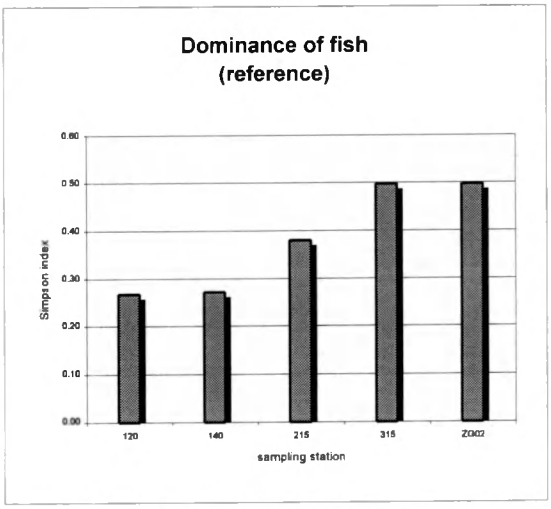
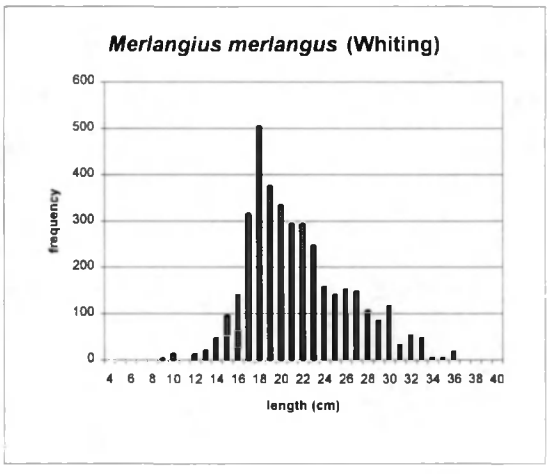
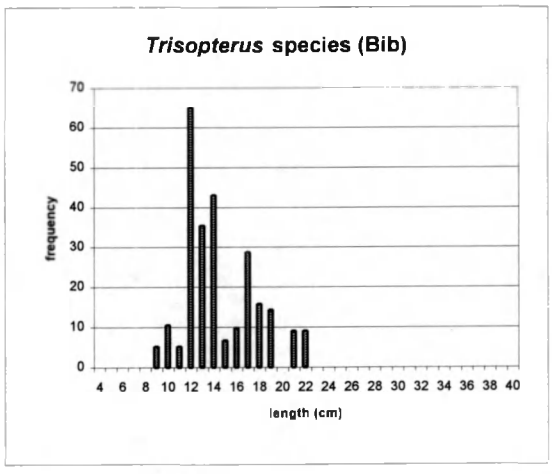
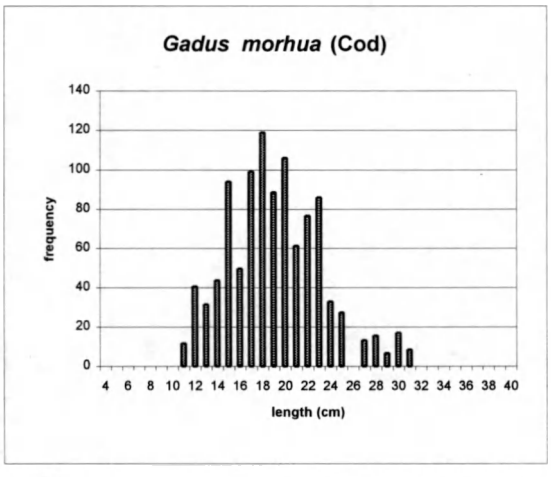
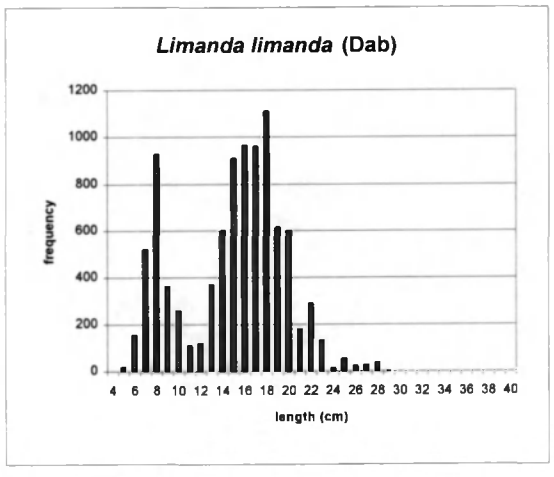


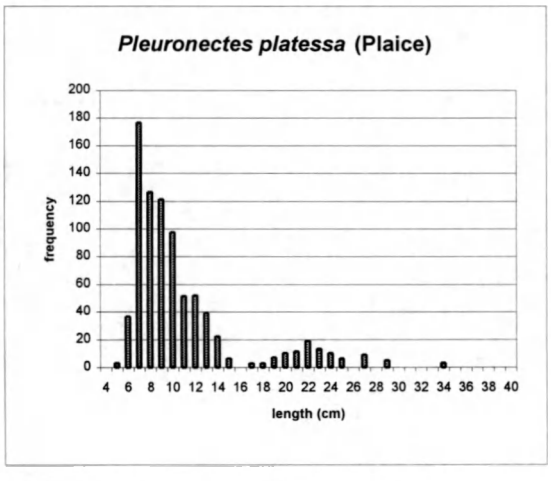
Fig. 14. Length-frequency distribution of the commercial fish species along the **Interconnector pipeline** (sampling stations 710-780-H4-340-H5-435-H6-H7-H8)











