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DISTRIBUTION AND ABUNDANCE OF BENTHIC ASSEMBLAGES IN EL-GAMIL BASIN (LAKE MANZALAH, EGYPT) A) MEIOBENTHOS

BY

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***Key words:* Meiobenthos, Lake Manzalah, distribution, composition.**

ABSTRACT

Meiobenthic fauna of El-Gamil Basin were studied during summer and winter of 1997 from 20 stations belonging to three sections. Sediment grain size analysis and organic matter content were determined at each station together with some environmental parameters of water.

Secchi disc readings showed a remarkable decrease in stations affected by discharge of wastewater. pH values were on the alkaline side and varied between 9 and 8.1. Dissolved oxygen concentration was high during winter. The highest values of salinity were recorded at section opposite to Boughas El-Gamil. Bottom sediments of the area were nearly homogenous composed mainly of clay loam at most localities. Organic matter was relatively high and varied from 6.98 % to 2.21%.

Meiobenthic community consisted mainly from four main groups, Foraminifera, Ostracoda, Nematoda and Copepoda in addition to small numbers of annelids, fish eggs and larvae of macrobenthos. The discharge of wastewater treatment plant decreased the number of individuals and species (diversity) in stations opposite to the discharge point. Distribution of meiobenthic taxa was closely correlated with organic matter, higher muddy content in the sediment and salinity.

INTRODUCTION

The meiobenthos of lakes has been little investigated in comparison with macrobenthos (Pennak, 1988; Moore & Bett, 1989). In contrast to the macrobenthos, meiobenthic species usually have a shorter life cycle, a faster metabolism and quicker reaction to changes in their environment (Lodge ***et al.***, 1988). This sensitivity to ecological disturbance permits these species to be used as potential indicators of environmental stress (Moore & Bett, 1989). Various approaches have been proposed for assessing pollution effects using meiobenthic community (Gray, 1981; Bodin, 1988; Herman & Heip, 1986; Ansari ***et al.***, 1984).

This present paper aims to study some abiotic parameters of water, sediment quality and its impacts on composition, abundance and distribution of meiobenthic community in El-Gamil Basin (part of Lake Manzalah) which influenced by different stress from the discharge of Port Said Wastewater Treatment Plant (WWTP) and marine water entering the lake through Boughas El-Gamil.

STUDY AREA

Lake Manzalah is the largest of the four Nile Delta Lakes. It is situated in the northeastern part of Egypt. It is bounded on the east by the Suez Canal and on the west by Damietta branch of the Nile and is separated from the Mediterranean Sea by a narrow sandy fringe at the north. The lake is connected to the Mediterranean Sea through a narrow channel (Boughas El-Gamil). The surface area of the lake has been significantly reduced in recent years, to an estimated 215,440 feddans (Ibrahim ***et al.***, 1997) as a result of land reclamation programs primarily on the lake's south border and on the east border in the vicinity of Port Said.

The islands and reed beds divided the lake into well defined basins (each is known as Bahr) having more or less distinctive ecological conditions.

The investigation area (El-Gamil Basin) is located in the northeast corner of the lake. The Port Said Wastewater Treatment Plant (WWTP) discharge into El-Gamil Basin through narrow culverts underneath the new Port Said ring road (Fig. 1)

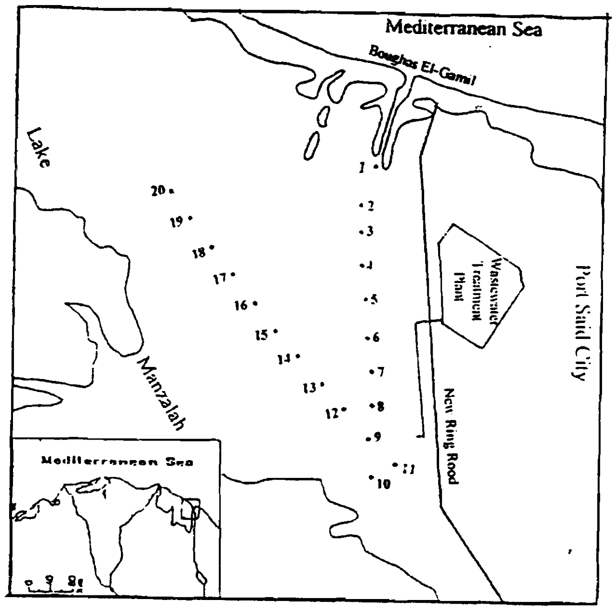


Figure 1. Map showing the location of the sampling sites.

