İSKENDERUN COAL FIRED POWER STATION

IDENTIFICATION OF BENTHIC INFAUNA

FINAL REPORT

Prepared by

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OCTOBER 1999

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1 INTRODUCTION

Recently a final report concerning the coal-fiered power plant in the Gulf of İskenderun has been submitted to PARMAŞ. In this report the time consuming laborious infaunal community of the benthic investigation was not included.

Here, the results of the benthic infaunal studies together with grain size analysis were appended. For the seek of completeness of this report some parts of the previous report repeated and not referred to.

2 MATERIAL AND METHODS

Material and method of benthic infauna investigations and the grain size analysis are given in the forthcoming. First the methods applied for infauna analysis are described. This is followed by the method of grain size analysis.

2.1 BENTHIC INFAUNA

Figure 1 shows locations of the benthic stations equally spaced within the study area off which the coal fired power station has been considered to built. Benthic study area covered 2.0 x 1.5 km^2 and 16 stations equally spaced with longitude and latitude of the area. Water depths of the stations measured were 1-2, 7, 15, and 20 m from coast seaward, respectively. Regarding to the bottom depths three different research vessels were used to deploy benthos-sampling device, a standard Van Veen grab (0.1 m^2 sampling area). Those vessels were R/V Bilim (general oceanographic-aimed ship), R/V Lamas (trawl boat), and a small air-filled boat (a zodiac). R/V Bilim was used to collect the samples at bottom depths deeper than 10 m, R/V Lamas at a bottom depth of 7 meters, and the zodiac at 1-2 meters.

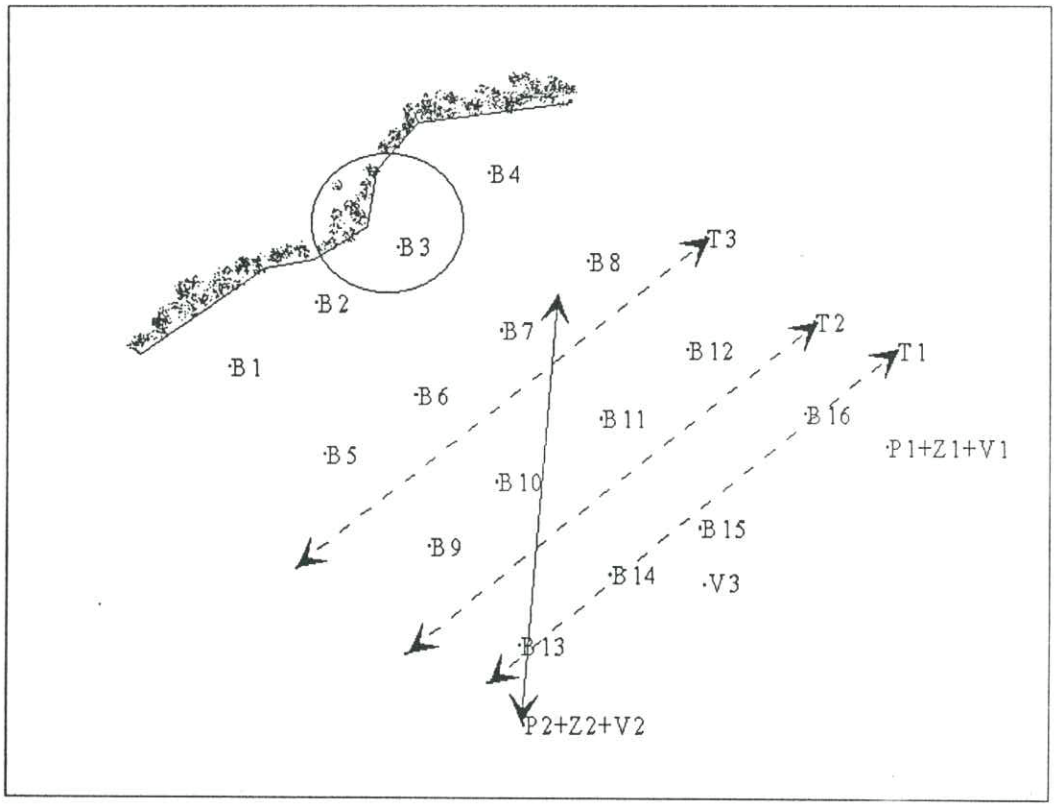

Figure 1: Sampling stations.

B = Benthic infauna P = Phytoplankton T = Trawl
Z = Zooplankton stations V = ROV records

The circle indicates diving site at the rocky shore; solid line is the diving transect.

Table 1: Sampling locations, water depth, date, and time of benthos stations

Station code	Latitude	Longitude	Depth (m)	Date	Time
B01	36 49.82	35 52.95	01	09.07.1999	09:54
B02	36 49.96	35 53.14	01	09.07.1999	09:47
B03	36 50.10	35 53.33	01	09.07.1999	09:40
B04	36 50.24	35 53.52	01	09.07.1999	09:30
B05	36 49.63	35 53.16	07	08.07.1998	11:01
B06	36 49.76	35 53.36	07	08.07.1999	10:49
B07	36 49.90	35 53.55	07	08.07.1999	10:42
B08	36 50.05	35 53.74	07	08.07.1999	10:30
B09	36 49.49	35 53.35	11	07.07.1999	16:05
B10	36 49.57	35 53.54	15	07.07.1999	15:50
B11	36 49.71	35 53.77	16	07.07.1999	16:01
B12	36 49.86	35 53.96	15	07.07.1999	16:09
B13	36 49.22	35 53.59	19	07.07.1999	11:00
B14	36 49.37	35 53.79	19	07.07.1999	16:30
B15	36 49.47	35 53.99	19	07.07.1999	16:18
B16	36 49.72	35 54.22	19.5	07.07.1999	16:52

The grab was deployed with an electrical winch at the deeper bottom in relative to coastal stations while on R/V Lamas (stations B5, B6, B7, B8) and R/V Bilim (B9, B10, B11, B12, B13, B14, B15 and B16). The grab was manually deployed at the coastal stations (stations B1, B2, B3 and B4). Then the samples were handed onto the zodiac. Two bottom samples were collected with the grab from each of all stations. One of them was used for macro-benthos data, and significant part of other was stored into a nylon bag for grain size analysis of the sediment. The nylon was labeled with station and sampling information, then was frozen for the laboratory analysis.