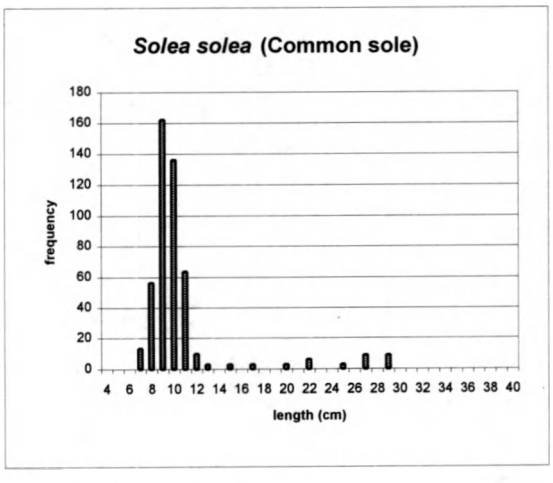
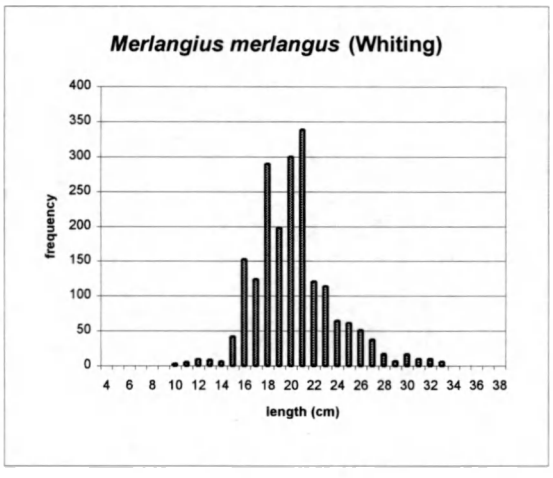
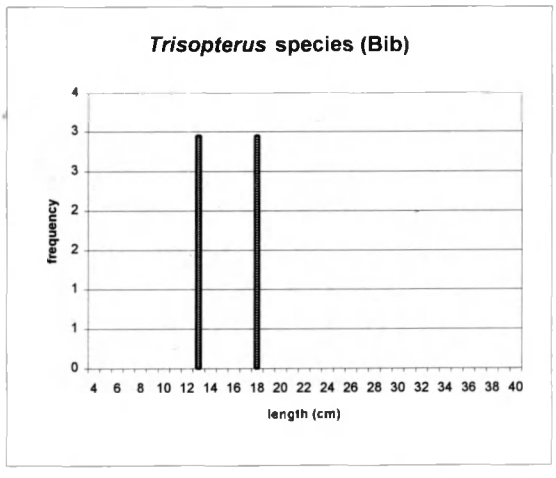
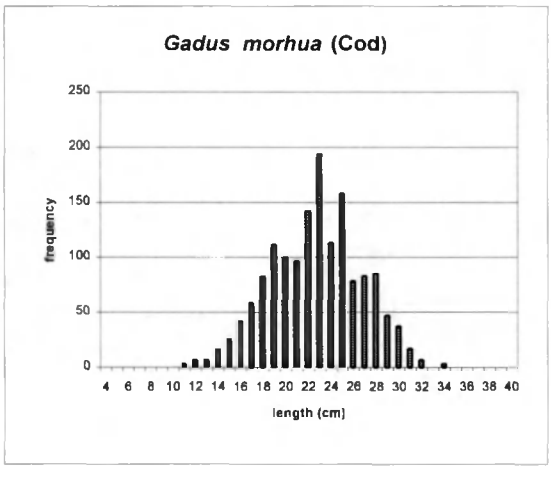
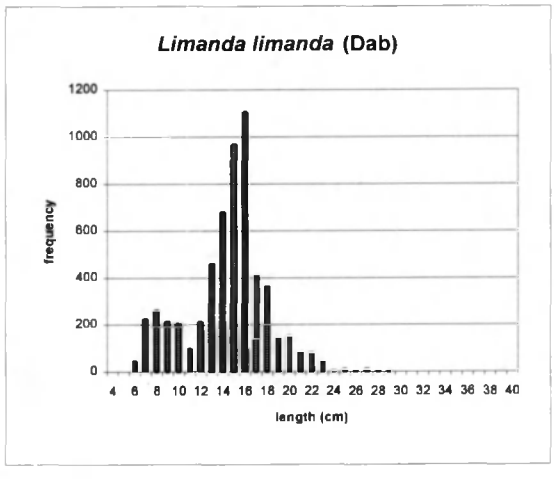


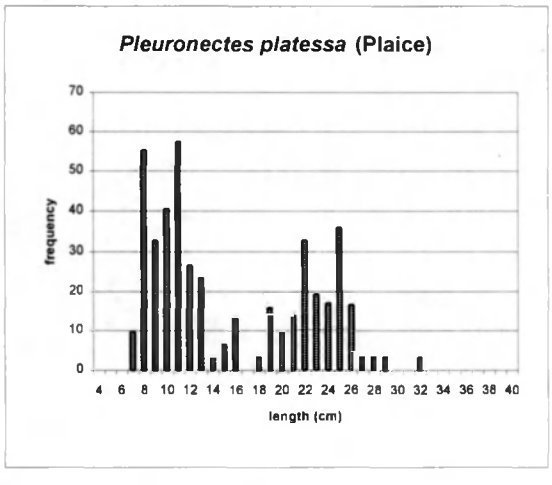
Fig. 15. Length-frequency distribution of the commercial fish species caught at the **reference** stations (sampling stations 120-215-315-ZG02)











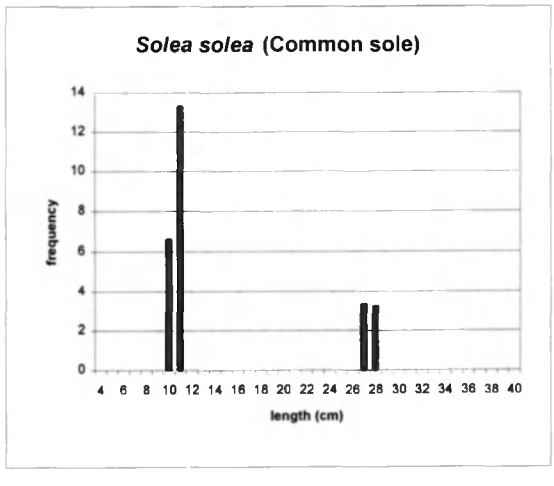
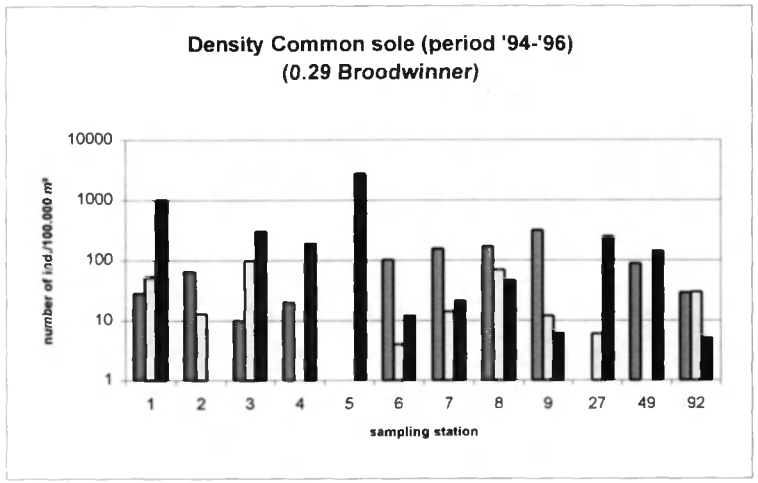
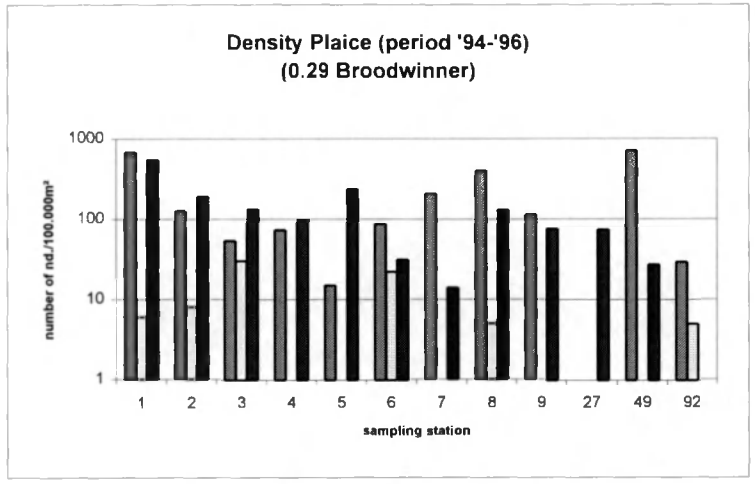
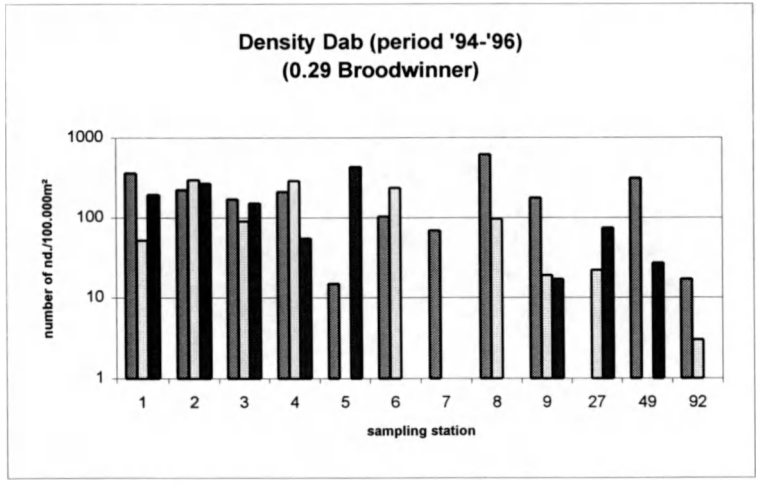