Table (1) Spatial variations of percentage of grain size analysis of sediment along sampling sites of El-Gamil Basin during 1997

Section	Stations no.	clay %	silt %	fine sand %	coarse sand %	sediment type
Section I	1	30.55	39.95	22.28	7.22	clay loam
	2	32.385	36.9	25.93	4.79	clay loam
	3	28.24	38.59	25.84	7.27	clay loam
	4	36.365	23.665	31.64	8.33	clay loam
	5	29.81	37.43	16.69	16.07	clay loam
	6	36.765	29.01	16.33	17.90	clay loam
Section II	7	28.615	25.335	34.80	11.25	clay loam
	8	21.535	30.84	37.15	10.47	clay
	9	21.06	38.535	33.14	7.27	clay
	10	32.625	27.78	18.77	20.83	clay loam
	11	24.495	31.655	32.58	11.27	loam
	12	27.15	29.785	30.33	12.74	loam
	13	22.47	27	42.34	8.37	sandy clay loam
Section III	14	26.15	19.525	44.16	10.17	sandy clay loam
	15	36.195	35.15	19.17	9.49	clay loam
	16	28.31	38.345	21.39	11.96	clay loam
	17	1.13	16.11	26.78	55.98	sandy
	18	22.715	17.635	49.57	10.08	sandy clay
	19	23.205	9.28	62.58	4.94	sandy
	20	23.51	17.05	50.85	8.95	sandy clay

MATERIALS AND METHODS

Sampling of different environmental factors of water and sediment and meiofauna were collected twice during summer and winter of 1997. As shown in Figure 1, samples were taken from selected 20 sites belonging to three sections (I, II & III). Section I includes 6 stations (1–6), section II includes 7 stations (7–13) and section III (14-20). From each station, the different environmental factors were measured as follow: -

Transparency was determined by a 25 cm diameter Secchi disc and expressed in cm. Hydrogen ion concentration (pH) and dissolved oxygen were measured by a Cole – Paramer Model 5566 water analyzer and probe. Salinity was measured with a YSI Corp Model 30150 FT instrument and expressed as g/l.

Sediment samples were collected from sampling stations using Ekman Grab sampler equivalent to 250 cm^2. The samples were air dried and transferred to the laboratory for grain size analysis as was described by Kilmer and Alexander (1949). The organic matter content of the sediment was determined by method described by Allison (1935).

Samples for meiofauna were taken from the sampling sites by Ekman grap sampler. At each site, area of 10 cm^2 was taken from the upper sediment surface. The samples were preserved in 4% formaldehyde solution.

In the laboratory, the collected meiofauna samples were passed through two sieves, the top one with a mesh opening of 500 µm (captured the macrofauna) and the bottom one with a mesh opening of 55 µm animals retained on the lower mesh were considered as meiofauna. The samples were stained with Rose Bengal. Quantitative analysis of meiofaunal composition was carried out under a dissecting microscope for sorting and identification to the species or a high taxa level.

RESULTS

I – Physico-chemical parameters

1 - Secchi disc readings (turbidity):

The investigated area showed small variations in the secchi disc readings ranged from 15 to 27 cm (Figure 2-a). Stations of sections II (7 14) are most influenced by polluted eutrophic water from WWTP of the lake included high concentrations of the suspended organic matter causing an increase in turbidity values.

2- Hydrogen ion concentration (pH)

As shown in (Figure 2-b), the pH values of water in the basin is always on alkaline side. The highest value was a in station 15 during winter while the lowest one 8.1 was in station 20 during summer. Stations of section I (1–6) showed relatively low pH values increased slightly in section II and section III.