Samples taken for macro-benthic study were sieved with a set of 2, 1 and 0.5 mm mesh size sifts. Sediments of soft-bottom samples were washed out with jet sprinkler water. The residuals left on each sift were transferred into separate plastic jars. 3% formaldehyde buffered with borax was added into the jars in order to preserve benthic organisms. The labels containing station information e.g. location and bottom depth of station, sampling date and time, and mesh size of sift used for the samples were stuck on the jars.

Sorting process of the benthic organisms is carried out in the Institute's laboratory. The process has been done under stereoscopic binocular. Sorted living organisms have been stored into a glass vial and preserved in 70% ethanol. The organisms were identified at species level, and counted.

Statistical evaluation applied for the present study was gathered under two different techniques, namely, univariate (diversity indices) and multivariate (hierarchical classification; cluster and multidimensional scaling (MDS).
Following TOMASCIK and SANDER (1987) diversity indices (species richness, evenness, and Shannon-Wiener index) were calculated to measure a relation to the total number of species present, to express how evenly the individuals are distributed among different species, and to incorporate both the species richness and equitability components, respectively.

The abundance was subjected to cluster analysis and MDS to find natural groupings of samples such that samples within a group are more similar than samples in different groups (FIELD et al., 1982). All statistical treatment and calculations were performed under a package PC program called PRIMER (Plymouth Routines In Multivariate Ecological Research; CARR, 1991).

2.2 GRAIN SIZE ANALYSIS

The technique of grain size analysis is based on FOLK's method (1974).

Sediments containing coarse materials (larger than 2 mm) were wet-sieved with a sieve of 2 mm. The total amount of material remaining on the sieve gives the percentage of gravel fraction (> 2 mm) present in the sediment sampled.

The sediment passing through the 2.0 mm screen was composed of a mixture of sand-mud. Sand was separated from mud by means of wet-sieving technique using a mesh size of 0.063 mm. The retained material larger than 0.063 mm in size was made up of sand. All material passing through the 0.063 mm sieve was mud. Gravel and sand fractions were dried for 2 days at about 60^0C in an oven and weighed at room temperature for their percentage calculation.

The mud fraction was divided into silt (0.063-0.004 mm) and clay (graine-size < 0.004 mm) fraction.

For this purpose, the mud fraction of the sample was transferred into 1 L graded cylinder, filled with distilled water, and stirred. After a retention of 20 sec, 20 ml of the suspension was withdrawn from the depth of 20 cm by a pipette. Thereafter, the suspension was left in cylinder for 2 hours for further sedimentation. After this time, 20 ml of suspension was withdrawn from the depth of 10 cm by means of pipette.

These withdrawn mud subtractions of the sediment were dried in an oven at temperature of about 60^0C for 2 days. The sub-fractions were then cooled to room temperature, and weighed out. The first separated fraction was the silt plus clay and the second (last one) largely composed of the silt. The difference (silt + clay – silt) will then give the amount of clay fractions in the sample.

3 RESULTS

Results are presented in conjunction with subject areas. Here, first the results of the benthic infauna and then the results of grain size analysis are given.

3.1 SPECIES AND ABUNDANCE OF BENTHIC INFAUNA

Totally 76 macro-benthic infaunal species was found at the investigated area. Distributions of the species within taxa are as follows:

# of species	Taxa
1	Nemertini,
40	Polychaeta,
17	Crustacea,
15	Mollusca,
2	Echinodermata, and
1	Cephalochordata (Table 2).

Number of species and abundance occurred at low number in the most shallow (B1, B2, B3, and B4 where the bottom depth measured 1 m) and relatively deeper stations (B16, B15, B13, and B9 where the bottom was deeper than 10 m). Number of species varied between 10 and a maximum of 30 at rest of the stations. The abundance at the stations ranged from 200 to 1000 individuals per square meter. Stations with respect to high abundance were located at a bottom depth of 7 m (B5, B6, and B7; Figure 2). CTD measurements casted at two deeper stations (B13 and B16) revealed that in relative to surface water, there was a layer of fresher water, (brackish water) clouding and shadowing the bottom. One of possible reasons for occurrence of the species at low number could be unfavourable effect of the brackish water on marine macro-benthos.

Table 2: Abundance (individuals/m^2) of benthic infaunal species found at stations
+ denotes occurrence of fragment of the species.