Fig. 16. : Total density of fish sampled during '94-'96 for common sole, plaice, dab and whiting.







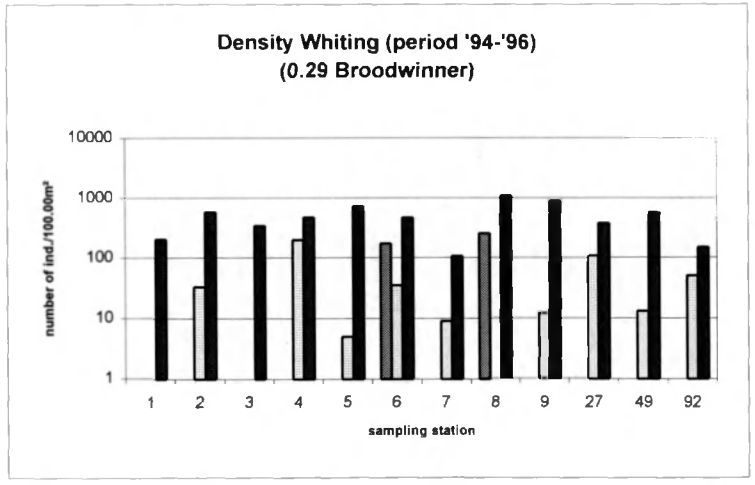


Fig. 17. : Total density of commercial fish sampled during the period '94-'96.

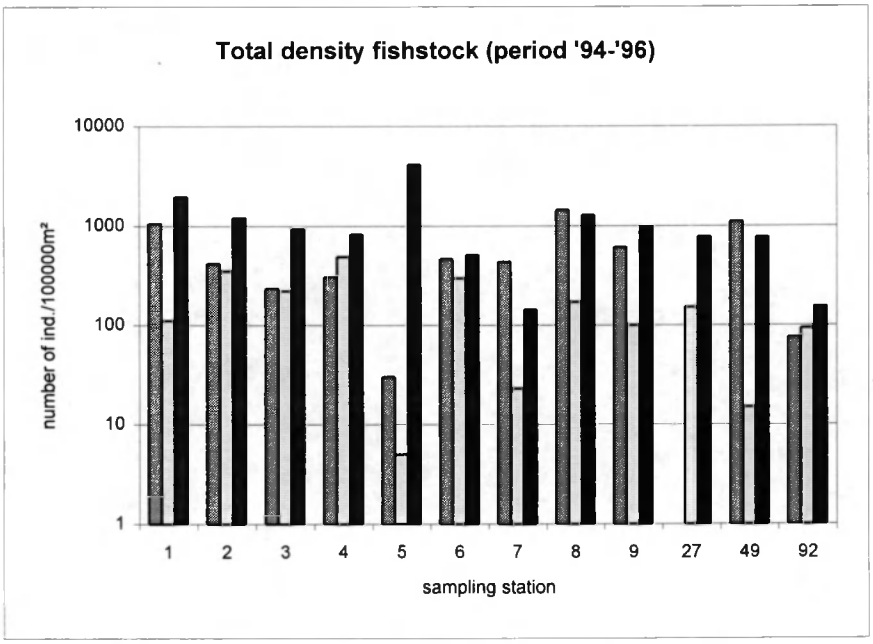
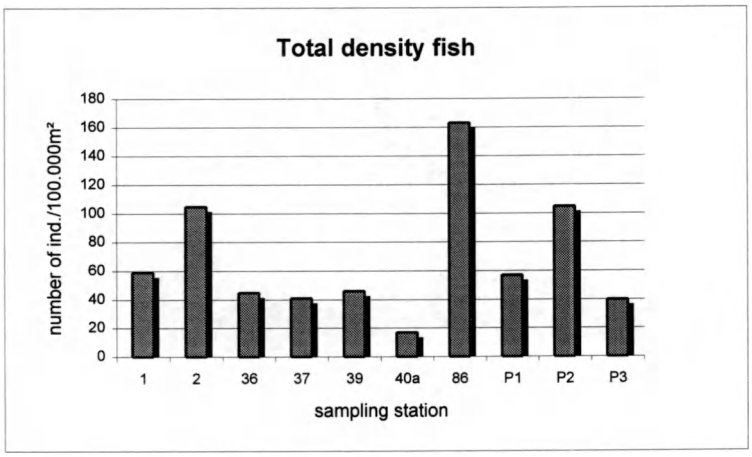
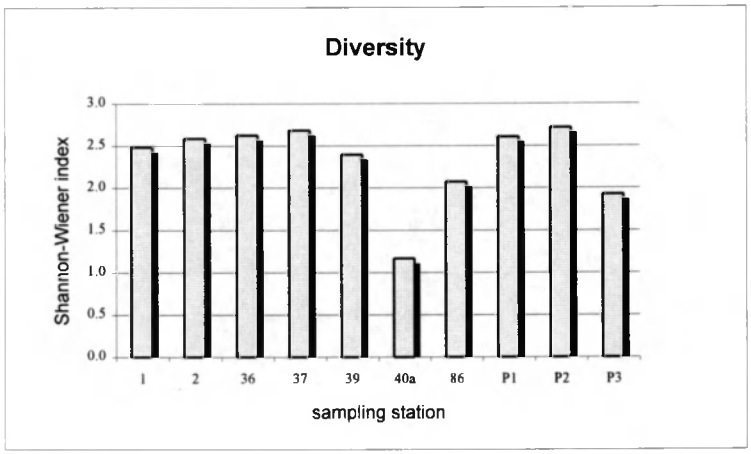