3 - Dissolved oxygen.

The values of dissolved oxygen are widely varied from summer to winter (Figure 2-c). The winter season values were very high compared with that of summer. This may be attributed to the decrease in water temperature which coincide with increasing of dissolved oxygen (Chang & Ouyang, 1988). Spatial distribution of dissolved oxygen showed a decrease in their values in stations of sector II which influenced by organic material coming from the WWTP. Most of dissolved oxygen are consumed during the decomposition of the organic materials. The same results were recorded by Konsuwa (1991) in Wadi El-Rayan Lakes.

4- Salinity.

Salinity is the most important indicator of changes in Lake Manzalah water quality. Salinity analysis shows that, water display a trend which is consistent with alternating flow through El-Gamil Basin of two types of water, saline water from the Mediterranean Sea and brackish/freshwater from the south agricultural and sewage drains. Thus high salinity of the lake was recorded in stations of section I which is opposite to the connector canal

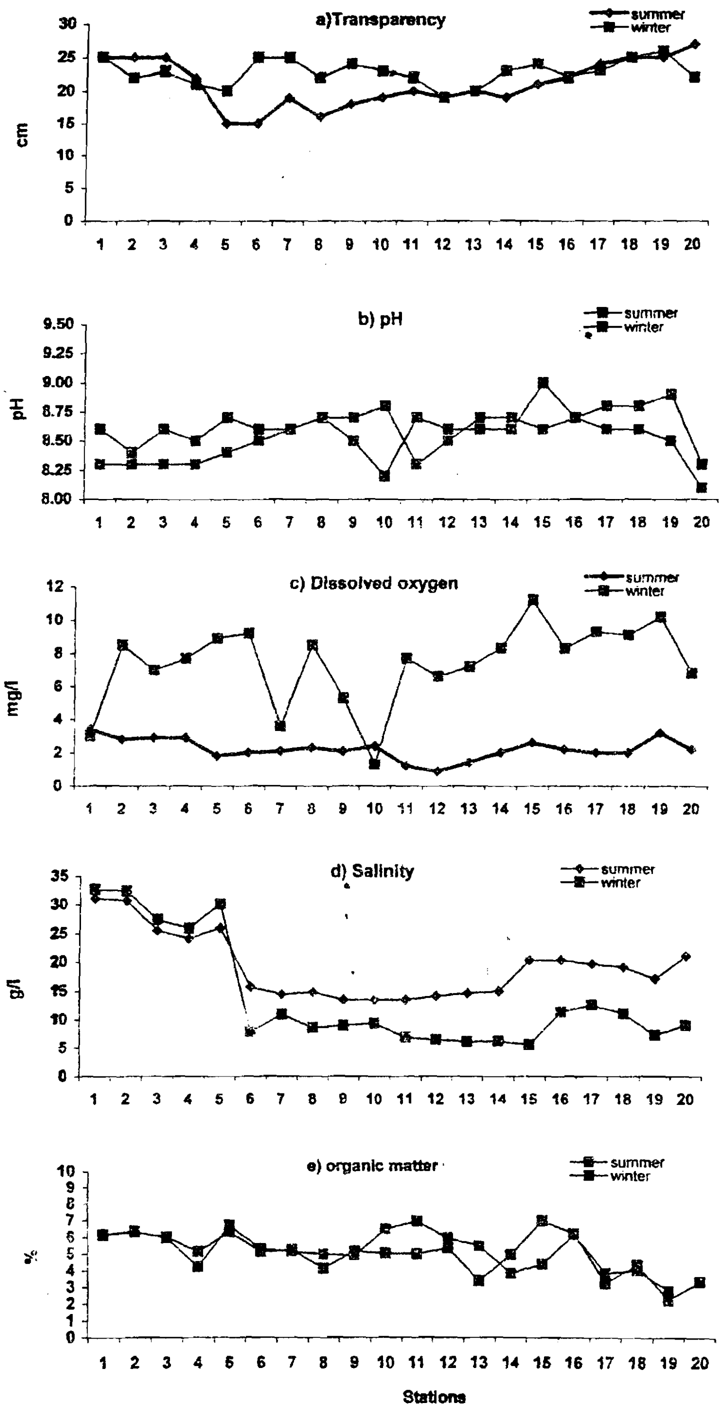


Figure (2) Spatial variations of physicochemical factors along sample sites of El-Gamil Basin