SPECIES	B 01	B 02	B 03	B 04	B 05	B 06	B 07	B 08	B 09	B 10	B 11	B 12	B 13	B 14	B 15	B 16
NEMERTINI																
Nemertini (sp.)	0	0	0	0	0	10		0	0	10	10	0	0	10	50	0
POLYCHAETA																
Harmothoe impar	0	0	0	0	0	0		0	0	0	10	0	0	0	0	0
Harmothoe sp.	0	0	0	0	0	10		0	0	0	0	0	10	10	0	32
Polynoidae (sp.)	0	0	0	0	10	0		10	0	0	0	0	0	0	0	0
Sigalion cf mathildae	0	0	0	0	10	30		0	0	0	0	0	0	0	0	0
Sigambra parva	0	0	0	0	60	0		0	0	0	10	10	10	30	0	48
Nephthys caeca	0	0	0	0	0	70		0	0	0	0	0	0	0	0	0
Nephthys hombergii	0	0	0	0	0	40		0	0	0	0	0	0	0	0	0
Nephthys sp.	0	0	0	0	20	30		0	0	10	0	0	0	0	10	0
Glycera tridactyla	0	0	0	0	0	20		0	0	0	0	40	0	30	0	10
Glycera cf rouxi	0	32	0	0	0	30		0	0	20	0	30	0	0	0	0
Glycera sp.	0	64	0	0	30	0		10	10	0	40	50	0	20	0	10
Diopatra cf neopolitana	0	0	0	0	0	0		0	0	10	0	0	0	0	0	0
Lumbrinerides cf amoureuxi	0	0	0	0	0	0		0	0	0	0	0	0	20	0	0
Lumbrineris sp.	20	0	0	0	0	0		0	0	0	0	0	0	0	0	0
Paradoneis lyra	0	0	0	0	0	0		0	0	0	0	20	20	30	0	0
Aricidea sp.	0	0	0	0	0	0		0	20	0	0	0	0	10	0	0
Aonides oxycephala	0	20	0	0	0	0		0	0	10	10	0	0	0	0	0
Nerine cf. Cirratulus	10	0	0	0	0	0		0	0	0	0	0	0	0	0	0
Malacoceros sp.	0	0	0	0	0	0		0	0	20	0	0	0	0	0	0
Nerinides sp.	0	0	10	10	0	0		0	0	0	0	0	0	0	10	0
Prinospio fallax	0	0	10	0	0	0		0	10	10	60	20	0	30	0	16
Prinospio cf cirrifera	0	0	0	0	0	0		0	0	0	10	0	0	0	0	0

Prinospio sp.	0	0	0	0	0	0		0	0	0	20	40	20	0	0	16
Spio filicornis	0	0	0	0	0	0		0	0	0	0	20	0	0	0	0
Spio sp.	0	16	0	0	0	20		0	0	0	10	0	0	20	0	0
Spiophanes bombyx	0	0	0	0	10	20		30	0	10	0	10	0	0	0	0
Spionidae (sp1.)	0	0	0	0	0	0		10	0	0	0	10	0	0	0	0
Spionidae (sp2.)	0	0	0	600	10	0		0	0	10	10	0	0	0	0	0
Magelona papillicornis	0	0	0	0	0	0		0	0	0	0	0	0	20	0	0
Spiochaepterus costarum	0	0	0	0	20	0		0	0	0	0	0	0	0	0	0
Cirratulus sp.	0	0	0	0	0	0		0	0	0	10	0	0	10	0	10
Monticellina heterochaeta	0	0	0	0	0	0		0	0	0	0	0	0	60	0	16
Heteromastus filiformis	0	0	0	0	50	0		0	20	0	0	0	30	290	0	20
Notomastus latericeus	0	0	10	0	10	40		0	110	0	320	570	30	10	10	20
Capitomastus sp.	0	0	0	0	0	0		0	60	0	10	10	20	20	0	0
Capitellidae (sp.)	0	0	0	0	10	0		0	0	0	10	0	0	0	0	0
Cossura sp.	0	0	0	0	0	0		0	0	0	0	0	0	20	0	16
Owenia fusiformis	0	0	0	0	20	20		0	0	0	0	0	0	0	0	0
Pomatoceros triqueter	40	0	0	0	0	0		0	0	0	0	0	0	0	0	0
CRUSTACEA																
Nebalia bipes	0	0	0	0	0	10		10	0	0	0	0	0	0	0	0
Alpheus glaber	0	0	0	0	0	0		0	0	0	20	20	0	10	10	0
Palaemonotes sp.	0	0	0	0	0	0		0	0	0	0	0	10	0	0	0
Processa elegantula	0	0	0	0	0	0		0	10	0	0	0	10	0	0	0
Processa sp.	0	0	0	0	0	0		0	0	0	0	0	0	10	0	0
Macrophthalmus graeffei	0	0	20	0	0	0		10	0	0	0	0	0	0	0	0
Portumnus latipes	0	0	10	0	0	0		0	0	0	0	0	0	0	0	0
Callianassa tyrrhena	0	0	0	0	0	0		10	0	0	0	0	70	40	30	30
Upogebia pusilla	0	0	0	0	0	10		0	10	0	0	0	10	0	10	0
Anomura sp.	10	0	0	0	0	0		0	0	0	0	0	0	0	0	0