Fig. 18. : Total density, diversity and dominance of the fishstock around the Belgian Continental Shelf (A. 962 R.V. Belgica campaign, August 1996)





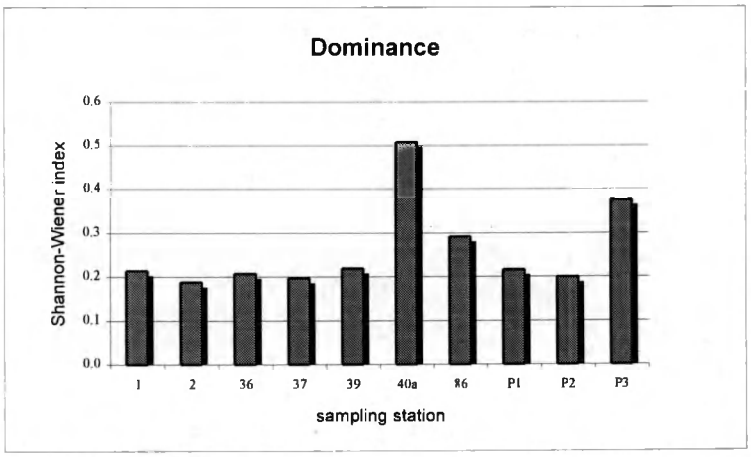


Table 11. : Density, diversity of fish species along the **Interconnector pipeline** (spring 1997)

STATION	**710**	**780**	**H4**	**340**	**H5**	**435**	**H6**	**H7**	**H8**	**Total**
Agonus cataphractus	1151	141	7	7	13	0	0	0	5	1324
Ammodytes tobianus	10	0	0	0	28	20	21	0	37	116
Arnoglossus laterna	0	0	3	0	0	0	0	0	11	14
Buglossidium luteum	17	3	3	0	3	8	30	0	0	64
Callionymus lyra	0	0	7	14	28	4	21	36	37	147
Callionymus recticulatus	0	0	10	0	35	20	17	9	21	112
Ciliata mustela	7	0	10	0	0	0	0	0	0	17
Clupea harengus	0	13	69	0	69	28	0	0	0	178
Gadus morhua	14	32	550	182	41	8	82	45	79	1032
Hyperoplus lanceolatus	0	0	0	0	13	28	0	0	5	46
Limanda limanda	250	256	3915	432	1273	718	283	273	1876	9275
Liparis liparis	17	38	3	0	0	0	0	0	0	58
Merlangius merlangus	10	83	695	429	132	185	549	645	611	3340
Microstomus kitt	0	3	0	0	0	0	0	0	0	3
Myoxocephalus scorpius	0	22	0	0	0	4	0	0	0	26
Platichthys flesus	3	10	3	3	9	4	9	9	0	50
Pleuronectes platessa	297	169	85	91	135	35	13	18	10	854
Pomatoschistus minutus	17	13	0	0	0	35	0	0	0	65
Scyliorhinus caniculus	0	3	0	0	0	0	0	0	0	3
Solea solea	284	157	13	3	3	8	0	0	0	467
Spratus spratus	64	29	10	0	0	67	30	0	42	242
Syngnatus acus	3	0	0	0	0	0	0	0	0	3
Trachurus vipera	0	0	0	0	427	568	1335	454	732	3516
Trigla gurnardus	0	0	0	3	0	12	326	45	269	655
Trisopterus luscus	7	3	26	17	3	4	0	82	116	258
total	2151	975	5409	1181	2212	1755	2716	1616	3851	21865
Diversity										
Number of species	15	16	16	10	15	18	12	10	14	
Shannon-Wiener index	2.14	3.03	1.38	2.04	2.08	2.37	2.19	2.26	2.23	
Simpson index	0.34	0.16	0.55	0.30	0.38	0.29	0.31	0.27	0.31	

Table 12. : Density, diversity of fish species of **reference** sampling stations (spring 1997)

STATION	**120**	**140**	**215**	**315**	**ZG02**	**Total**
Agonus cataphractus	3	19	7	9	10	48
Ammodytes tobianus	0	0	11	3	3	17
Buglossidium luteum	0	0	0	18	20	38
Callionymus lyra	0	0	42	50	57	150
Callionymus recticulatus	0	0	18	21	24	62
Ciliata mustela	3	0	0	3	3	10
Clupea harengus	845	0	99	6	7	956
Gadus morhua	1592	16	57	100	114	1879
Gobius niger	0	0	0	3	3	6
Hyperoplus lanceolatus	0	0	4	0	0	4
Limanda limanda	1977	6	1127	1848	2103	7061
Liparis liparis	0	3	0	0	0	3
Merlangius merlangus	217	6	46	469	534	1273
Micromesistius poutassou	3	0	0	0	0	3
Myoxocephalus scorpius	36	0	0	6	7	48
Platichthys flesus	45	13	32	0	0	90
Pleuronectes platessa	178	28	53	109	124	493
Pomatoschistus minutus	36	25	21	21	24	126
Raja clavata	0	0	4	0	0	4
Solea solea	10	113	0	15	17	154
Spratus spratus	282	0	53	0	0	334
Syngnatus acus	0	6	0	0	0	6
Trachurus vipera	0	0	353	32	37	423
Trisopterus luscus	0	0	7	0	0	7
total	5226	235	1932	2713	3088	13193
Diversity						
Number of species	13	10	15	16	16	
Shannon-Wiener index	2.26	2.50	2.17	1.65	1.65	
Simpson index	0.27	0.27	0.38	0.50	0.50	

Table 13. : Total density for the commercial fish species cod, dab, plaice, common sole and whiting (period '94-'96 ; 0.29 Broodwinner)

September '94
number of species (# ind./ 100,000m²)

Genus species		sampling station												
		1	2	3	4	5	6	7	8	9	27	49	92	Total
Cod	*Gadus morhua*	0	0	0	0	0	0	0	0	0	0	0	0	0
Dab	*Limanda limanda*	360	223	171	212	15	103	69	617	177	0	311	17	2275
Plaice	*Pleuronectes platessa*	663	125	53	72	15	86	208	400	113	0	710	29	2474
Common sole	*Solea solea*	28	65	10	20	0	103	156	171	314	0	88	29	984
Whiting	*Merlangius merlangius*	0	0	0	0	0	172	0	251	0	0	0	0	423
	total	1051	413	234	304	30	464	433	1439	604	0	1109	75	6156

September '95
number of species (# ind./ 100,000m²)