(Boughas El-Gamil) (Figure, 2-c). On the other hand, a remarkable decrease in salinity in stations of section II resulted from brackish/freshwater flowing monthly from various drains discharges into the southern lake.

II – Sedimentological parameters: -

1 – Organic matter.

Organic matter of El-Gamil Basin was relatively high. Its percentage ranged from 6.98 % in station 15 during winter to 2.21 % in station 19 during the same season. (Figure 2-e) shows that, organic matter content in the sediments of stations in the section III were generally lower than that of sections I and II. This is due to the increased percentage of sand in this area (Table 1). A negative correlation was obtained between the organic carbon and sand content of the sediment ($r = -0.69$ and $p < 0.05$). The same observations were recorded in subtropical lagoon in Mexico (Noguera and Hendrickx, 1997)

2 – Grain size analysis.

The bottom sediments of the investigated area were generally homogenous. Stations 11, 12, 18 and 19 were characterized by the presence of shell fragments of molluscs in addition to remains of calcareous tube worms and barnacles. As shown in Table (1), the bottom samples collected from stations of sections I and II are mainly clay loam, while increasing percent of sand in the sediment was observed in most stations of section III.

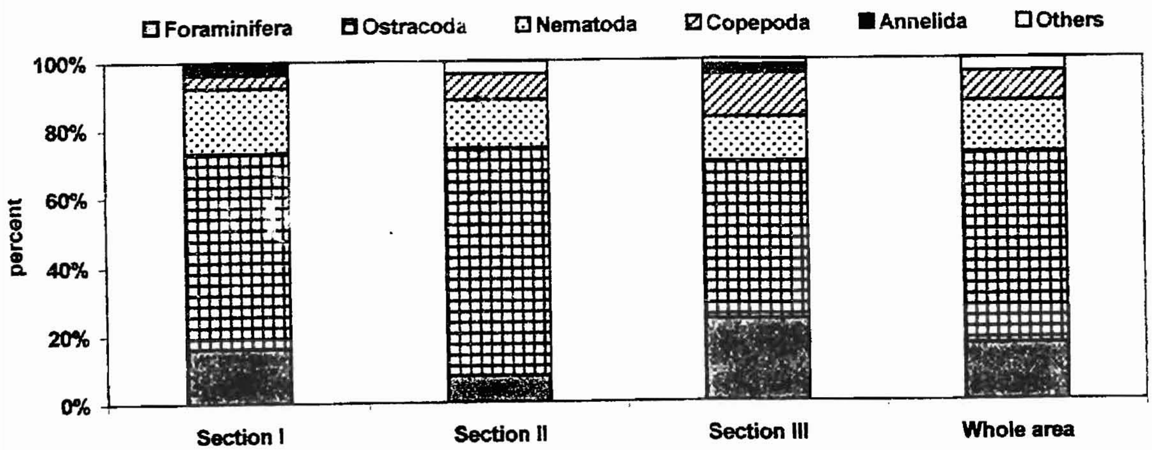
III- Meiobenthic fauna

1 - Density and composition:

Five major meiobenthic groups were recorded in the benthic samples (Ostracoda, Foraminifera, Nematoda and Copepoda). Specimens of small Annelida, Cyclopoid, Copepoda, fish eggs and larvae of macrobenthic species were also found. Ostracoda was the most abundant group contributing numerically 55.70% of the total number of organisms. Foraminifera and Nematoda followed Ostracoda in their abundance constituting 16.54% and 15.08% of the total number of meiobenthos, respectively. The other groups accounted for 12.68% of the total faunal density (Figure 3). In sampling sections, Ostracoda occupied also the first position but with different ratios (57.11% in section I, 66.62% in section II and 46.06% in section III). As shown