Apseudes latreillei	0	0	0	0	0	10		0	0	0	0	0	0	0	0	0
Eurydice pulchra	0	0	10	0	0	0		0	0	0	0	0	0	0	0	0
Ampelisca brevicornis	0	0	0	0	20	20		60	0	0	0	0	10	0	0	0
Bathyporeia lindstromi	40	0	0	0	0	0		0	0	0	0	0	0	0	0	0
Caprella sp.	0	0	0	0	0	0		0	0	0	0	0	10	0	0	0
Leucothoe richiardii	0	0	0	0	10	30		0	0	0	0	0	0	0	0	0
Urothoe grimaldii	0	0	0	20	0	0		0	0	0	0	0	0	0	0	0
MOLLUSCA																
Bittium reticulatum	0	0	0	0	0	0		0	0	20	0	0	0	0	0	0
Bittium submamillatum	0	0	0	0	0	0		0	0	20	0	0	0	0	0	0
Caecum trachea	0	0	0	0	0	0		0	0	10	0	0	0	0	0	0
Nassarius sp.	10	0	0	10	0	0		0	0	10	0	0	0	0	0	0
Anachis savignyi	10	0	0	0	0	0		0	0	0	0	0	0	0	0	0
Acteon tornatilis	0	0	0	0	10	0		0	0	0	0	0	0	0	0	0
Odostomia sp.(juv)	0	0	0	0	0	0		0	0	10	0	0	0	0	0	0
Tellina sp. (juv.)	0	0	0	0	40	30		10	0	30	0	0	0	0	0	0
Macoma cumana	0	0	0	0	10	40		0	0	0	0	0	0	0	0	0
Abra alba	0	0	0	0	70	10		20	0	40	0	0	0	0	0	0
Abra prismatica	0	0	0	0	30	0		0	10	40	0	0	10	30	0	0
Abra sp. (juv.)	0	0	0	0	180	20		70	0	50	50	0	10	10	0	0
Pharus legumen	0	0	0	0	20	30		0	0	0	0	0	0	0	0	0
Loripes lacteus	0	0	0	0	0	10		0	0	0	0	0	0	0	0	0
Myrtea spinifera	0	0	0	0	30	20		0	0	10	0	0	0	0	0	0
ECHINODERMATA																
Echinocardium cordatum	0	0	0	0	480	220		90	0	20	0	0	0	0	0	0
Amphipholis squamata kol)	0	0	0	0	+	0		0	0	+	0	+	0	0	0	0
CEPHALOCHORDATA																
Amphioxus lanceolatum	10	0	0	0	0	0		0	0	0	0	0	0	0	0	0

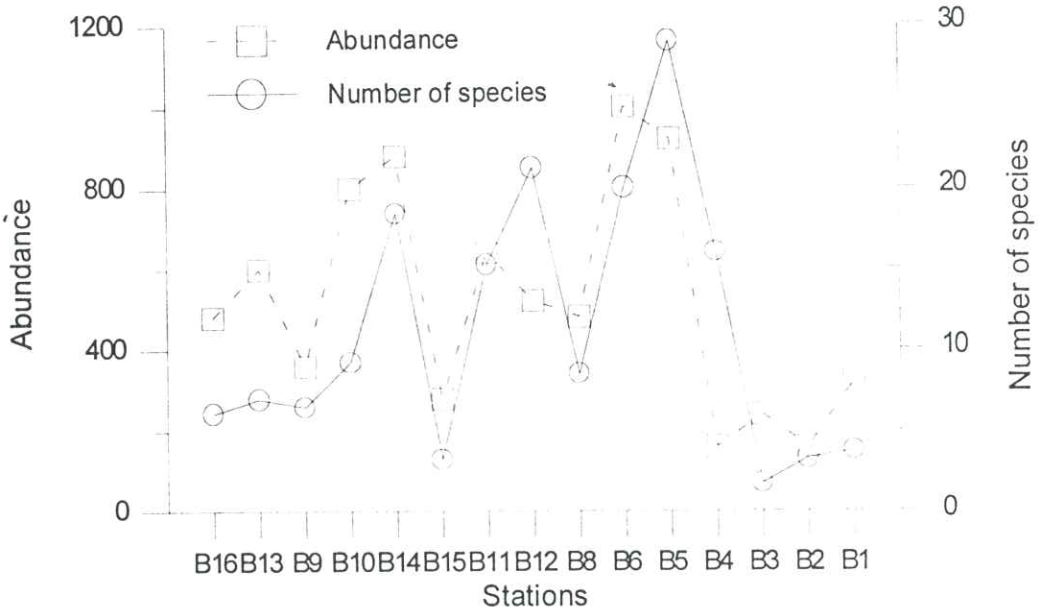

Figure 2: Total number of species and their abundance (individuals/m^2) found at the stations.

Figure 3 shows percent occurrence of the total species at high taxa level, regardless of their abundance. Taxon, Polychaeta, appeared to predominate the all stations. Highest occurrence of the taxon was observed at stations B16, B12, B11, and B2. Species, *Glycera* sp., *Notomastus latericeus* was commonly present at the stations. Nemertini and Cephalochordata species were observed at stations B6, B10, B11, B14, and B15 and B1, respectively whereas species of rest taxa were present at all stations. Crustacean species, *Alpheus glaber, Callianassa tyrrhena, Ampelisca brevicornis* became more predominant in relative to other species. An amphipod species, *Ampelisca brevicornis* dominated only stations B5, B6 and B8 where the bottom read 7 m depth. A species from Mollusca, *Abra* sp (juv.) was found at 50% of the total stations. *Abra prismatica* and *Tellina* sp (juv.) followed this from commonly present molluscan species. *Echinocardium cordatum*, a species of Echinodermata, predominated stations B5, B6, B8 where *Ampelisca brevicornis* was abundantly observed.

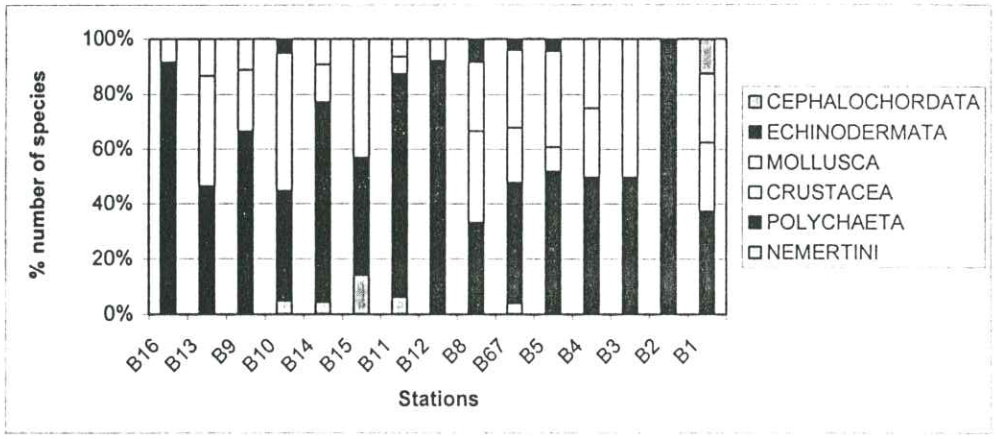

Figure 3: Distribution of percent number of species at taxa level at the stations.