Genus species		sampling station												
		1	2	3	4	5	6	7	8	9	27	49	92	Total
Cod	*Gadus morhua*	0	0	0	0	0	0	0	0	57	17	2	5	81
Dab	*Limanda limanda*	52	296	90	289	0	236	0	96	19	22	0	3	1103
Plaice	*Pleuronectes platessa*	6	8	30	0	0	22	0	5	0	0	0	5	76
Common sole	*Solea solea*	53	13	100	0	0	4	14	70	12	6	0	30	302
Whiting	*Merlangius merlangius*	0	33	0	198	5	35	9	0	12	106	13	50	461
	total	111	350	220	487	5	297	23	171	100	151	15	93	2023

September '96
number of species (# ind./ 100,000m²)

Genus species		sampling station												
		1	2	3	4	5	6	7	8	9	27	49	92	Total
Cod	*Gadus morhua*	0	6	0	0	0	0	0	8	0	11	0	0	25
Dab	*Limanda limanda*	194	269	151	55	429	0	0	0	17	74	27	0	1216
Plaice	*Pleuronectes platessa*	543	191	132	98	234	31	14	130	75	73	27	0	1548
Common sole	*Solea solea*	1002	173	305	192	2727	12	21	46	6	248	141	5	4878
Whiting	*Merlangius merlangius*	201	568	338	470	722	464	107	1088	878	369	571	148	5924
	total	1940	1207	926	815	4112	507	142	1272	976	775	766	153	13591

Table 17. : Length-frequency distribution of the commercial fish species caught during period '94-'96 (0.29 Broodwinner)(density in # ind./100.000m²)

1994	Stations	1	2	3	4	5	6	7	8	9	27	49	92
Common sole	<13	22	19	5	10	-	11	75	114	171	-	41	17
	13 - 19	6	46	5	10	-	46	81	57	103	-	47	6
	20 -23	-	-	-	-	-	23	-	-	40	-	-	6
	>23	-	-	-	-	-	23	-	-	-	-	-	-
Plaice	<13	562	69	53	62	15	57	191	240	40	-	503	23
	13 - 19	101	51	-	10	-	29	17	137	51	-	207	6
	20 - 24	-	5	-	-	-	-	-	23	11	-	-	-
	>24	-	-	-	-	-	-	-	-	11	-	-	-
Dab	<11	360	144	166	202	-	92	69	617	177	-	311	17
	11 - 14	-	37	5	-	10	11	-	-	-	-	-	-
	15 - 19	-	42	-	10	-	-	-	-	-	-	-	-
	>19	-	-	-	-	5	-	-	-	-	-	-	-
Whiting	<22	-	-	-	-	-	92	-	240	-	-	-	-
	22 - 30	-	-	-	-	-	69	-	11	-	-	-	-
	>30	-	-	-	-	-	11	-	-	-	-	-	-

1995	Stations	1	2	3	4	5	6	7	8	9	27	49	92
Common sole	<13	35	13	75	-	-	-	14	59	-	6	-	25
	13 - 19	12	-	20	-	-	4	-	11	6	-	-	5
	20 -23	6	-	5	-	-	-	-	-	-	-	-	-
	>23	-	-	-	-	-	-	-	-	6	-	-	-
Plaice	<13	-	-	30	-	-	9	-	-	-	-	-	5
	13 - 19	6	4	-	-	-	4	-	5	-	-	-	-
	20 - 24	-	-	-	-	-	9	-	-	-	-	-	-
	>24	-	4	-	-	-	-	-	-	-	-	-	-
Dab	<11	35	234	65	145	-	100	-	43	-	11	-	30
	11 - 14	-	8	10	59	-	31	-	16	6	-	-	-
	15 - 19	17	54	15	85	-	92	-	37	13	11	-	-
	>19	-	-	-	-	-	13	-	-	-	-	-	-
Whiting	<22	-	25	-	145	-	35	9	-	6	95	13	50
	22 - 30	-	8	-	53	5	-	-	-	-	11	-	-
	>30	-	-	-	-	-	-	-	-	6	-	-	-
Cod	<22	-	-	-	-	-	-	-	-	-	-	-	-
	22-35	-	-	-	-	-	-	-	-	38	-	2	-
	>35	-	-	-	-	-	-	-	-	19	17	-	5

1996	Station	1	2	3	4	5	6	7	8	9	27	49	92
Common sole	<13	962	125	305	192	2420	2	6	36	-	240	130	5
	13 - 19	20	30	-	-	96	-	5	-	-	-	-	-
	20 -23	20	18	-	-	191	-	10	10	-	8	10	-
	>23	-	-	-	10	20	10	-	-	6	-	1	-
Plaice	<13	533	100	110	98	122	31	14	130	75	70	27	-
	13 - 19	-	62	12	-	27	-	-	-	-	3	-	-
	20 - 24	10	29	10	-	58	-	-	-	-	-	-	-
	>24	-	-	-	-	27	-	-	-	-	-	-	-
Dab	<11	174	168	130	50	159	-	-	-	17	74	27	-
	11 - 14	20	86	11	5	164	-	-	-	-	-	-	-
	15 - 19	-	15	10	-	85	-	-	-	-	-	-	-
	>19	-	-	-	-	21	-	-	-	-	-	-	-
Whiting	<22	191	520	330	450	679	464	107	1078	878	350	570	100
	22 - 30	10	34	8	20	27	-	-	-	-	19	1	48
	>30	-	14	-	-	16	-	-	10	-	-	-	-
Cod	<22	-	6	-	-	-	-	-	8	-	-	-	-
	22 - 35	-	-	-	-	-	-	-	-	-	-	-	-
	>35	-	-	-	-	-	-	-	-	-	11	-	-

Table 15. : Density, diversity and dominance of fishstock around the Belgian Continental Shelf and in the vicinity of the Interconnector pipeline (August 1996 ; A. 962 R.V. Belgica)(density in # ind./100.000m²)

Genus species		sampling station										
		1	**2**	**36**	**37**	**39**	**40a**	**86**	**P1**	**P2**	**P3**	**Total**
Solenette	*Buglossidium luteum*	3	26	13	1	0	0	12	5	1	0	61
Red gurnard	*Aspitrigla cuculus*	3	1	2	6	0	0	0	1	8	3	24
Brill	*Scophthalmus rhombus*	1	0	0	0	0	0	0	0	0	0	1
Cod	*Gadus morhua*	0	0	1	0	0	0	0	0	1	1	3
Stripped red mullet	*Mullus surmuletus*	0	0	0	0	0	0	0	0	3	0	3
Tub gurnard	*Trigla lucerna*	0	1	0	2	1	0	1	4	2	0	11
Spotted ray	*Raja montagui*	0	0	0	0	0	0	0	1	0	0	1
Dab	*Limanda limanda*	0	24	4	14	10	0	71	19	18	0	160
Plaice	*Pleuronectes platessa*	17	12	0	8	10	1	29	16	7	23	123
Greater sand eel	*Hyperoplus lanceolatus*	3	0	0	0	0	0	0	1	0	0	4
Bib	*Trisopterus* species	0	1	0	0	0	0	4	0	20	1	26
Common sole	*Solea solea*	14	13	4	4	1	11	41	4	36	5	133
Lemon sole	*Microstomus kitt*	0	0	0	3	0	0	0	0	7	6	16
Scaldfish	*Arnoglossus laterna*	3	22	14	1	14	0	5	5	2	0	66
Flounder	*Platichthys flesus*	0	0	0	0	0	5	0	0	0	0	5
Triggerfish	*Balistes carolinensis*	0	0	1	0	1	0	0	0	0	0	2
Raitt's sand eel	*Ammodytes marinus*	0	0	3	2	1	0	0	0	0	0	6
Lesser sand eel	*Ammodytes tobianus*	15	5	3	0	8	0	0	1	0	1	33
	total :	59	105	45	41	46	17	163	57	105	40	678
	number of species :	8	9	9	9	8	3	7	10	11	7	
	Shannon-Wiener diversity :	2.49	2.59	2.63	2.69	2.40	1.17	2.07	2.61	2.72	1.92	
	Simpson dominance :	0.21	0.19	0.21	0.20	0.22	0.51	0.29	0.22	0.20	0.38	