Table (2) Species composition and abundance (number of individuals /10 cm^2) of meiobenthos in sampling sections of the are investigated

Species name	Sector I		Sector II		Sector III		Average	
	summer	winter	summer	winter	summer	winter	summer	winter
Foraminifera								
Ammonia sp.	89	502	51	152	152	228	97	294
Qunqueloculina sp.	177	59	0	0	76	0	84	20
Ostracoda								
ostracoda species	1180	413	1264	505	1113	531	1186	483
Nematoda								
Nematoda species	118	325	278	126	303	202	233	218
Copepoda								
Harpacticoida	325	89	152	0	101	0	193	30
Cyclopodia	0	30	0	76	0	0	0	35
Annelida								
Chaetogaster limnaei	0	0	0	0	76	0	25	0
Polydora ciliata	0	89	0	0	0	0	0	30
Others								
Fish eggs	30	0	0	0	0	0	10	0
Veliger larvae	0	30	51	25	0	0	17	18
Nauplis larvae	0	0	0	25	0	25	0	17
Total	1919	1537	1796	909	1821	986	1845	1144



ig (3) Percentage composition of meiofaunal taxa in El-Gamil Basin (Lake Manzalah) in (Figure 4), the highest meiofaunal density was 3435 individuals/10 cm^2 at station 15 and 3364 individuals/10 cm^2 at station 1. The lowest values of meiofauna were found at station 17 and 11 where 620 and 709 individuals / 10 cm^2 were recorded, respectively.

Concerning sections, the highest population density was recorded in section I during summer followed by section III and section II during the same season. During winter the highest density was observed in section III followed by section III and section II (Table 1)

2 - Spatial distribution of major taxa:

a) Foraminifera

As shown in (Figure 5), Foraminifera was common at stations of section I. The highest density was recorded at station 1 (1151 individuals/10 cm^2) and station4 (532 individuals/10 cm^2). A noticeable decrease was observed at stations of section II (89 individuals/10 cm^2 in stations 10 and 11). These species were not recorded at stations 7, 9, 12 & 13. Foraminifera was represented by two species namely, ***Ammonia*** sp. and ***Qunqueloculina*** sp.

b) Ostracoda:

Ostracods were the most dominant group of meiofauna throughout the study period. Their density ranged from 2301 individuals/10 cm^2 at station 15 to 266 individuals/10 cm^2 at stations 4 & 16 (Figure 5). The density of ostracods was a maximal at section II with an average of 885 individuals/10 cm^2. At the sametime, the density of ostracods were nearly similar at sections I and III (Table 2).

c) Nematoda:

As shown in (Figure 5), nematods were numerically high at station 1 reaching 1062 individuals/10 cm^2. At the sametime, the lowest density was recorded at stations 8, 9 & 10. They were not observed at stations 2, 4, 5, 6, 11 and 14. Concerning sampling sections, the lowest density was recorded at section I during summer, while the highest one was observed at the same section during winter (Table 2).