Figure 4 shows numerical importance of the taxa among the stations. Species belonging to Polycheata were abundantly found in the investigated area. Their abundance comprised at least 30 % of total abundance. Molluscan species were abundantly common at the all stations. Crustacean and Echinodermata species then followed these. Abundances of *Spionidae* (sp2), *Heteromastus filiformis*, *Prinospio fallax* and *Notomastus latericeus* (Polychaeta) varied between 20 and 600 individuals per square meter at stations where the bottom depth was greater than 10 meters (Table 2). *Callianassa tyrrhena* and *Ampleisca brevicornis* were the most abundant crustacean species. Their abundances were in a range of 10 to 70 individuals per square meter of station bottom. *Palamonotes* sp. and *Processa* sp. were scarce. The most abundant species of Mollusca was, in the first instance, *Abra* sp. (juv.). *Abra alba* was recognized to be a second important species in term of abundance. *Echinocardium cordatum* was a single and abundant species of Echinodermata.

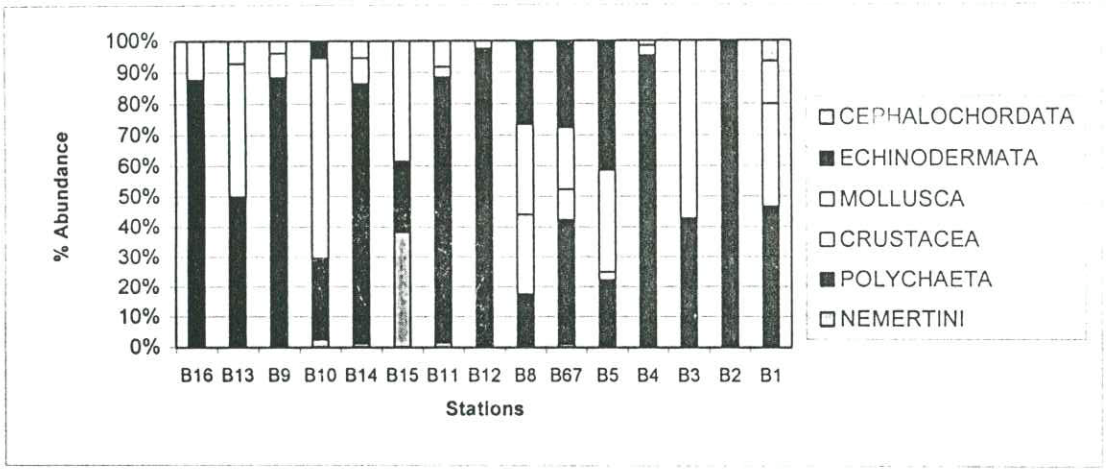

Figure 4: Distribution of percent abundance of the species at taxa level at the stations.

Figure 5 shows the classification analysis for species abundance based on data that is given in Table 2. On the dendograms, group 1 and 2 are clearly separated from each other at in case of a truncation of 30% similarity level. Stations of group 1 represented by shallower depths in relation to stations of group 2 (B12, B11 B14, B16, B9, and B13). Multi-dimensional scaling (MDS) configuration shows a clearer separation of the groups 3. Stations B3 and B15 occupying an intermediate position between group 1 (shallower stations) and group 2 (relatively, deeper stations).

Indications were obtained for the variables correlated with group difference (Figures 6 and 7) by superimposing measured environmental factors on the two dimensional configuration of the stations position obtained from the faunistic multivariate analyses. Figure 7 shows the MDS configuration with superimposition of variables, water depth and a fraction of grain size, clay. Neither sand nor gravel and silt fractions are correlated closely with the group positions.

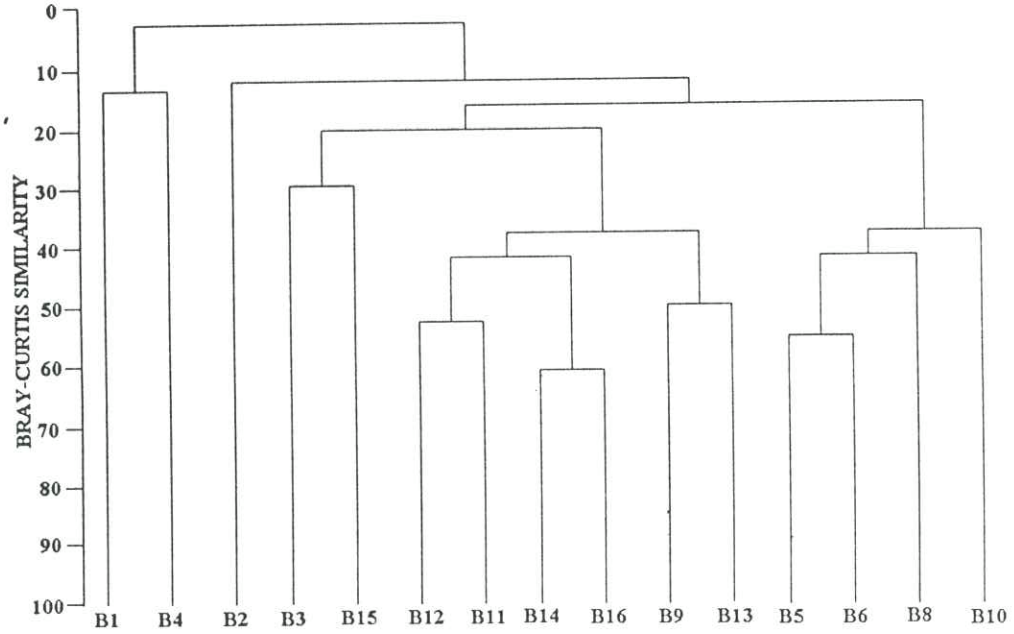

Figure 5: Dendogram for group-average clustering of Bray-Curtis similarities (y-axis) between the 15 station macrobenthic faunal samples (x-axis).
Species abundance data (Table 2), double-square root- transformed.