Appendix

Description of the commercial fish species

Bib -*Trisopterus luscus*:

Colour: pale coppery with 4 or 5 broad dark vertical bars (not seen in trawled fish). Size: to 30 cm SL. Rarely to 45 cm, usually 15-20 cm.

Habitat: adults offshore, at depths of 30-100 m and sometimes considerably deeper, young close to the shore, immature often in large shoals, over sandy areas. Behaviour: demersal and gregarious fish. Food: bottom crustaceans, occasionally small fish and polychaetes. Reproduction: mainly March and April, at depths of 50-70 m, mature at the end of first year.

Distribution: Skagerrak, North Sea, British Isles, southward to Morocco, western Mediterranean.

Common names:
steenbolk [Ne]
tacaud [Fr]

Cod - *Gadus morhua*:

Colour: variable, generally sandy brown, with a green tinge, densely mottled with small brownish or greyish marks on the sides and back, the belly white. In coastal regions and in the Baltic and White Seas the colour is darker and motley. Size: to 190 cm SL, usually 50-80 cm.

Habitat: continental shelf from shoreline to 600 m depth or even deeper, usually 150-200 m, at bottom or in intermediate water layer between 30-80 m off bottom in Atlantic and less deep in Baltic and White Sea. Behaviour: gregarious, forming shoals and undertaking spawning and feeding migrations. Food: diet of adults is variable and consists mainly of herring, capelin, haddock, codling and other fish present in numbers, also euphausiids, hyperiids, amphipods, polychaetes, etc. Reproduction: spawning over the continental shelf of northern Europe, especially at Lofoten Islands, inside 200 m line, from February to April and from March to May in coastal region of White Sea.

Distribution: North Atlantic and adjacent seas, from Bay of Biscay to Greenland, Spitzbergen and Novaya Zemlya Baltic and White Sea also in western North Atlantic and both sides of North Pacific

Common names:
kabeljauw[Ne]
morue [Fr]

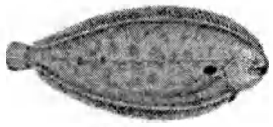
Common sole - *Solea solea*:

Colour: eyed side greyish-brown to reddish-brown, with large and diffuse dark spots; pectoral fin on eyed side with a blackish blotch at posterior end of fin; hind part of caudal fin generally darker than rest. Size: to 70 cm SL.

Habitat: demersal on sandy and muddy bottoms, from the shore down to 200 m. Food: polychaete worms, molluscs, small crustaceans. Reproduction: spawns January-April, with two peaks in February (Mediterranean), or December-May (Bay of Biscay), or April-June (North Sea).

Distribution: eastern Atlantic (southward from Trondheim Fjord, also North Sea and western Baltic) and Mediterranean (also Sea of Marmara, Bosphorus and south-western Black Sea). Elsewhere, southward to Senegal.

Common names:
tong [Ne]
sole commune [Fr]



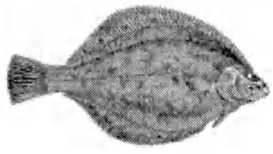
Dab - *Limanda limanda*:

Colour: eyed side often with small rusty-red spots. Size: to 40 cm SL, seldom more than 30 cm.

Habitat: on sandy bottoms, from a few metres to about 100 m. Food: mainly crustaceans and small fishes. Reproduction: spawns from January to August; larvae settle at depths of 10-20 m. Commercial importance: caught as by-catch and mainly marketed as fillets.

Distribution: eastern Atlantic, from Bay of Biscay to White Sea, also Iceland.

Common names:
schar [Ne]
limande [Fr]



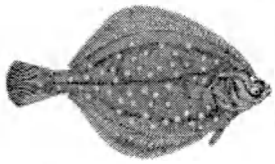
Plaice - *Pleuronectes platessa*:

Colour: see genus. Size: to about 100 cm SL, seldom more than 35-40 cm.

Habitat: on mixed bottoms, from a few metres to about 100 m, the older the deeper the occurrence. Food: mainly thin-shelled molluscs and polychaetes. Reproduction: spawns from December to January when the temperature is about 6 °C. Commercial importance: the most important flatfish in weight for fisheries in Europe.

Distribution: western Mediterranean (occurrences in the eastern Mediterranean doubtful) and along European coasts to White Sea; occasionally off Greenland.

Common names:
schol [Ne]
plie [Fr]



Whiting - *Merlangius merlangus*:

Colour: variable, yellowish-brown, dark blue or green, sides yellowish-grey, white and silvery on belly. Size: to 70 cm SL, usually 30-40 cm; smaller in Black Sea, to 58 cm, usually 15-20 cm.

Habitat: shallow water, rarely below 200 m, usually 30-100 m, over sandy or muddy ground, young live closer to the shore, 5-30 m. Behaviour: above the bottom and often near surface. Food: crustaceans and fishes, proportion of fishes increasing with age. Reproduction: from January in the south to July in the north, throughout range.

Distribution: European coasts from Iceland and south-western Barents Sea to northern coasts of Portugal, western Baltic to Gotland Island, doubtful in western Mediterranean, Black Sea, adjacent parts of Azov Sea, Sea of Marmora, Aegean Sea and Adriatic.

Common names:
wijting [Ne]
merlan [Fr]

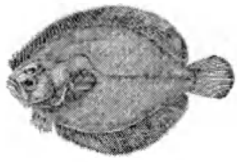
Description of the fish species

Brill - *Scophthalmus rhombus*:

Colour: brownish or greyish, often with numerous small, dark spots. Size: to about 75 cm SL. Habitat: benthic on the continental shelf. Food: benthic invertebrates and small fish. Commercial importance: species reach a sufficient size and are abundant enough to be important for fisheries.

Distribution: whole Mediterranean and Black Sea; also eastern Atlantic along European coasts to 64° N.