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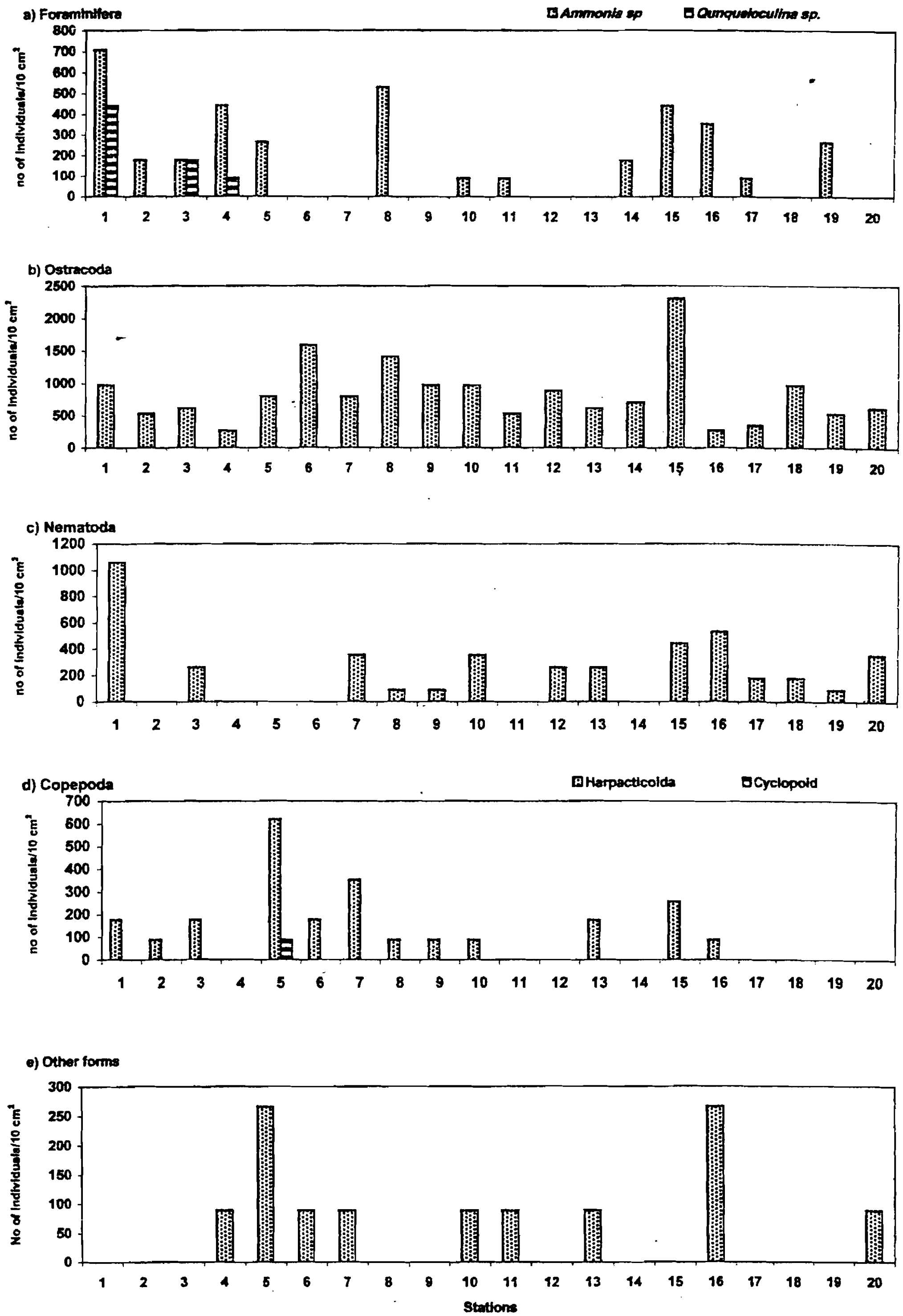

Fig (5) Distribution and abundance of major meiofaunal taxa

d) Copepoda:

The spatial distribution of Copepoda ranged from 709 individuals/10 cm^2 at station 5 to 89 at station 2, 8, 9, 10 & 16. They were composed mainly of two orders Harpacticoida and Cyclopoida. The individuals of copepods species were not recorded at stations 4, 11, 12, 17, 18, 19 & 20. They showed a relatively highest density at section I (Table 2).

e) Other forms

Small numbers of annelids, veliger larvae, nauplius larvae and fish eggs were recorded in meiobenthic samples. Their highest occurrence were recorded at stations 5 & 16 where non found at stations 1, 2, 8, 9, 14, 15, 17, 18, & 19 (Fig.(5).

DISCUSSION

The annual average number of total meiobenthos in the area sustained 1495 individuals/10 cm^2. Section II, which is opposite to WWTP effluents was less productive section where 1353 individuals/10 cm^2 were recorded. This may be due to impact of WWTP discharge on these animals which cause decrease in their density. Gray (1981) related the decline in meiobenthic number and diversity to the impact of pollution. The effect of WWTP is obvious also on the diversity of meiobenthic species (Table 2).