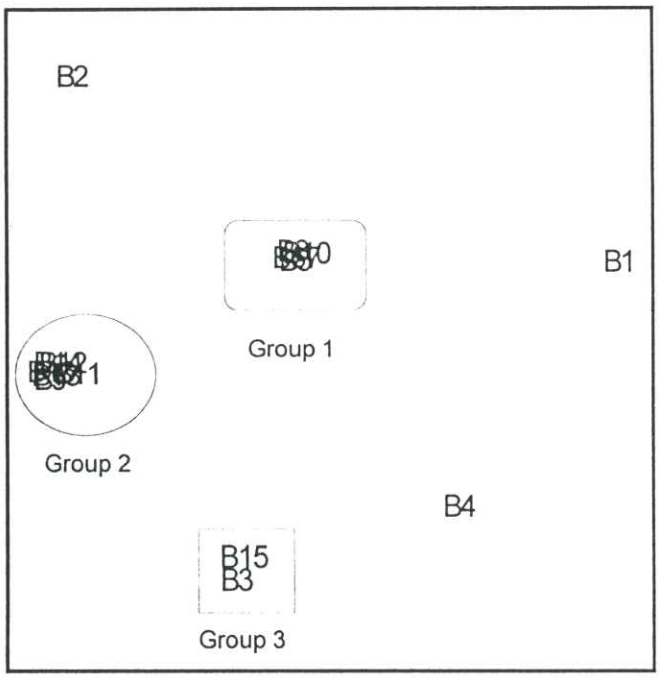

Figure 6: Multi-dimensional scaling (MDS) ordination, based on Bray-Curtis similarities between grab samples of the macrofauna. Samples are grouped by similarity in species counts (orientation and scale arbitrary).
Abundance are √√-transformed. Stress coefficient is 0.047.
Group 1 includes stations B10, B8, B6, and B5
Group 2 stations B13, B9, B16, B14, B11, and B12.