Common names:
griet [Ne]
barbue [Fr]



Flounder - *Platichthys flesus*:

Colour: brownish, greyish or olivaceous, uniform or variously blotched and mottled with darker marks; faint red spots on the eyed side. Size: to 50 cm SL, but seldom more than 30 cm.

Habitat: at shallow depths with soft bottoms; often found in brackish water and in rivers and lakes. Food: small fishes and invertebrates. Reproduction: spawns in February-June. In some areas, e.g. the western Baltic, it hybridizes with the plaice (Pleuronectes platessa) and the hybrids are very common. Commercial importance: mainly important to fisheries in Baltic and Danish waters.

Distribution: eastern Atlantic, from the White Sea to Mediterranean and Black Sea.

Common names:
bot [Ne]
flet [Fr]

Lemon sole - *Microstomus kitt*:

Colour: brownish or greyish, often spotted, marbled or blotched with paler and darker marks; usually some dark spots on median fins. Size: to about 45 cm, seldom more than 20-30 cm.

Habitat: most often on stony bottoms at 20-200 m. Food: a variety of small invertebrates, but polychaetes seem to dominate. Reproduction: spawns between April and September. Commercial importance: an important food fish.

Distribution: eastern Atlantic, from the Bay of Biscay to the White Sea and off Iceland.

Common names:
tongschar [Ne]
limande-sole [Fr]

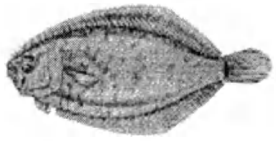
Scaldfish - *Arnoglossus imperialis*:

Colour: eyed side greyish or brownish with irregular darker markings; fins with some small spots or blotches; males with distinct black spot on posterior part of pelvic fins; in females, this spot present but greyish and often indistinct. Size: to about 25 cm SL.

Habitat: on sandy or muddy bottoms down to 350 m. Food: small fishes and invertebrates. Reproduction: in spring.

Distribution: eastern Atlantic, from Scotland southward. Elsewhere, south to Angola and in western Mediterranean.

Common names:
vervloekte tong [Ne]
arnoglosse impérial [Fr]



Solenette - *Buglossidium luteum*:

Colour: eyed side sandy yellow or light brown, with small brown or 2 grey spots; dorsal and anal fins with every fourth to seventh finray dark for most of its length. Size: to 15 cm SL.

Habitat: demersal on sandy bottoms of continental shelf and slope, at depths of 5-450 m (mainly at 10-40 m). Food: wide range of small bottom-living organisms, mainly crustaceans (copepods, amphipods, cumaceans), bivalve molluscs and polychaetes. Reproduction: spawns in February (Mediterranean), March, April-June (Bay of Biscay) and July-August (western part English Channel, North Sea, western Ireland).

Distribution: eastern Atlantic (Iceland and Scotland southward, also North Sea, Kattegat and Baltic) and Mediterranean (including Adriatic, Sea of Marmara, Bosphorus).

Common names:
dwergtong [Ne]
petite sole jaune [Fr]

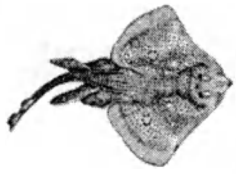
Spotted ray - *Raja montagui*:

Colour: upper surface brownish with numerous small darker spots which do not reach the margins of the disc or of the pelvic fins; frequently a concentration of dark spots forming a ring around a pale centre on hind part of each pectoral fin (resembling an eye-spot) and occasionally several pale white blotches, underside white. Size: to about 80 cm TL.

Habitat: benthic, from inshore waters to about 100 m; moderately common, regularly marketed. Food: preference for crustaceans. Reproduction: oviparous; egg-cases laid in summer, embryos developing in 5-6 months, 64-77 by 37-46 mm (excluding horns).

Distribution: Atlantic coasts from Morocco northward to the Shetlands, southern North Sea and Baltic Sea, also western part of Mediterranean (to Tunisia and to western Greece).

Common names:
gevlekte rog [Ne]
raie douce [Fr]



Stripped red mullet - *Mullus surmuletus*:

Colour: reddish with brown edges on the scale margins, pink on the sides with three lengthwise yellow bands; the first dorsal fin yellowish with dark markings, mainly on the upper part of the fin membrane. Size: to 40 cm SL, usually 20-25 cm.

Habitat: benthic on broken and rough ground but also taken in fair quantities over sand and soft bottoms at depths less than 100 m. Less gregarious than Mullus barbatus. Food: entirely composed of bottom organisms (crustaceans, chiefly shrimps and amphipods, polychaetes, molluscs and benthic fishes) except during their pelagic life (larval crustaceans and copepods). Reproduction: spawns from May to July; the eggs and larvae are pelagic.

Distribution: along the coasts of Europe from the English Channel (rare in North Sea) to Gibraltar, also northern part of West Africa to Dakar and in the Mediterranean and Black Seas.

Common names:
zeebarbeel [Ne]
rouget barbet [Fr]

Trigger fish - *Balistes carolinensis*:

Colour: greenish-grey or bluish, variegated clear and dark. Pale blue lines or spots on fins. Size: 40 cm SL.

Habitat: chiefly over rocky bottoms, at 10-100 m; often under floating wreckage; juveniles in Sargassum in tropical Atlantic. Behaviour: usually solitary. Food: molluscs and crustaceans. Reproduction: in summer; eggs on bottom, in a cavity made by female, guarded by male; juveniles without elongated caudal rays.

Distribution: Mediterranean (common), Black Sea (rare) and on both sides of Atlantic (from North Sea to Angola and from Nova Scotia to Argentina)

Common names:
trekkervis [Ne]
baliste [Fr]

Tub gurnard - *Trigla lucerna*:

Colour: pink or reddish-brown, sometimes mottled on back, golden to white ventrally; outer face of pectoral fins pinkish-violet or blue, spotted with white or green, and light blue or red on margins. Size: to 75 cm, usually 35 cm.

Habitat: sand, muddy sand or gravel bottoms from about 20 to 300 m depth. Behaviour: may be found in surface waters, good swimmer, can penetrate estuaries. Food: predator on fish, crustaceans and molluscs. Reproduction: spawning from May to July and the young are found in shallow bays or even estuaries in late summer.

Distribution: in eastern Atlantic from Norway to West African coast (Cape Blanc); not recorded at Madeira and the Azores, Mediterranean and Black Seas.

Common names:
rode poon [Ne]
grondin perlon [Fr]

Greater sand eel - *Hyperoplus lanceolatus*:

Colour: a conspicuous dark spot (a little less than eye diameter) on either side of snout; back green/blue (juveniles often distinctly greenish when mixed with Ammodytes species). Size: to 40 cm.

Habitat: inshore, including the inter-tidal zone and estuaries, and offshore to about 60 m depth. Commonly associated with Ammodytes species, but probably less gregarious.
Food: initially zooplankton, but for lengths greater than 10-15 cm small fish, such as clupeids and ammodytids dominate the diet. Reproduction: summer batch spawner; ripe adults occurring March-August.