The high abundance of meiofauna during summer season was probably attributed to a rise in water temperature which was accompanied by number abundant food supply and increasing rate of reproduction and growth of species. Similar high densities during summer were observed by Rudnick ***et al.***, (1985) in some coastal marine ecosystem.

Little information has been acquired on the relation of meiobenthic species to the environment. Meiobenthic community in El-Gamil Basin showed a remarkable change from site to another. The distribution of total meiofauna at different sampling sites was mostly related with sedimentological analysis. Many authors e.g. Bouwman ***et al.*** (1984) and Castel (1992) showed that, the increase in density of meiobenthic communities is results from accumulation of organic matter content. Our results indicate that high densities of meiofauna were related to high contents of organic matter ($r = 0.620$, $p < 0.05$, Table 3). Sediments with higher mud content are generally characterized by high density of meiofauna (Coull, 1988 and Giere ***et al.***, 1988). The use of correlation between sediment type and meiofauna showed that mud was highly positive correlate with total density of meiofauna at the whole sampled sites ($r = 0.559$, $p < 0.05$).

Another factor that seems to influence the distribution of meiofauna taxa is interaction between meiofauna and macrofauna. Giere (1993) showed that macrobenthos decrease the number of meiobenthos through mechanical disturbance of sediments. A negative correlation was observed between total number of macrobenthos (Fishar, 1999) and meiobenthos in sampled localities was recorded ($r = -0.0493$).

The reaction of different meiobenthic taxa to different environmental factors was different (Table 3). Foraminifera which is the most important group showed a great positive relations with mud content ($r = 0.34$, $P < 0.05$) and organic matter content of the sediment ($r = 0.616$, $P < 0.05$). The same results were obtained in Tarkawa Bay, Nigeria by Ajao and Fagade (1991). They stated that the abundance of living benthic Foraminifera was shown to be dependant on silt-clay content (mud) and organic matter.

Salinity also affects positively the abundance of this group. They showed their highest population density at stations of section I which located opposite to Boughas El-Gamil. This is because most of them are marine origin. On the other hand, a significant negative correlation ($r = -0.247$, $P < 0.05$) was observed between the distribution of salinity and ostracods density in the sampling area. Bouwman *et al.* (1984) found that nematods were more tolerant to low oxygen content than other taxa. In our results, the density of this group showed a negative correlation with oxygen values ($r = -0.383$, $P < 0.05$).

Table (3) Correlation between major meiofaunal taxa and some abiotic variables at El-Gamil Basin during period of study

		Silt	Clay	Mud	Sand	Dissolved oxygen	transparency	Salinity	Organic matter
Total meiofaun	r	0.495	0.446	0.559	-0.538	-0.052	-0.030	0.214	0.620
	P - value	0.000000012	0.000000005	0.000000002	0.000021073	0.000000088	0.000000130	0.000008129	0.000000013
Foraminifera	r	0.320	0.249	0.340	-0.352	0.065	0.280	0.589	0.616
	P - value	0.000295908	0.000155673	0.000164790	0.002506560	0.000040543	0.000271935	0.000060501	0.000381324
Ostracoda	r	0.241	0.357	0.349	-0.301	0.154	-0.194	-0.247	0.141
	P - value	0.000001145	0.000000337	0.000000309	0.000048878	0.000001074	0.000002232	0.000223122	0.000001141
Nematoda	r	0.294	0.101	0.242	-0.298	-0.383	0.385	0.230	0.637
	P - value	0.000288075	0.000431543	0.000272374	0.001361146	0.001026669	0.000141758	0.003771327	0.000231367
Copepoda	r	0.458	0.370	0.494	-0.414	-0.134	-0.406	0.335	0.404
	P - value	0.001570264	0.002629386	0.001703704	0.047561966	0.015097099	0.015009197	0.002445511	0.001597661

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