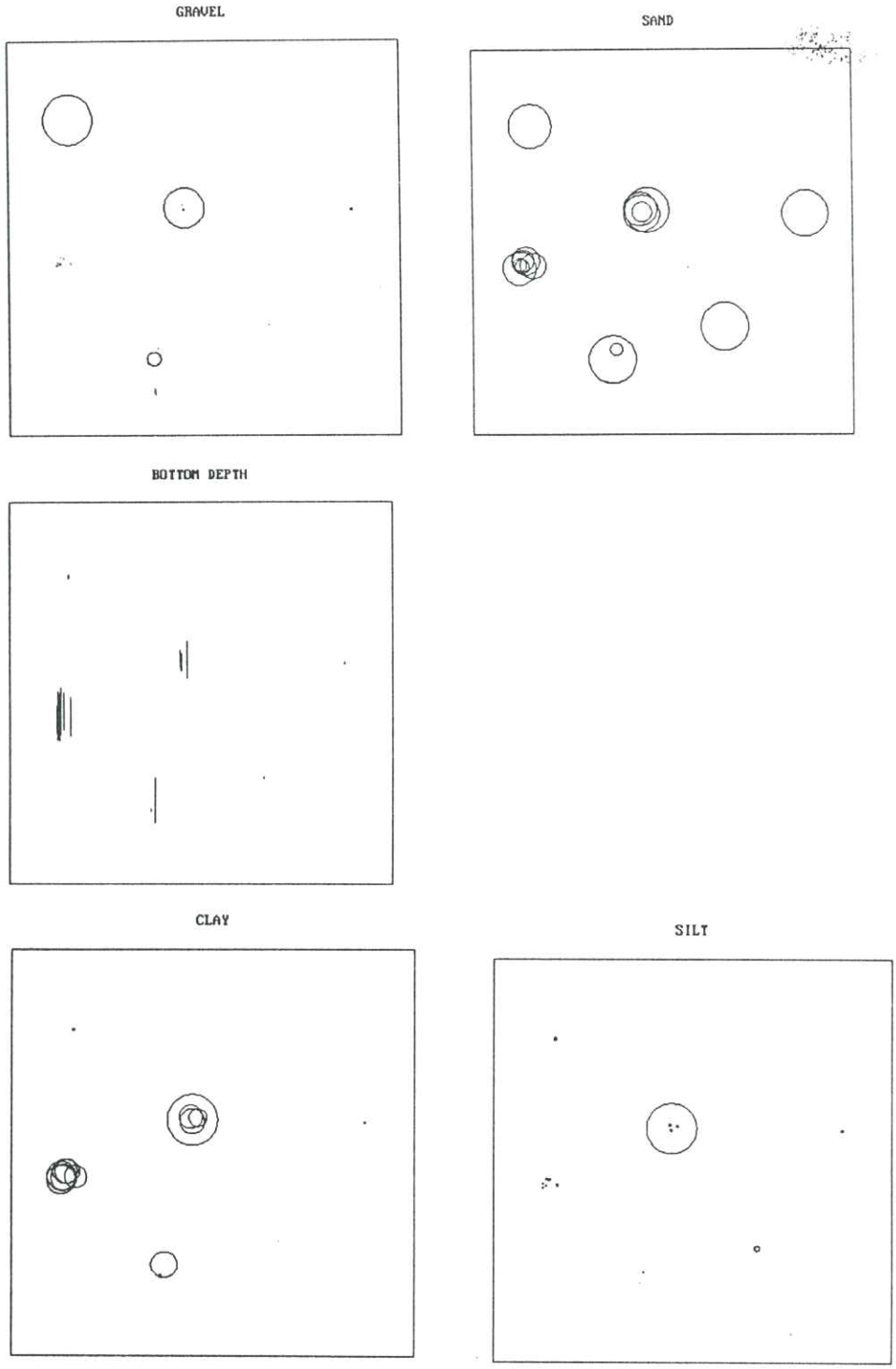

Figure 7: MDS ordination of the 15 macrofaunal samples from the investigated area, exactly as in Fig. 5, with superimposed sysmbols of lineal dimensions proportinal to the values of the measured environmental variables (bottom depth, % gravel, % sand, % silt and % clay) at the site.

Echinocardium cordata contributed most (15.51%) to the similarity with group 1 and was followed by *Abra* sp (juv.), *Abra alba*, and *Tellina* sp. (percent contribution of 14.19; 11.7 and 11.68, respectively; Table 3).

Table 3: Percent contribution of most important species to similarity within group 1

AV. ABUN = average species abundance,
SD = standard deviation of the abundance among the stations of the group,
AVGE = average similarity,
SDEV = standard deviation of similarity,
RATIO = AVGE/SDEV,
PERCENT = percent similarity of the species, and
CUM % = % cumulative similarity.

GROUP 1 AVERAGE SIMILARITY = 40.75 S.D.= 7.982							
SPECIES	AV.ABUN	SD	AVGE SIM	SDEV	RATIO	PERCENT	CUM %
E. cordata	202.50	202.71	6.3	1.51	4.20	15.51	15.51
Abra sp.(juv.)	80.00	69.76	5.8	1.65	3.51	14.19	29.71
A. alba	35.00	26.46	4.8	1.18	4.02	11.70	41.40
Tellina sp.	27.50	12.58	4.8	0.42	11.23	11.68	53.08
S. bombyx	17.50	9.57	4.3	0.86	5.04	10.62	63.70
A. brevicornis	25.00	25.17	2.4	2.70	0.90	5.93	69.63
M. spinifera	15.00	12.91	1.9	2.09	0.91	4.68	74.31
Nephthys sp.	15.00	12.91	1.9	2.09	0.91	4.68	78.99

The most important species with regard to the contrbution to simalarity within group 2 belonged mainly to Polychaeta while Mollusca and Echinodermata species played important role in natural grouping of stations within group 1. A Polychaeta species, *Notomastus latericeus* had a percent contribution of 19.1 in similarity within group 2. *Pronospio fallax, Glycera* sp. *Capitomastus* sp. , and *Sigambra parva* were other reasonable species of Polychaeta in natural grouping of site 2 (Table 4).

Table 4: Percent contribution of most important species to similarity within group 2

AV. ABUN = average species abundance,
SD = standard deviation of the abundance among the stations of the group,
AVGE = average similarity,
SDEV = standard deviation of similarity,
RATIO = AVGE/SDEV,
PERCENT = percent similarity of the species, and
CUM % = % cumulative similarity.

GROUP 2 AVERAGE SIMILARITY = 41.38 S.D.= 7.963							
SPECIES	AV.ABUN	SD	AVGE SIM	SDEV	RATIO	PERCENT	CUM %
N. latericeus	176.67	225.18	7.9	3.04	2.60	19.10	19.10
P. fallax	22.67	20.85	4.3	3.23	1.33	10.36	29.46
Glycera sp.	21.67	19.41	4.2	3.20	1.31	10.12	39.58
Capitomastus sp.	20.00	20.98	4.0	3.10	1.29	9.66	49.24
S. parva	18.01	17.68	3.7	2.80	1.33	8.97	58.21
H. filiformis	60.00	113.31	2.9	3.84	0.77	7.09	65.30
Prinospio sp.	16.00	14.97	2.8	3.51	0.79	6.67	71.98
C. tyrrhena	23.33	28.75	1.4	2.99	0.48	3.45	75.42

The species principally responsible for the station to station changes in community structures (as measured by Bray-Curtis dissimilarity) are given Table 5. Most important species as a discriminator between group 1 and 2 were *Echinocardium cordatum*, *Abra alba*, and *Tellina* sp. Those species were abundantly found at stations of group 1 whereas no individual of the species was encountered at stations of group 2 (Table 5).

Table 5: Pairwise comparison between groups in species contributions to total average dissimilarity between groups 1 & 2.

AV.ABN = average abundance of species i,
SD = standard deviation of average abundance,
AV.TRM = average dissimilarity of species i between the groups,
% = percent average dissimilarity of species i between the groups,
% CUM = cumulative % contribution to total average dissimilarity.

* denotes good discriminators of groups.

AVERAGE DISSIMILARITY BETWEEN GROUPS 2 & 1 = 82.24 STD.DEV = 5.985									
	GROUP 2		GROUP 1						
SPECIES	AV. ABN	S.D.	AV. ABN	S.D.	AV. TRM	S.D.	RATIO	%	% CUM
E. cordatum	0.00	0.00	202.50	202.71	4.67	1.23	3.79*	5.68	5.68
A. alba	0.00	0.00	35.00	26.46	3.24	0.81	3.98*	3.94	9.62
N. latericeus	176.67	225.18	12.50	18.93	3.22	2.52	1.28	3.91	13.53
Tellina sp	0.00	0.00	27.50	12.58	3.07	0.44	6.92*	3.74	17.27
Abra sp.	11.67	19.41	80.00	69.76	2.69	1.94	1.39	3.27	20.54
Capitomastus sp.	20.00	20.98	0.00	0.00	2.46	1.49	1.65	2.99	23.53
S. bombyx	1.67	4.08	17.50	9.57	2.43	1.29	1.88	2.95	26.48
A. brevicornis	1.67	4.08	25.00	25.17	2.30	1.81	1.27	2.80	29.28
H. filiformis	60.00	113.31	12.50	25.00	2.30	1.85	1.24	2.80	32.08
S. parva	18.01	17.68	15.00	30.00	2.15	1.40	1.54	2.61	34.70
Prinospio sp.	22.67	20.85	2.50	5.00	2.11	1.43	1.48	2.57	37.26