Distribution: eastern North Atlantic from eastern Murman (70° N) and Spitzbergen (75° N) to Portugal (38° N) including Iceland and much of the Baltic. Not recorded from Mediterranean and Barents Seas.

Common names:
smelt [Ne]
lançon [Fr]

Lesser sand eel - *Ammodytes marinus*:

Colour: a sharp division on the sides of head, between dark upper and paler lower areas. Size: to 25 cm SL.

Habitat: abundant offshore, less common in inshore littoral habitats (mostly as juveniles). Alternates between lying buried in the sandy substrate and swimming in schools in the water mass. Food: zooplankton and some large diatoms. Reproduction: winter spawner; ripe adults occurring November-February, post-larvae February-May and occasionally to June (North Sea).

Distribution: eastern North Atlantic from 74° N (Novaya Zemblya and Bear Is.) to 49° N (Channel Islands, western English Channel), including eastern Greenland, Iceland, Barents Sea (but not the White Sea) and the Baltic (but not the Gulfs of Bothnia and Finland).

Common names:
zandspiering [Ne]
equille [Fr]

Red gurnard - *Aspitrigla cuculus*:

Colour: bright red above, pale below; pelvic fins pink; anal fin with a milky white base; pectoral and dorsal fins yellowish. Size: to 50 cm, usually to 25 cm.

Habitat: benthic on mud, sand, gravel, crags and rocks between 30 and 250 m. Behaviour: locally abundant, probably forms occasional aggregates. Food: benthic crustaceans, other invertebrates and bottomdwelling fishes. Reproduction: spawning in summer (April-August).

Distribution: in the eastern Atlantic from British Isles to Mauritania, north of 15° N, the Azores and Madeira, rare in North Sea; in Mediterranean, southern coasts of Spain, Morocco, Algeria, Tunisia, rare in 30°N northern and eastern Mediterranean.

Common names:
engelse poon [Ne]
grondin rouge [Fr]

Herring - *Clupea harengus:*

Colour: back dark blue, flanks silvery (without any dark spots). Size: to 40 cm, usually 20-25 cm.

Habitat: coastal pelagic down to 200 m, mainly offshore, the juveniles occurring in shallow water near the banks where they were spawned, but moving into deeper water after two years; shoaling, with complex feeding and spawning migrations, whose times and extent correlate with the numerous more or less distinct races which can be recognized on morphological grounds (mainly numbers of vertebrae, finrays, scales and gillrakers).

Food: small planktonic copepods in the first year; thereafter, mainly copepods (especially Calanus finmarchicus and Temora longicornis), but also hyperid amphipods, euphausiids, mysid shrimps, small fishes, arrow-worms, ctenophores and pteropods. Reproduction: at least one population is spawning in any month of the year, each race having a different spawning time and place (e.g. bays and inshore waters at 15-40 m, or on edges of ocean banks down to 200 m); eggs demersal, adhering to sea-bed.

Distribution: Atlantic coasts from Bay of Biscay northward to Greenland, Iceland, Spitsbergen and east to Novaya Zemlya; White Sea, south-eastern part of Barents Sea and adjacent gulfs and bays, also part of Kara Sea and Baltic. Elsewhere, western North Atlantic, from South Carolina to Greenland. Formerly very abundant and still the third most exploited clupeoid fish, but stocks seriously depleted by over-fishing, especially in the North Sea.

Common names:
haring [Ne]
hareng commun [Fr]

Sprat - *Sprattus sprattus:*

Colour: back blue/green, flanks silvery. Size: to 16 cm, usually 8-12 cm.

Habitat: coastal pelagic, often in shallow water close to shore, sometimes tolerating very low salinities (to 4‰); shoaling, with strong migrations between winter feeding and spring and summer spawning grounds. Food: adults, on planktonic crustaceans (especially Calanus, Pseudocalanus and Temora) juveniles on diatoms and eggs and larvae of these copepods. Reproduction: some spawning almost throughout year, either near to coast or up to 100 km out to sea, mainly in July to May (Black Sea), December to April (Mediterranean), April to August (Atlantic and Baltic) or as early as January in English Channel.

Distribution: Atlantic coasts from northern Morocco northwards to North Sea and Baltic; also Mediterranean, Adriatic and Black Sea.

Common names:
sprot [Ne]
sprat [Fr]

Lesser weever - *Trachurus vipera:*

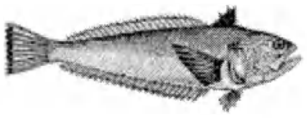
Colour: yellowish-brown with brown spots often forming some longitudinal lines on sides. Size: to about 15 cm SL.

Habitat : Littoral and benthic.On sandy, muddy or gravelly bottoms, from a few metres to about 150 m (in winter). Rest on the bottom, often burried with eyes and tip of first dorsal fin exposed. Food: they feed on smal invertebrates and fishes, cheifly captured by night. Reproduction : during the summer months.

Distribution: Mediterranean, Adriatic, eastern Atlantic from the Skagerrak, Scotland and Ireland to the Canaries. Locally very common.

Note. This species is considered as the most dangerous of the European weevers, both for its poison and for its frequent occurrence very near to beaches.

Common names:
kleine pieterman [Ne]
petite vive [Fr]



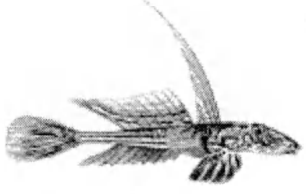
Dragonet - *Callionymus lyra:*

Colour: yellowish-brown, adult males with blue spots and stripes on head, body and dorsal fins; females and young males with saddles and green-brown blotches. Size: to 30 cm (males), 20 cm (females).

Habitat: benthic, on sandy and muddy bottoms, sublittoral to 430 m. Territorial, males aggressive to each other. Complex courtship behaviour with 4 phases: courtship, pairing, ascending, releasing eggs and milt. Food: small bottom invertebrates, mainly worms and crustaceans. Reproduction: April-August (North Sea), February August (Mediterranean); eggs and larvae pelagic.

Distribution: northern Mediterranean, Gibraltar and Algeria to the western Black Sea, including the Aegean and Adriatic; southern Iceland and Norway south to Mauritania; also, the Azores and the Canaries.

Common names:
pitvis [Ne]
dragonnet lyre [Fr]



Reticulate Dragonnet - *Callionymus reticulatus:*

Colour: orange or brown dorsally, with 6 darker patches, belly white. Second dorsal in males with dark blotches in vertical or oblique rows, in females colourless. Size: to 11 cm (males), 6.5 cm (females).

Habitat: benthic, sandy bottoms, tidal zone to 110 m; occasionally enters brackish waters. Food: small bottom invertebrates, mainly worms and crustaceans. Reproduction: March-June (North Sea); eggs and larvae pelagic.

Distribution: western Mediterranean (Malaga). Atlantic from Mauritania north to the North Sea (Heligoland), western Norway, Irish Sea and south-western Ireland.

Common names:
rasterpitvis [Ne]