Fig. 8 shows ranges of species diversity, evenness, and richness. Stations B10 and B6 had highest Shannon diversity, closely followed by stations B14 and B5 as have been repeatedly for Margalef's species richness. Evenness was however about at the same level for all stations with an exception of station B4 that had lowest diversity indices. At the station, *Echinocardium cordatum* and a Polychaeta species, *Spionidae* (sp2.) predominated the bottom.

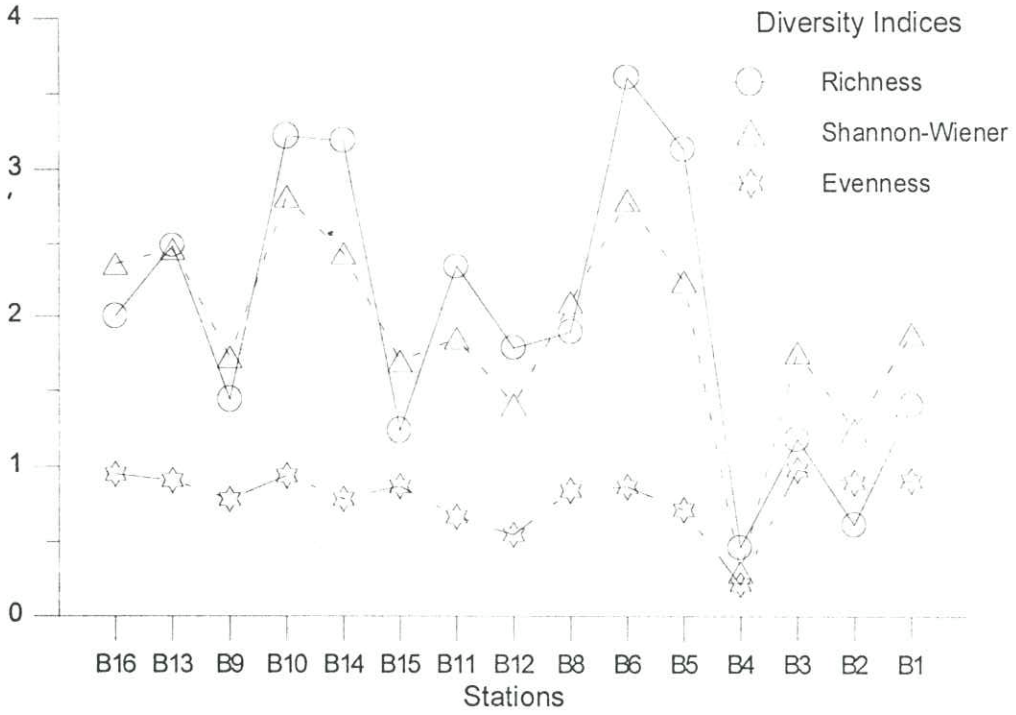

Figure 8: Basic descriptive variables for macrofauna samples from the site (species richness, diversity, and evenness).

3.2 GRAIN SIZE ANALYSIS - BOTTOM STRUCTURE OF THE SITE

Figure 9 shows percent composition of grain size in the sediment of each station. Sediment of stations having bottom depth greater than 10 meter was composed mainly of sandy silt. As the bottom depth was shoaled, grain size of the sediment became coarser and gravel concentration in the sediment was high at the shallowest stations.

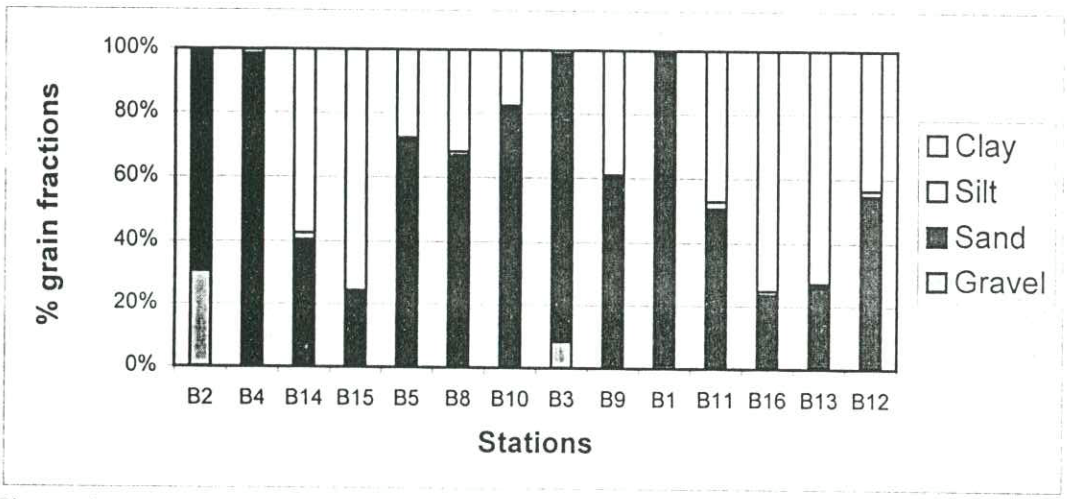

Figure 9: Percent grain size composition of bottom sediment collected at the stations.

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